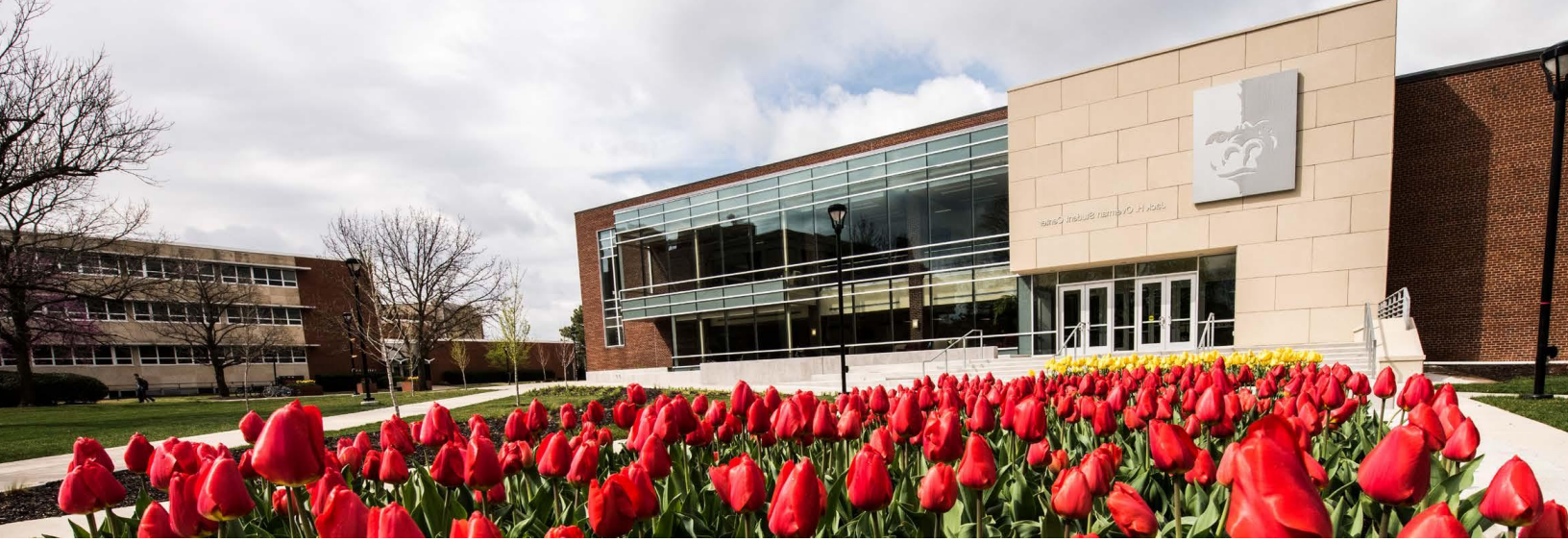

Pittsburg State University

Student Research Abstracts

Spring 2025

(April 10, 2025)

A
Oral/Poster: Science & Technology

B
Oral/Poster: Business, Education, & Humanities

C
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9:10 AM	A-Grad	Priyankkumar Patel	Trade-off Between Limonene-based Reprocessable and Non-Reprocessable Epoxy Thermosets: Role of Aliphatic Diamines in Polymer Networks Design
9:30 AM	A-Grad	Riya Patel	Bio-Based Composite Materials with Enhanced Mechanical Strength and Good Flame Retardancy
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11:00 AM	A-Grad	Urvashi Gondaliya	Metal Disulfide Fe/Co/Ni as Electrocatalyst for Overall Water Splitting
11:20 AM	A-Grad	Guna Vennapusa	Predictive analytics in Healthcare
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Schedule for Oral Presentations

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9:30 AM	A-Grad	Harsh Panchal	Developing FeCo-NC Alloy For Optimizing Electrocatalytic Activity In Water Splitting And Oxygen Reduction
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Schedule for Oral Presentations

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8:50 AM	A-UGrad	Jordan Haworth	Using Rock Bass' (Ambloplites Rupestris) Diet to Explain Competition of Limited Resources Between Non Native and Native Species in the Spring River and Shoal Creek of Southeast
9:10 AM	A-UGrad	Hannah Posterick	Quercetin/Epoxidized soybean oil loaded Magnesium hydroxide composite particles with antimicrobial properties
9:30 AM	A-UGrad	Megan Abdilla	Cochineal Insects Contribute to Monitoring the Freshness of Cheese
9:50 AM	A-UGrad	Noah Freiburger	Synthesis of Zinc Hydroxide/Biotin/Gelatin Composite Particles and Their Biological Function
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10:20 AM	A-UGrad	Syed Inayat Ali Shah	A Novel Approach for Fabrication of Lactose Fibers Using Melt Centrifugal/Rotary Jet Spinning
10:40 AM	A-UGrad	Heather Burrow	Seasonal Use of Abandoned Mined Lands by Non-breeding Birds: Preliminary Findings
11:00 AM	A-UGrad	Taylor D'Amico	Equine Assisted Psychotherapy and Military Veterans with Post Traumatic Stress Disorder
11:20 AM	A-UGrad	Seth Loudermilk	Mathematical Breakthroughs Driven by Wartime in the Twentieth Century
11:40 AM	A-UGrad	Ayushee Dasgupta	Exploring the gut microbiota of gray bats in Kansas following culturable and metagenomic approaches
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8:50 AM	B-UGrad	Kennadie Campbell	Prepackaged Curriculum: The Death of a Profession
9:10 AM	B-UGrad	Justin Miles	Navigating the NIL Era: Exploring Pittsburg State University's Role in Supporting Student-Athlete Entrepreneurship
9:30 AM	B-UGrad	Saatvik Sabarwal	Factors Affecting Gas Price Inflation in the U.S. Over the Last Two Decades
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10:20 AM	B-UGrad	Likun Liu	An Empirical Analysis of Factors Influencing Crime Rates in the United States
10:40 AM	B-UGrad	Anthony O. Cole Smith	Determinants of U.S. Beef Prices
11:00 AM	B-UGrad	Brendon Gahagan	Affording the American Dream: Analyzing the Economic Factors Shaping U.S. Housing Affordability
11:20 AM	B-UGrad	Gunnar Jefferis	Wage Determinants in the United States
11:40 AM	B-UGrad	Kunkler Logan	Demographic and socioeconomic determinants of cancer rates
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Schedule for Poster Presentations

Poster Setup: 8:30 am to 11:30 am

All posters will be displayed in Ballrooms A and B

Timing for viewing the posters: 2:00 pm-4:00 pm

Oral Presentations

Category A

Undergraduate and Graduate Students

Presenting Student: Braidy Hunt
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Andrew George

Title: Using Automated Radio Telemetry to Track Gray Bats in Southeast Kansas

Abstract: The Gray Bat (Myotis grisescens) is a federally endangered species that reaches the westernmost limit of its geographic range in southeast Kansas. Gray Bats are migratory, traveling biannually between summer colonies and large communal hibernacula. However, little is known about the timing of migration, routes taken, and connectivity among caves. Our objective was to track migrating Gray Bats using the Motus automated telemetry network, an international collaborative project for tracking migratory animals. In fall 2023 and 2024, we attached 40 transmitters to Gray Bats near Pittsburg, Kansas. We also deployed Motus nodes at the two known roost exits, and at the most known Gray Bat hibernacula in Missouri. Our preliminary results suggest that Gray Bats departed from their summer roost near Pittsburg in late October and early November, traveling east into Missouri. We plan to deploy more nodes and track 20 additional bats in 2025. The expanding Motus network will continue to enhance our understanding of the movement ecology of Gray Bats and other migratory animals.

Presenting Student: Jordan Haworth
Co-Authors: Joshua A. Holloway, Alesha Lawson, Brayden Martin, Christine Helman, Evie Parsons, Hannah McCoy, James Leeper, Jisu Park, Sinclaire Kemp
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. James Whitney

Title: Using Rock Bass' (Ambloplites Rupestris) Diet to Explain Competition of Limited Resources Between Non Native and Native Species in the Spring River and Shoal Creek of Southeast

Abstract: Rock bass (Ambloplites rupestris) are a nonnative species that negatively impact native species in Southeast Kansas streams due to competition of limited resources, such as food. A diet study was conducted on 26 collected rock bass to assess their impact on Kansas streams, which indirectly affects native fish. Rock bass were collected at three different sites in shoal creek: below Shermerhorn, Quapaw nation lands, and at Shermerhorn, as well as from two sites on the Spring River: Baxter Springs and below the Empire Lake. Rock bass were collected by the Pittsburg State Fisheries Management fall 2024 class using backpack electrofishing and seining. Each rock bass was dissected by the Fisheries Management class in order to see what each fish's diet was composed of. Studies showed that the majority of rock bass consisted of a diet of crayfish (Orconectes) (39%), hellgrammites (Corydalus) (35%), and cactus fly larvae (Copestylum) (23%). From our studies, we can infer that nonnative species such as rock bass are competing for limited resources with imperiled native species such as Redspot Chubs (Nocomis asper).

Presenting Student: Hannah Posterick
Co-Authors: Irene Zegar, Chris Ward, Anuradha Ghosh, Alessandro F. Martins
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: Quercetin/Epoxidized soybean oil loaded Magnesium hydroxide composite particles with antimicrobial properties

Abstract: In recent years, developing novel composite particles has gained significant attention in the pharmaceutical industry. Quercetin, a flavonoid (a type of plant pigment and antioxidant), is found in various fruits, vegetables, and grains. Studies have shown that quercetin has anti-inflammatory, antioxidant, and potential immune-boosting properties. On the other hand, epoxidized soybean oil (ESO) is a chemical compound derived from soybean oil, modified through the epoxidation process. ESO is commonly used as a plasticizer in products such as paints, coatings, adhesives, and sealants. However, there have been few studies exploring the application of ESO in biomedical materials.

In this study, we loaded quercetin and ESO onto magnesium hydroxide particles and evaluated their antimicrobial properties. The chemical structure of the composite particles was confirmed through Fourier-transform infrared spectroscopy (FTIR). Additionally, we measured the UV-Vis spectra of magnesium chloride (MgCI2), quercetin, and ESO as precursors for the quercetin/ESO-loaded magnesium hydroxide composite particles. The antimicrobial activity of the composite particles was tested against Staphylococcus aureus, and Escherichia coli. The composite particles containing 1 and 2 g of quercetin demonstrated excellent antimicrobial properties against Staphylococcus aureus, with similar inhibition zones observed. However, they were ineffective against Escherichia coli. Our work is ongoing to study the effects of these particles against cancer cell lines.

Presenting Student: Megan Abdilla
Co-Authors: Asher Freiburger
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: Cochineal Insects Contribute to Monitoring the Freshness of Cheese

Abstract: The application of natural dyes in food safety has gained significant attention due to their biocompatibility and eco-friendliness. This study focuses on the application of carminic acid from cochineal insects (Dactylopius coccus) as a color sensor for monitoring the freshness of cheese. Carminic acid is sensitive to pH changes, making it an ideal indicator for detecting spoilage in cheese storage caused by microbial activity and acidity fluctuations. The corn starch, chosen as a carrier for carminic acid due to its biodegradability and non-toxicity, was utilized as a robust biomaterial. For this purpose, carminic acid was dissolved in aqueous solution followed by the addition of starch. Lithium chloride was added into the final dispersion, to study the color sensing properties. The synthesized particles were centrifuged, dried in an oven and pressed in tablet forms for the cheese monitoring. FTIR analytical characterization confirmed the stability of carminic acid and various salts within the starch matrix and their responsiveness to pH variations in the range typically observed during cheese spoilage. Spectrocolorimeter tests demonstrated that the tablets successfully detected early spoilage in various cheese samples, with visible color changes correlating to pH thresholds indicative of spoilage onset. The results suggest that carminic acid-loaded starch tablets are a reliable, cost-effective, and consumer-friendly solution for monitoring cheese freshness. This approach highlights the potential of natural dye-based sensors in advancing food safety, providing a practical solution for producers and consumers to ensure high-quality standards in dairy products.

Presenting Student: Noah Freiburger
Co-Authors: Chris Ward, Anuradha Ghosh, Alessandro F. Martins
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: Synthesis of Zinc Hydroxide/Biotin/Gelatin Composite Particles and Their Biological Function

Abstract: Composite particles have emerged as a promising multifunctional platform for cancer therapy due to their biocompatibility and targeted drug delivery. This study focuses on the synthesis and evaluation of zinc hydroxide/biotin/gelatin composite particles for the potential antimicrobial and targeted cancer treatment. Zinc hydroxide serves as an antimicrobial agent with cytotoxic properties, while biotin, also known as vitamin B7, helps with the metabolic processes of cells. On the other hand, gelatin was used as a stabilizing matrix. In this study, synthesis process involved co-precipitation of zinc hydroxide within a biotin-functionalized gelatin matrix, forming microparticles. Characterization technique included Fourier-transform infrared spectroscopy (FTIR) confirmed the chemical structure of the composite particles. In vitro cytotoxicity assays using MCF-7 (breast cancer cell lines), demonstrated the enhanced efficacy of the composite particles in the following order: zinc hydroxide/biotin < zinc hydroxide < zinc hydroxide/gelatin < Zinc Hydroxide/Biotin/Gelatin, attributed to the synergistic effects of biotin targeting and gelatin-mediated controlled release.
Our composite particles were also tested against Staphylococcus aureus and revealed an excellent antibacterial property. These findings underscore the potential of zinc hydroxide/biotin/gelatin composite particles as an innovative therapeutic platform for targeted and efficient cancer treatment, paving the way for further preclinical and clinical investigations.

Presenting Student: Syed Inayat Ali Shah
Co-Authors: Arifur Rahman
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: A Novel Approach for Fabrication of Lactose Fibers Using Melt Centrifugal/Rotary Jet Spinning

Abstract: Lactose is a naturally occurring disaccharide composed of one molecule of glucose and one molecule of galactose. It is primarily found in milk and dairy products and has various applications in the food and pharmaceutical industries.
Due to its non-toxic nature, we aimed to fabricate lactose fibers using the melt centrifugal/rotary jet spinning (MCRJS) process and assess their potential biological properties.
For this purpose, we fabricated lactose fibers and incorporated stearyl glycyrrhetinate as an active ingredient to evaluate its effects. Stearyl glycyrrhetinate, derived from licorice root, is known for its anti-inflammatory, antioxid ant, and skin-soothing properties.
The properties of stearyl glycyrrhetinate-loaded lactose fibers were assessed using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR). Additionally, the biological properties of the fabricated lactose fibers were evaluated through microbial culture testing. FTIR spectroscopy confirmed chemical interactions between stearyl glycyrrhetinate and lactose molecules. The composite fibers also demonstrated antimicrobial properties, making them promising candidates for various biomedical applications, such as wound dressings, tissue scaffolds, and controlled drug release systems. These findings highlight the potential of the MCRJS process for producing biocompatible lactose-based fibers and emphasize the versatility of this technique in developing fibrous materials.

Presenting Student: Heather Burrow
Student Status: Undergraduate
Major: Biology (Wildlife Ecology & Conservation)
Research Advisor: Dr. Andrew George

Title: Seasonal Use of Abandoned Mined Lands by Non-breeding Birds: Preliminary Findings

Abstract: During winter and migration, birds rely on habitat that provides high-energy food and protection from predators and adverse weather. Abandoned mined lands (AMLs) are disturbed ecosystems that often include a mosaic of successional habitats, some of which may support diverse bird communities. Our goal is to establish a long-term banding study to investigate bird use of AMLs during the non-breeding season. We established 4 study sites in 2023 in a formerly surface-mined landscape in Crawford County, in southeast Kansas. We used constant-effort mist-netting to survey birds each month, including biweekly during fall and spring migration. Thus far, we have captured 57 species on AMLs, including 12 residents and 45 migrants, of which 24 do not breed in the study region. Analysis of seasonal demographics and body condition is ongoing. In December 2024 we began attaching Motus tags to Harris's Sparrow to study their regional movements and habitat use during winter. Our project emphasizes the potential conservation value of AMLs for birds during the non-breeding portions of their full annual cycle.

Presenting Student: Ayushee Dasgupta
Student Status: Undergraduate
Major: Biology and Chemistry
Research Advisor: Dr. Anuradha Ghosh

Title: Exploring the gut microbiota of gray bats in Kansas following culturable and metagenomic approaches

Abstract: Bats play essential roles in ecosystems, controlling insect populations but also acting as disease reservoirs, as highlighted by recent pandemics. This study examines bacterial diversity in the Gray Bat (Myotis grisescens) in Southeast Kansas. From guano samples, 32 bacterial isolates were obtained, majority was Gram-positive (65%). Sugar fermentation profiles showed 78% of isolates fermented all tested sugars, and a smaller proportion showed urea hydrolysis (21%) as well as indole production (3%). Sequencing with an Illumina miniSequencer yielded 2.9 million reads, with Serratia, Achromobacter, Lysinibacillus, and Bacillus as the most abundant genera. Ongoing research aims to characterize the gut microbiota of male and female bats. Beta diversity analysis showed 68% of variance, indicating greater intra-variability in females. Alpha diversity (Chao1 and Shannon indices) indicated comparable species richness, with slightly higher diversity in females. Identifying bacteria associated with bats supports disease prevention and bat conservation efforts.

Presenting Student: Taylor D'Amico
Student Status: Undergraduate
Major: Criminal Justice & Psychology
Research Advisor: Dr. Gary Wilson, Dr. Julie Allision

Title: Equine Assisted Psychotherapy and Military Veterans with Post Traumatic Stress Disorder

Abstract: This study explores the effectiveness of Equine-Assisted Psychotherapy [EAP] as a treatment for military veterans suffering from Post-Traumatic Stress Disorder [PTSD]. PTSD is a prevalent and debilitating disorder among veterans, often resulting from exposure to combat trauma. This research aims to evaluate whether EAP, which utilizes Bilateral Stimulation [BLS] through horse's movement, can provide a viable alternative or supplement to conventional treatments. The study involved 17 veterans who completed a questionnaire regarding their PTSD symptoms, treatment experiences, and interest in EAP. The research findings revealed that veterans who participated in EAP showed significant improvements in their psychological well-being, with many expressing interest in pursuing the therapy further. In comparison, those who had used EMDR also reported success with this treatment, suggesting a positive correlation between BLS therapies and PTSD symptom reduction. The study concludes that EAP, in combination with EMDR, may offer a promising therapeutic approach for veterans with PTSD, emphasizing the need for further research into alternative treatments for this population.

Presenting Student: Seth Loudermilk
Student Status: Undergraduate
Major: Mathematics
Research Advisor: Dr. Cynthia Huffman

Title: Mathematical Breakthroughs Driven by Wartime in the Twentieth Century

Abstract: Major mathematical breakthroughs have occurred during times of war. Given the historical and geopolitical relevance of wars, a sample from World War I, World War II, and the Cold War was explored to highlight their contributions to mathematics. This was achieved through investigating published work originating from each war. Secondary sources are used to discuss the modern impact. The twentieth century was chosen due to its recency and modern applications that have exerted a significant influence in society. The research highlighted key innovative trends during and surrounding the time of war. World War I led to aeronautical development impacting all aviation. The research started with three equations describing a force accelerating in the \(x,y,\) and \(z\) directions. From there, the research follows in the footsteps of George Bryan to derive the two equations which describe aeronautical stabilization. World War II spurred the development of encryption and decryption to ensure secure data transmission. The research followed the original questions posed and answered by Claude E. Shannon on secrecy, including both theoretical and practical considerations. Lastly, the Cold War fostered fast data analysis, condensing vast amounts of information. This is illustrated in calculating complex Fourier series through the Fast Fourier Transform (FFT). Therefore, wartime innovations have played an essential role in the advancement of mathematics.

Presenting Student: Brayden Letterman
Co-Authors: Erik Jantz, Erin Petro
Student Status: Graduate
Major: Biology
Research Advisor: Dr. Anuradha Ghosh

Title: Distribution of ticks and tick-borne disease in Southeast Kansas public recreational parks

Abstract: The distribution of ticks and tick-borne diseases is not well-documented in southeast Kansas despite bordering one of the greatest hotspots for disease in the United States. The range and distribution of ticks has been changing over the past century because of anthropogenic factors such as habitat loss, climate change, and overabundance of white-tailed deer. Two public recreational parks with heavy human and pet traffic in Crawford County, Kansas were sampled to determine which ticks are present in the months of greatest activity. Ticks were collected using a flagging technique that promoted only collecting questing ticks. A total of 436 lone star ticks were the dominant tick species across both collection sites (90.5%, Males-202, Females-164, Nymphs-70). A total of 46 American dog ticks were also detected across both sites (9.5%, Males-24, Females-22). After grouping ticks into pools, both species of ticks were found to be carrying ehrlichiosis pathogens, with unusually high rates of E. ewingii detected in lone star tick pools (E. chaffeensis 12.9%, E. ewingii 21.0%). American dog tick pools carried a lower proportion of only E. ewingii (12.5%). Rickettsia spp., which could include pathogenic spotted fever rickettsiae, were also detected in both ticks (Lone star: 68.8% of pools; American dog: 18.5%). This data should be used to update public resources and better prepare local health departments. Continuing to monitor tick distribution and pathogen load will be vital as their range keeps changing.

Presenting Student: Dharmikkumar Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Mechanically Robust, Self-Healing, and Reprocessable Geraniol Based Epoxy Vitrimer by Dynamic Boronic Ester Bonds

Abstract: Covalent Adaptable Networks (CANs) are an emerging class of polymers with reversible covalent crosslinks that respond dynamically to external stimuli. Unlike conventional thermosets, CANs-particularly vitrimers- exhibit self-healing, reprocessability, shape memory, and recyclability due to their adaptable crosslinking chemistry. The widespread use of thermosets has led to growing concerns over the depletion of petroleum-based resources and environmental impact. To address these challenges, bio-based alternatives offer a sustainable pathway for developing high-performance materials. Geraniol, a naturally occurring monoterpenoid alcohol found in various plant oils, serves as a promising renewable feedstock for polymer synthesis. This study presents the first development of a geraniol-based epoxy vitrimer synthesized via a thermally activated thiol-epoxy click reaction between a geraniol-derived epoxy resin and a diboronic ester dithiol (DBDT) cross-linker. The incorporation of dynamic boronic ester bonds facilitates topological rearrangements, enabling efficient self-healing and reprocessability. The vitrimer demonstrates excellent thermal stability and mechanical strength, with a glass transition temperature (Tg) of 38.43℃ determined through Dynamic Mechanical Analysis (DMA). Additionally, it exhibits a tensile strength of approximately 19 MPa, shape memory behavior, solvent-based recyclability, and outstanding mechanical strength retention after reprocessing. The vitrimer also features a rapid relaxation time of 9 seconds at 140C and an activation energy of 22.44 kJ/mol, highlighting its efficient bond exchange capability. These attributes make the developed vitrimer a strong candidate for sustainable, high-performance applications, offering a viable alternative to traditional thermosets with enhanced environmental benefits.

Presenting Student: Priyankkumar Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Trade-off Between Limonene-based Reprocessable and Non-Reprocessable Epoxy Thermosets: Role of Aliphatic Diamines in Polymer Networks Design

Abstract: The increasing demand for sustainable materials, driven by environmental concerns and the rapid depletion of fossil fuel resources, has led to significant advancements in the fabrication of bio-based thermosets. Renewable alternatives, such as limonene-derived epoxy prepolymers, offer a promising replacement for petroleum-based thermosetting polymers, exhibiting comparable mechanical strength, thermal stability, and chemical resistance for applications in films, composites, coatings, and adhesives. This study presents the synthesis and characterization of limonene-based epoxy prepolymers through a two-step process, followed by their thermal crosslinking with various aliphatic diamines to fabricate thermosets. Incorporating cystamine, a disulfide-containing diamine, facilitated the formation of a covalent adaptable network via disulfide metathesis, yielding a reprocessable thermoset with self-healing capabilities, recyclability, and an extended lifespan. In contrast, thermosets cured with conventional aliphatic diamines formed permanently crosslinked networks with enhanced mechanical strength, thermal stability, and chemical resistance, making them suitable for high-performance applications requiring long-term durability with a maximum tensile strength of 11.62 MPa at an elongation of 22.2 %. Differential scanning calorimetry (DSC) was employed to elucidate the curing kinetics and crosslinking behavior, while thermogravimetric analysis (TGA) confirmed the excellent thermal stability of the synthesized materials. Additionally, dynamic mechanical analysis (DMA) and tensile testing demonstrated desirable mechanical properties. The absolute value of the glass transition temperature (Tg) determined from DMA analysis was 18 °C, above which the malleable thermoset exhibited dynamic behavior due to disulfide bond exchange. Furthermore, the reprocessable thermoset exhibited a maximum tensile strength of 3.1 MPa at an elongation of 65 % and excellent reprocessability. Overall, this study highlights the potential of limonene-derived epoxy thermosets as sustainable alternatives, offering robust properties such as reprocessability, self-healing, and high-performance networks.

Presenting Student: Riya Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Bio-Based Composite Materials with Enhanced Mechanical Strength and Good Flame Retardancy

Abstract: Composite materials play a crucial role in modern industries due to their high mechanical strength, making them suitable for aerospace, automotive, construction, and healthcare applications. Generally, these materials are synthesized by petroleum-based epoxy resins. However, in the 21st researchers are inclined towards renewable resources to produce composite materials. Vegetable oils (VOs) serve as a promising alternative to petroleum-based polyols and epoxies due to their chemical versatility. VOs contain unsaturated double bonds which can be chemically modified. Here, in this research, non-edible vegetable oil (castor oil) was used to synthesize bio polyols. A ring-opening reaction was used to convert castor oil into castor oil polyol (COP). The synthesized COP was characterized by FT-IR and GPC. Composite materials were synthesized by using COP, TiO2 as an inorganic filler, and three different flame retardants (FRs). Melamine (MA), melamine phytate (MPHT) and melamine phosphate (MP) were used as FRs. Here, melamine phytate was synthesized by using bio-based phytic acid. The MPHT 3wt% composite exhibited the highest compression strength (52 MPa) among all synthesized materials. Moreover, tensile strength and hardness were 22 MPa and 70 respectively. Importantly, only 2% weight loss was observed in MPHT 5wt% sample which is lower among all synthesized materials. These composite materials exhibit thermally stability, with significant degradation occurring near 400oC. Chemical compatibility was also performed for the composite materials in water and toluene. These bio-based composite materials offer a sustainable alternative to traditional petroleum-based products, with benefits including renewable sourcing, lower environmental impact, and good mechanical strength.

Presenting Student: Tanuj Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Soybean Oil-Derived Acrylate/Methacrylate Ether for High-Resolution Additive Manufacturing

Abstract: The advent of multi-material 3D printing, which allows for the simultaneous deposition of materials to create complex, functionally graded structures with varied mechanical properties, has significantly expanded the potential applications of additive manufacturing (AM). This has improved the performance and adaptability of printed components in a variety of sectors. The large range of materials for multi-material 3D printing are still mostly made from petroleum oil, despite these advancements, which restrict the technologies' potential for wider use and their economic feasibility. By lessening its environmental impact, the use of bio-based resources in place of conventional petroleum-based products has garnered significant attention in the development of sustainable ink for AM. Vegetable oil, a low-cost, biodegradable plant-based resource, is being explored as a substitute feedstock for 3D printing. This study has developed novel photo-curable resins based on soybean oil (ESBO_HEA/HEMA) for vat photopolymerization in digital light processing (DLP). The epoxidized soybean oil (ESO) was transformed into acrylated/methacrylated soybean oil (ESBO_HEA/HEMA) using a one-pot oxirane ring opening technique. This synthesized soybean oil acrylate/methacrylate, combined with photoinitiator (TPO) and/or reactive diluents (TMPTA), has been used to create a range of DLP inks for 3D printing. Additionally, all the formulated inks' rheological characteristics, particularly the viscosity of the resin-were examined and found to be in good agreement for DLP 3D printing. Furthermore, the effect of reactive diluents (TMPTA) on the mechanical (DMA, tensile strength, and hardness) and thermal (DSC, TGA) behavior of the 3D-printed object was also investigated. Adding 20% TMPTA to ESBO_HEA increased tensile strength from 4.8 MPa to 9.2 MPa and Shore A hardness from 68 to 85, improving rigidity. DMA showed a rise in storage modulus from 22 MPa to 41 MPa, indicating enhanced stiffness.

Presenting Student: Vardhan Moduga
Student Status: Graduate
Major: Master of Sciences in Technology
Research Advisor: Dr. Tatiana Goris

Title: How Does Amazon's Al Chatbot, Rufus, Impact Customer Satisfaction?

Abstract: This study examines how Amazon's Al-powered chatbot, Rufus, influences customer satisfaction in e-commerce. As Al-driven customer support becomes more common, it is essential to assess whether features like accuracy, response time, and personalization contribute to a positive user experience. Using a quantitative research approach, this study incorporates descriptive and correlational analysis to measure how these factors impact user satisfaction.

Data will be collected through a structured survey of 40+ participants who have used Rufus at least five times. The survey will assess response time, accuracy, personalization, and overall satisfaction levels using a 5-point scale. The study will test three key hypotheses: (1) higher accuracy increases trust and satisfaction; (2) faster response times improve user experience; and (3) personalized responses lead to higher engagement.

Findings from previous research indicate that Al chatbots can enhance or hinder customer interactions depending on their design. However, existing studies focus on general Al use in customer service, with limited insights into e-commerce-specific bots like Rufus. This study aims to fill that gap by providing data-backed insights into Al chatbot performance.

The results will help Amazon and other e-commerce businesses refine chatbot features to better serve customers. By identifying strengths and limitations, this research contributes to improving Al-driven customer interactions, making online shopping more efficient, engaging, and user-friendly.

Presenting Student: Sauravkumar Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Study of Different Isocyanates on the Properties of Limonene and Geraniol-Based Polyurethane Films

Abstract: Plant-and animal-derived materials are gaining attention as potential substitutes for petroleum-based polymers. Growing environmental consciousness and the demand for greener and more sustainable materials are some of the primary causes of this change. A way to support the green and safe use of polyurethane is the thiol-ene click reaction, which is used to create biobased polyols. Limonene and geraniol are both plant-derived chemicals that contain unsaturated C=C (carbon-carbon double) bonds. Mercaptoethanol was used as a thiol compound in the thiol-ene click reaction to prepare bio-based polyols. Polyurethane films were synthesized by reacting polyols with isophorone diisocyanate (IPDI) and cyclohexyl isocyanate (CHDI), followed by film casting. The resulting PU films were cured at 70C to ensure complete crosslinking. To understand the structural and morphological characteristics, Fourier Transform Infrared Spectroscopy (FTIR) will be used. Tensile and hardness tests are also conducted to determine the mechanical properties of the synthesized PU films. Thermogravimetric analysis (TGA) and differential calorimetry (DSC) were employed to investigate the thermal properties of the PU films. The gel fraction analysis further supported the crosslinking efficiency in the PU networks. In this work, when comparing IPDI and CHDI in terms of mechanical properties in PU films, IPDI provides better mechanical properties than CHDI. The Tg's of LM+IPDI, LM+CHDI, GM+IPDI and GM+CHDI were 34.58, 56.49, 75 and 56.49 ℃, respectively. The GM+IPDI demonstrated better mechanical properties (Tensile Strength of 36.02 MPa) than the others due to the higher cross-linking density and complete network.

Presenting Student: Urvashi Gondaliya
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: Metal Disulfide Fe/Co/Ni as Electrocatalyst for Overall Water Splitting

Abstract: Water splitting represents a significant milestone in the advancement of renewable energy, providing a sustainable approach to extracting pure hydrogen and oxygen from water. This process plays a crucial role in clean energy production. Transition metal disulfides such as cobalt disulfide (CoS_2), nickel disulfide (NiS_2), and iron disulfide (FeS_2) serve as vital catalysts in electrochemical water splitting, facilitating both the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). Their availability, cost-effectiveness, and eco-friendly nature make them promising candidates for improving this process. This study aims to examine how microwave synthesis influences material properties by employing a consistent methodology. Among the synthesized materials, CoS_2 and FeS2 exhibited superior electrocatalytic performance compared to NiS_2, demonstrating enhanced current output and overall efficiency in water splitting. The resulting catalysts effectively supported both HER and OER in an alkaline medium (1 M KOH). The recorded overpotentials for OER were 358 mV, 321 mV, and 273 mV, while for HER, they were 163 mV, 168 mV, and 230 mV for CoS_2, NiS_2, and FeS_2, respectively, at a current density of 10 mA/cm^2.

Presenting Student: Guna Vennapusa
Student Status: Graduate
Major: Technology
Research Advisor: Dr. Goris Tatiana

Title: Predictive Analytics in Healthcare

Abstract: Predictive analytics is transforming the healthcare industry by helping doctors in informed decision-making. By analyzing the trends in health data, AI-powered tools can predict the patient's risk factors, enhance diagnostics, and even forecast potential emergencies before they occur. These advancements bring great possibilities, but they may also raise pressing ethical and practical concerns.

One of the primary challenges is to make sure that AI-generated insights should support human expertise, rather than replacing it. While healthcare has majorly relied on clinical knowledge and ethical guidelines, Al brings new debates on accountability and decision-making. For instance, what it may lead to, when an algorithm makes a flawed prediction. How can we safeguard against biases in healthcare data causing unequal treatment? How do we monitor these technologies to ensure they stay transported and accountable? This paper discusses both the advantages and challenges of predictive analytics in healthcare, stressing the importance of well-crafted regulations, ethical governance, and accountable Al development.

Presenting Student: Yashkumar N. Patel
Co-Authors: Rutu Patel, Mayankkumar L. Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Improving Polyurethane Adhesives through Schiff Base Crosslinkers: A Sustainable Approach Using Soybean Oil

Abstract: Historically, polyurethanes (PUs) have typically been made using petroleum-based polyols such as urea or phenol formaldehyde, both of which pose risks to human health and harm the environment. As a result, sectors have recently expressed interest in developing bio-based PUs made from polyol sourced from vegetable oil and diisocyanate. In this study, PU-based adhesives are developed using soybean oil polyol (SOP) and methylene diphenyl diisocyanate. To improve the performance of the synthesized PU adhesive, Schiff-based diols designated as VB and VH have been added to the system as crosslinkers, derived from butane diamine, hexane diamine, and vanillin. The successful creation of PU has been confirmed using Fourier transform infrared spectroscopy (FT-IR) spectra. The tensile strength of adhesive samples was tested on oak wood specimens. Among adhesive samples using VB, VB-10wt.% demonstrated the highest tensile strength at 4400 KPa when compared to all other weight percentages (wt.%). In contrast, VH-based adhesive samples recorded their maximum tensile strength for VH-10wt.% at 5000 KPa. In both cases, as the wt.% of Schiff base diol increases, the tensile strength decreases to 3800 KPa for VB-15wt.% and 2900 KPa for VH-15wt.%. Furthermore, the produced PU adhesive samples demonstrate thermal stability, as confirmed through thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) evaluations. Moreover, the tests for gel content and degree of swelling further illustrate the efficiency of crosslinking in the PU adhesive materials.

Presenting Student: Kemilaben Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Zn-Assisted Synthesis of M (Mn/Fe/Co/Ni)-N-C Catalysts: For Multifunctional Electrochemical Activity

Abstract: The design and development of atomically dispersed M-N-C catalysts (metal (M) supported on nitrogen-carbon (NC) matrix with high multifunctional electrocatalytic performance is desirable but remains a significant challenge. In this study, we synthesized M-N-C catalysts (M = Fe, Co, Mn, and Ni) using Zn-assisted high-temperature treatment and characterized them using various techniques. The prepared catalysts were tested for their electrocatalytic performance towards oxygen and hydrogen evolution reaction (OER and HER) as well as oxygen reduction reaction (ORR) in alkaline media. The results indicated that Mn-N-C catalyst showed higher performance towards both the ORR ($E_{1/2}$ = 0.90 V) and OER (n^{10} = 279 mV/cm^2) as compared to other prepared catalysts. In contrast, Fe-N-C displayed excellent HER activity (n_{10}= 169 mV/cm^2) as compared to others. The theoretical investigations suggested that Mn-N-C catalyst possessed HOMO energy close to LUMO of O_2, facilitating easy electron transfer from HOMO (3d of Mn) to LUMO (pi* of O_2), weakening the O-O bond. Whereas, in the case of HER of Fe-N-C catalyst, the results indicated optimum binding energy to remove O_2 and H_2 from the active site. This work provides a new approach to tuning the electronic and electrochemical features of the M-N-C catalyst, suggesting significant implications for catalyst design in energy conversion devices.

Presenting Student: Ashwitha Reddy Kandadi
Student Status: Graduate
Major: Master of Science in Technology with an emphasis on Technology Management
Research Advisor: Dr. Trevor Maiseroulle

Title: Perceptions of smallholder farmers on usage of drone technology in the southern part of India

Abstract: Agriculture is a major sector in India, where more people's livelihoods depend on agriculture. Now, with the improvement of drone technology, most of the farmers are using drones in agriculture for crop improvement. This study discusses how smallholder farmers in the southern part of India perceive the use of drone technology in agriculture. The main purpose of this study is to understand the farmers' opinions about using drones in agriculture for spraying pesticides, protecting crops, and reducing costs by compared to traditional methods. This study used a qualitative method to gather detailed information on the use of drone technology. For this method, the study chose five smallholder farmers based on the size of their land and interviewed each one with eight questions. The findings provide farmers, the government, and other consumers with useful information that could lead to better support for drone technology in farms. The results motivate more smallholder farmers to try drones, help the government in establishing training programs, and contribute to making drones more affordable to all farmers. This study also provides guidance to farmers on how to utilize drones to enhance crop production. This study helps us all understand developments in agriculture and gives us ideas for future research.

Presenting Student: Vinash Chaudhari
Student Status: Graduate
Major: Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Biobased Polyesters Derived from 1,4-Butanediol and Various Aliphatic Diacids

Abstract: Biobased polyesters were synthesized from 1,4-butanediol and a series of aliphatic dicarboxylic acids, namely succinic acid, adipic acid, and sebacic acid using melt polycondensation. The resulting polymers poly(butylene succinate) (PPeS), poly(butylene adipate) (PPeA), and poly(butylene sebacate) (PPeSe) were characterized with intrinsic viscosity, nuclear magnetic resonance (NMR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA) and tensile testing. All the polymers had a weight-average molecular weight of over 50,000 g/mol and melting temperature (T_m) ranging from 50 to 116 °C, PPeA exhibited a lower melting temperature due to semicrystalline structure and rapid crystallization. The "even-even" effect was observed, contributing to an increased tensile strength of PPeA. All the polymers exhibit good thermal stability, mechanical properties, and tensile properties compared to polyethylene. These biobased and potentially biodegradable polyesters appear to be promising for practical applications like packaging, biomedical materials, and environmentally friendly plastics.

Presenting Student: Harsh Panchal
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K Gupta

Title: Developing FeCo-NC Alloy For Optimizing Electrocatalytic Activity in Water Splitting and Oxygen Reduction

Abstract: With the increasing demand for sustainable energy, developing efficient electrocatalysts for key reactions like the oxygen evolution reaction (OER), hydrogen evolution reaction (HER), and oxygen reduction reaction (ORR) is crucial. This study explores the design of a FeCo-NC/CNT alloy catalyst with tunable Fe/Co ratios to enhance catalytic performance. The catalyst was synthesized using hydrothermal and pyrolysis methods, forming a well-structured alloy supported by nitrogen-doped carbon. Characterization confirmed the successful integration of Fe and Co into the NC/CNT framework, improving conductivity and increasing active sites for reactions. Electrochemical tests showed that the $Fe_{0.9}Co_{0.1}$-CNT catalyst exhibited the best performance, with an OER overpotential of 247 mV, an HER overpotential of 71 mV at 10 mA/cm^2, and an ORR half-wave potential ($E_{1/2}$) of 0.87 V vs. RHE. Its OER activity is comparable to iridium oxide, a standard noble metal catalyst, highlighting its potential as a cost-effective and efficient alternative. The synergy between Fe and Co in the NC/CNT matrix enhances reaction kinetics and electron transfer, making this catalyst a strong candidate for fuel cells, metal-air batteries, and water-splitting applications. This research emphasizes the importance of optimizing metal composition and catalyst structure to develop high-performance, affordable electrocatalysts, contributing to the advancement of sustainable energy technologies.

Presenting Student: Sagar Jariwala
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram Gupta

Title: Utilization of Dimethyl Methylphosphonate (DMMP) as an Effective Flame Retardant in Hemp Seed Oil-Based Bio-Polyol for Rigid Polyurethane Foams

Abstract: A novel hemp seed oil-based polyol was synthesized via epoxidation and ring opening of crude hemp seed oil (HSO). The successful synthesis of polyol was characterized by running several confirmatory tests such as FTIR, hydroxyl value, and acid value. The results attested to the synthesis of polyol, which was used to produce rigid polyurethane foams (RPUF) by composing polyol, hardener, catalyst, blowing agent, and DMMP flame-retardant additive in the form of Liquid with increasing concentrations. In addition to this, the majority of RPUF presented a closed-cell content greater than 65%. Also, significant improvement in flame retardancy was recorded as the neat HSO-based RPUF had a burning time of 104 seconds and a weight loss of 81.57%. Yet, adding 10 wt.% of DMMP was reduced to 13 seconds, and weight loss was 3 wt.%, respectively. Hence, our study was successful in manufacturing biobased RPUFs. Additionally, further research can be done to improve the properties of the hemp seed oil foams that are produced, which can likely be used commercially for consumer and income generation needs.

Oral Presentations

Category B

Undergraduate and Graduate Students

Presenting Student: Addison Redd
Student Status: Undergraduate
Major: Criminal Justice
Research Advisor: Dr. Gary Wilson

Title: P3 Waves Correlation in Diagnostic of Psychopathy

Abstract: This research aims to inform psychopathy is characterized by the persistent accounts of antisocial behavior, impaired empathy for others. It is a complex personality disorder that possesses many significant challenges in diagnostic techniques. It is uniquely challenging in diagnosing and treating an individual with psychopathy. Advancements in Magnetic Resonance Imaging, such as fMRI (Functional Magnetic Resonance Imaging), to analyze P3 waves in the brain whilst in use. P3 waves are a component of event-related potential (ERPs), that reflect cognitive process like decision making. P3 waves have been seen as impaired in those that have been diagnosed with psychopathy. By analyzing P3 waves and the latency that has been seen to occur, psychologists can begin to identify the neurological factors that are associated with psychopathy and determine neurocognitive abnormalities. FMRIs allow researchers to better understand the individual brain structures that are associated with empathy, emotions, and moral decision making which are typically underdeveloped in those with psychopathy. This research explores the implications and uses of P3 waves' integrations as a diagnostic tool for those undergoing testing for psychopathy. Hypothesizing that the implication of P3 waves as a diagnostic tool will become a more reliable way of diagnosing psychopathy, and have huge implications within the criminal justice system, and informing early detection and treatment options.

Presenting Student: Kennadie Campbell
Student Status: Undergraduate
Major: Elementary Education (K-6)
Research Advisor: Dr. Mark Diacopolous

Title: Prepackaged Curriculum: The Death of a Profession

Abstract: For my academic honors this semester, I intend to complete a project on the reality of premade curriculum. I will answer the following questions:
1) Does prepackaged curricula undermine teacher's sense of professional responsibility and professionalism? 2) Does prepackaged curricula actually meet student needs? 3) Who are prepackaged curricula for?
I will examine curriculums like Eureka Math, Common Core, and premade curriculum boxes. I will speak with educators across all ages (preschool to high school) about their experiences with premade curriculum and how it caters to their students, versus the student needs it does not meet. I will clearly discuss elements of the curriculum and its strengths and weaknesses.
In order to complete my project, I will interview at minimum five teachers total.
Preferably, two teachers at the elementary school level, two teachers at the middle school level, and one teacher at the high school level. Within the elementary school level curriculum, I would like to interview one teacher at the K-2 level and one teacher at the 4-5 level. Within middle school level, I would like to interview one sixth grade teacher and one eighth grade teacher. At the high school level, I would like to interview a sophomore teacher. My findings will be presented as an oral presentation of roughly 15 minutes accompanied by an essay of a minimum of ten pages. I will present my findings to my classmates and at the research emporium. The project is above and beyond class requirements as it requires extensive research outside of class and requires me to do much deeper and extensive work exploring curriculums than required by the class. I will be taking time outside of class to interview teachers, and writing/organizing my project outside of class time. Whereas in class we do not get real-world examples of premade prepackaged curriculum that is being used in the field, I will be able to examine curricula that are being implemented by teachers. I will also be able to get into the field and access multiple varieties of curricula.

Presenting Student: Justin Miles
Student Status: Undergraduate
Major: Business Management
Research Advisor: Darrell Pulliam

Title: Navigating the NIL Era: Exploring Pittsburg State University's Role in Supporting Student-Athlete Entrepreneurship

Abstract: In a new era of college sports, student-athletes are now able to receive compensation for the use of their Name, Image, and Likeness (NIL). Athletes have the opportunity to be paid for doing promotional activities with businesses, sell merchandise, and do much more. This new model has many different benefits and challenges. One benefit of this all, is athletes are now much more encouraged to seek different entrepreneurial opportunities. Even at a small school level, the development of this system is growing more and more prominent.

Amid these changes, there is a role for Pittsburg State University to fill in through helping these athletes take advantage of this new wave of possibilities. This project's goal will be to determine, "What impact does the evolving NIL landscape have on student-athletes' entrepreneurial ventures, and how can Pittsburg State University support students in navigating these opportunities"

This study will consist of quantitative data and surveys with PSU athletes and area businesses interested in using these athletes' name, image, and likeness for marketing purposes. The findings of this study will not only help these athletes better navigate these opportunities, but will also make Pittsburg State a welcoming location for all athletes hoping to seek entrepreneurial ventures.

Presenting Student: Saatvik Sabarwal
Student Status: Undergraduate
Major: Data Science & Information System and Business Economics
Research Advisor: Dr. Heather Eckstein

Title: Factors Affecting Gas Price Inflation in the U.S. Over the Last Two Decades

Abstract: Gasoline price inflation in the U.S. has been a persistent concern, influenced by crude oil prices, geopolitical events, regulatory policies, and financial market speculation. This study analyzes gasoline price fluctuations from 2004 to 2023, highlighting major disruptions such as the 2008 financial crisis and the COVID-19 pandemic. While traditionally considered inelastic, gasoline demand exhibits greater long-run elasticity, driven by shifts in driving behavior, fuel efficiency improvements, and electric vehicle (EV) adoption.

Using time-series econometric models, this research examines key factors affecting price volatility. Short-run demand remains inelastic, but over time, sustained high prices encourage consumers to switch to fuel-efficient vehicles and alternative energy sources. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models reveal that price volatility is amplified by speculative trading and global supply shocks. Government policies, such as fuel taxes, environmental regulations, and subsidies, further influence price dynamics.

Findings suggest that future gasoline consumption will decline due to technological advancements and regulatory shifts. Understanding these market forces is crucial for policymakers aiming to mitigate price volatility and transition toward sustainable energy solutions. This research provides valuable insights into the evolving nature of gasoline demand, offering strategies to balance economic stability with environmental sustainability.

Presenting Student: Gacke
Student Status: Undergraduate
Major: Economics
Research Advisor: Dr. Michael Davidsson

Title: Determining NFL Running Back Value

Abstract: The analysis of sports analytics is an imperfect metric to evaluate player performance. In the NFL, player salaries are increasing at record levels as is the salary cap, or money teams are allowed to spend on players, is increasing at a similar rate. The allocation of these millions is the difficult job of NFL teams' front office where the combination of analytics, player performance, and financial analysis combine. The purpose of this study is to help general managers and decision makers use econometric analysis to win games, and inevitably contribute to the winning of a championship. The analysis consists of NFL running backs specifically and weather the positions wage disparity is justified. Despite the high visibility and importance of the skill position, running backs salaries are among the lowest quartile in the league. This value over salary metric being tested is a team's tool for individual analysis in comparing monetary value against league average performance metrics such as Yards Per Attempt, Touchdowns, Success Percentage, Attempts, and Cap hit. In the attempt to capture a player's true value, the results should give insight to weather a player's value on the field is being under or overcompensated off the field. The findings show correlation between salary and performance with a few main challenges. The age and health of the player as well as the structure of NFL contracts. In conclusion, by applying statical models with data analytics. This paper aims to provide a better view of running backs market value in the NFL, along with contributing to the broadening of existing economic analysis in sports.

Presenting Student: Likun Liu
Student Status: Undergraduate
Major: Economics
Research Advisor: Dr. Michael Davidsson

Title: An Empirical Analysis of Factors Influencing Crime Rates in the United States

Abstract: Criminality has long been a significant component of society, shaping how people develop and improve legislation. It is a major concern for both public authorities and citizens, making the question of what drives individuals to engage in illegal activities a central issue. This study investigates the key factors influencing crime rates in the United States, with the objective of providing empirical evidence and actionable suggestions for reducing crime rates. This research builds upon existing literature by examining factors such as public police expenditure, real GDP, and poverty rate. Data was collected from sources like the Uniform Crime Report, U.S. Census, American Community Survey, and FRED for the period 1995-2020. An Ordinary Least Squares (OLS) regression analysis was then conducted.

The findings indicate that increased government expenditure on policing has a significant negative impact on crime rates, suggesting that stronger law enforcement efforts contribute to crime reduction. Conversely, the unemployment rate shows a positive correlation with crime, reinforcing the idea that economic hardship drives criminal activity. These results provide valuable insights for policymakers, suggesting that a balanced approach-combining effective policing with economic initiatives-may yield the best outcomes for crime prevention.

Presenting Student: Anthony O. Cole Smith
Student Status: Undergraduate
Major: Finance and Economics
Research Advisor: Dr. Michael Davidsson

Title: Determinants of U.S. Beef Prices

Abstract: The beef industry is vital to the United States economy and directly affects what Americans choose to consume. However, this industry is constantly changing, and the factors influencing beef pricing are evolving. This study takes historical data and aims to analyze beef price determinants by examining variables like slaughter counts, byproduct prices, substitute prices, seasonality, income, inflation, and feed costs. Utilizing a time series regression model, the research evaluates the impact of these variables on the farm, wholesale, and retail levels. The preliminary findings indicate that the consumer price index (CPI) for food, slaughter volumes, feed prices, and byproduct values are very significant predictors of beef prices at all levels. Additionally, seasonal trends and the prices of substitute meats also affect price fluctuations. The study also highlights breakpoints in the data occurring over multiple spans in time.

Presenting Student: Brendon Gahagan
Student Status: Undergraduate
Major: Finance and Economics
Research Advisor: Dr. Michael Davidsson

Title: Affording the American Dream: Analyzing the Economic Factors Shaping U.S. Housing Affordability

Abstract: Housing affordability is a critical component of financial stability and quality of life for many Americans. Over the past three decades, the U.S. housing market has undergone substantial changes due to economic shifts, with varying impacts on affordability across different regions. The purpose of this study is to examine national real estate trends from 1995 to 2023 to explore the relationship between economic factors and housing affordability. Using the Mortgage to Income Ratio (MTI) as the measure for housing affordability this study uses a pooled regression model with time-series data, this research incorporates five key independent variables: median household income, inflation rate, 30-year fixed mortgage rate, median home price, and unemployment rate. The data was obtained from The Federal Reserve Economic Data (FRED) and includes 1,450 observations from all 50 US states. To estimate the results using causality we expect higher mortgage rates, unemployment, inflation, and home prices will negatively impact affordability and higher household income should positively impact affordability. Through this study I hope to test this hypothesis and quantify the effects of economic variables and the extent to which they affect housing affordability and real estate trends. These findings could help both buyers and sellers in the housing market make more informed decisions about the best time to buy or sell based on the current state of the economy.

Presenting Student: Gunnar Jefferis
Student Status: Undergraduate
Major: Finance, Business Economics
Research Advisor: Dr. Michael Davidsson

Title: Wage Determinants in the United States

Abstract: This study aims to analyze and quantify the macroeconomic factors that determine Wages in the United States from 2000 through 2020. Wages can be defined as Total Weekly Earnings of full-time wage seasonally adjusted for individuals 16 years and older. This study will use quarterly data that includes 84 observations. The determinants that this study will focus on are the Unemployment rate, GDP growth rate, the Consumer Price index, Labor Productivity, the Employment Population rate, the Federal Funds rate, and Personal Consumption Expenditure. This study will use a pooled regression to help us analyze the data along with using the Ordinary Least Square Regression model. As this study tries to explain and examine the determinants of total weekly earnings from a macroeconomic view, there was a significant positive relationship between Wages and Labor Productivity with an increase of 1.31%. This can be explained when firms produce more, they will be able to pay the workers more. There was a significant positive relationship between Wages and the Federal Funds rate which saw an increase of 1.57%. When the Federal Funds Rate is low it encourages more borrowing and spending which makes businesses invest in themselves this could explain the increase in wages and the Federal Funds Rate. There was also a significant positive relationship between Wages and Personal Consumption Expenditure. Personal Consumption Expenditure will increase by 8% when wages increase. When individuals make more in wages, they tend to spend more this can explain the positive relationship between Wages and Personal Consumption Expenditure.

Presenting Student: Kunkler Logan
Student Status: Undergraduate
Major: Finance and Economics
Research Advisor: Dr. Heather Eckstein

Title: Demographic and socioeconomic determinants of cancer rates

Abstract: Cancer is one of the leading causes of death in the United States. The National Cancer Institute defines cancer as a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body. Even with advancements in treatment methods there is no cure and even once in remission the cancer can come back. This study aims to answer how demographic and socioeconomic factors impact the cancer rate around the United States. A multivariate pooled regression analysis is conducted using linear panel data. To run the regression, we are using ordinary least squares. Cancer rate is the dependent variable. Population, gender, age, race, median household income, and marriage rate are the independent variables. Results from the regression show that male, female, median household income and marriage cause the cancer rate to increase, and they are all significant. Population, ages, and races all cause the cancer rate to decrease. They are all significant but the age group 0-24. AR (1) and AR (2) were used to help the regression model. The implication of these results shows that population, gender, ages 25 and above, ethnicity, median household income, and marriage rates play a significant role in shaping cancer rates in
the United States.

Presenting Student: Nicholas Walker
Student Status: Undergraduate
Major: Finance, Business Economics
Research Advisor: Dr. Heather Eckstein

Title: Development in Basketball: A Glimpse into the Changes of the NBA

Abstract: The game of basketball is ever-changing and the style of playing has been further developed steadily over time. Professional sports teams must use statistical analysis to keep up with these changes to both increase their profitability and franchise value and to win games. Through reading the articles for literature review, it is seen that franchises can increase their value and revenue through winning games. The development of basketball in the NBA can be observed by determining which aspects of team statistics impact the number of games a team wins in a season. This is done by separating a total of 1,135 teams into eight groups organized by the years the season were played in. The teams included are every team in every season since the introduction of the three-point line in the 1979-1980 season. This excludes seasons in which a full 82 game season was not played. Descriptive statistics were looked at to receive insight on how the game has nominally changed in terms of the statistics that were included. Using ordinary least squares, it was discovered that two-point percentages, total rebounds, and turnovers are variables that are significantly affect the total number of wins in every group. The variable that had the largest change in impact was the three-point percentage. This variable was not significant early on. However, since becoming significant in group three, its coefficient has only grown larger. This study is designed for the identification of NBA trends overtime and what it currently takes to win games.

Presenting Student: Trevor Bohnenblust
Student Status: Undergraduate
Major: Finance and Business Economics
Research Advisor: Dr. Michael Davidsson

Title: Market Augmentation of the U.S. Soybean Crush Spread

Abstract: The soybean crush spread is a key profitability measure in the soybean processing industry that relates the difference between the combined weighted values of soybean meal and soybean oil and the average domestic price of soybeans. The goal of this study is to identify and measure the factors influencing the U.S. soybean crush spread through key macroeconomic, market-specific, and commodity price variables for the period of 1986-2023. Additionally, the study assesses how regulatory shifts in governmental biofuel policy impact soybean oil demand, and, by extension, the crush spread. This econometric study utilizes a linear OLS regression technique to model the change in the dependent variable, the average crop-year soybean crush spread, with average U.S. corn price, soybean use, crude oil price, ethanol production, livestock feed demand, freight costs, U.S. dollar index, and shifts in renewable fuel policy as the independent variables. Preliminary results show that corn prices, soybean use, ethanol production and freight costs were a positively correlated with the soybean crush spread, while oil prices, feed demand, and biofuel policy implementation were negatively correlated with the crush spread.

Presenting Student: Rylee Liermann
Student Status: Undergraduate
Major: Accounting
Research Advisor: Dr. Kaylah Lewis

Title: Implementing the Congressional District Electoral Method in All States

Abstract: The congressional district method is currently used by Nebraska and Maine to award each state's electoral votes based on the popular vote winner in individual congressional districts, rather than the state's overall popular vote winner. This system is superior to winner-take-all, therefore all fifty states should join Nebraska and Maine in using the congressional district method. With voters in the United States demanding changes to the electoral college system, the congressional district method provides a fair compromise that satisfies the demands for reform. Additionally, the congressional district method provides better representation to all voters compared to the current electoral college system. Due to better representation, all fifty states implementing the congressional district method would increase voter turnout across the country, as shown in Nebraska and Maine. It would also equalize power between states by eliminating the disproportionate influence held by swing states and ensuring the issues of voters in all states are equally important to presidential candidates. Finally, implementing the congressional district method should receive bipartisan support, as it makes elections fairer overall and does not disproportionally benefit either political party. While there are some possible drawbacks to the congressional district method, such as the risk for gerrymandering and an increase in presidential campaigns costs, the benefits of this electoral method are far greater than the potential issues. The congressional district should be implemented across all fifty states to give every voter a voice in presidential elections and to satisfy the demand for electoral college reform.

Presenting Student: Jada Ortiz Hope Rainey
Student Status: Graduate
Major: Communication
Research Advisor: Dr. Alicia M. Mason

Title: Enhancing Web and Language Accessibility in Electronic Informed Consent Documentation (eICDs) for Web-Based Human Subjects Research

Abstract: Informed consent is a cornerstone of ethical and legal principles that uphold research participants' voluntary involvement in applied and clinical studies. In the United States, informed consent documentation (ICD) is most commonly required in medical, research, legal, educational, and digital contexts, ensuring individuals understand and voluntarily agree to participation. Regulatory bodies, institutional review boards (IRBs), and clinical trial sponsors have yet to establish uniform guidelines to ensure readability and comprehension of ICDs. Electronic informed consent (eICDs) have been found to be hindered by habituation (Karegar, et al., 2020), design (Mclnnis, et al., 2024), and comprehension challenges (Foe & Larson, 2016). To understand informed consent practices in the Communication discipline a comprehensive web and language accessibility analysis was conducted using both manual and computer automated analysis techniques. Research studies included in this analysis were sampled through COMMNotes, a public forum hosted by the National Communication Association (NCA). Findings, interpretation, and limitations are reported.

Oral Presentations

Category C

Undergraduate and Graduate Students

Presenting Student: Kate Hileman
Co-Authors: Elizabeth Catlin, Katie Conner, Logan Emmett
Student Status: Undergraduate
Major: Graphic Communications
Research Advisor: Dr. Jason Reid

Title: Insights from the Pittsburg State Web Experience Study

Abstract: This study examines the user experience of the Pittsburg State University website, focusing on navigation, event discovery, and access to essential student resources. Through moderated usability testing, we identified key pain points, including inconsistent navigation, unintuitive filtering systems, and difficulty locating critical pages such as financial aid, enrollment, and student jobs. While participants found the Events page generally accessible, they expected more personalization and clarity in filtering options. Additionally, returning to the homepage was a frequent challenge due to unclear navigation cues, broken links, and inconsistent button functionality. Essential tools like student job listings and housing applications were either difficult to find or required navigating to external sites, disrupting the user experience. Using these insights, we propose targeted improvements to streamline navigation, enhanced filtering features, and ensure seamless access to vital resources. Our findings aim to inform future website enhancements that prioritize usability, reduce frustration, and improve engagement for the PSU community.

Presenting Student: Khadija Ceesay
Student Status: Graduate
Major: English
Research Advisor: Dr. Lori Martin

Title: Beyond the Poster: Unveiling the Realities of War and the Trauma of Soldiers in Literature from WWI to Vietnam

Abstract: Recruitment posters from World War I, II and the Vietnam War all had a common theme: displaying the duty and bravery of those who chose to put their country first by enlisting. These posters promised a romanticized heroism and a revered future where freedom is achieved for all. But the reality of these conflicts was rooted in an imperialist cycle at the expense of millions of people. This presentation aims to exhibit and understand not only the atrocities that soldiers experience but their inability to re-inhabit their societies as a result of mental, emotional, and physical disabilities as illustrated by Tim O'Brien, Ernest Hemingway, and Kurt Vonnegut in their novels that span three subsequent wars. Each writer challenges the glorification and necessity of war by depicting disconnected relationships, fragmented realities, and the characters' inability to reclaim an identity that is removed from destruction and violence. The purpose of closely analyzing the authors, their books and supporting literary articles is to understand the perception of war versus the reality through the experiences of the characters and how these experiences accurately or inaccurately portray that of real soldiers during the appropriate times. This analysis also aims to understand the role that gender, the perception of masculinity and nationalism was weaponized against soldiers to keep them complicit in this system.

Oral Presentations

Category D

Undergraduate and Graduate Students

Presenting Student: Keegan Gardner
Student Status: Undergraduate
Major: Nursing
Research Advisor: Dr. Barbara McClaskey

Title: Trauma-Informed Care

Abstract: The purpose of the evidence-based project is to express the importance of Trauma-Informed Care in the care of pediatric patients and the prevention of adverse complications in adulthood. The idea of Trauma-Informed Care is to communicate with all psychiatric patients as if they have experienced a trauma. Trauma-informed care or TIC is a communication approach to help avoid retraumatizing pediatric patients who have experienced a traumatic event, or who may not have expressed such an experience. TIC is a strategy for nurses to shift their perspectives of trauma, to understand that trauma is experienced differently for everyone, and to acknowledge that trauma is broad in its description. The long-term side effects of trauma can impact children into their adult life. Some adverse effects of trauma include high cortisol levels from stress, anxiety and depression, diabetes, heart problems, and other potential health issues. Some interventions for TIC are mostly based on how a nurse can approach a patient who has experienced trauma. High-quality TIC involves trust, respect, and understanding. Implementing TIC on a pediatric level in mental health services can help prevent long-term adverse effects in adulthood.

Poster Presentations

Category A

Undergraduate and Graduate Students

Presenting Student: Clarissa Wedman
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Neil Snow

Title: Vascular Plant Diversity at the Monahan Outdoor Education Center: 2024

Abstract: Native and non-native plant species are indicators of ecosystem health and resilience. The Monahan Outdoor Education Center is a 156-acre reclaimed mined land area located approximately 1.5 km northeast of Cherokee in Crawford County. This field site is owned by PSU and is situated in the southern part of the state's historic coal mining area. A previous PSU botanist (Timme, ca. 2000) produced a preliminary but incomplete unpublished checklist of 89 vascular plant species, which we believed was significantly short of what likely occurs on the Monahan. We hypothesized that many additional species would be found with further fieldwork. To test this hypothesis, the first author collected plants almost every weekend during the 2024 flowering season. Our primary goal was to document all vascular plants among the Monahan's old fields, and forested, and wetland areas. The results revealed over 100 additional species not documented initially, which now total 139 for the property. Curiously, 45 of the originally reported species were not found during the current survey, which highlights changes in distributions through time. Our data represent a chronological snapshot of species distributions on the Monahan and serve as baseline data for future comparisons at an important field site of PSU.

Presenting Student: Debmalyo Rudra Sarma, Owen Long
Co-Authors: Carter McDonald, Annalyse Gilmore, Laken Hunter, Ayushee Dasgupta, Hailey Lemcke
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Anuradha Ghosh

Title: Metagenome analysis of poultry litter collected from commercial farms in southeast Kansas with a focus on antibiotic resistant and foodborne pathogens

Abstract: There is growing concern on the use of antibiotics in food animals and poultry. Efforts are in place to bring in a change to the usage of antibiotics in animal husbandry primarily addressing the negative impact on human health besides acknowledging other confounding factors. As per CDC data shows each year in the U.S., Salmonella causes about 1.35 million infections, 26,500 hospitalizations, and 420 deaths while more than 2.8 million antimicrobial-resistant infections occur. The specific aims of this research were to investigate the abundance of antibiotic resistant enterococci as well as to determine the prevalence of pathogenic Salmonella serovers in poultry samples. Poultry litter was collected from 13 different farms around southeast Kansas using the collection kit that contained 5 collection tubes. One gram of each sample was diluted with phosphate-buffered saline and evenly distributed on Neogen Petrifilm Rapid Aerobic Count plate and subsequently based on dilution count plated on mEnterococcus agar. A total of 65 putative enterococcal colonies were streaked on nutrient agar and confirmed at the genus level using esculin hydrolysis. All confirmed isolates will be characterized for antibiotic resistance and virulence profile. A fraction of each litter sample was processed for total DNA extraction using MagBeads FastDNA Kit for feces. DNA concentration was determined using agarose gel electrophoresis and nanodrop. Further experiments will focus on PCR amplification and metagenome sequence analysis. The data obtained from this research will not only address food safety issues but will actively contribute to potential risk mitigation strategies.

Presenting Student: Jackson Reid, Gage Singer, Kate Tyree, Katie Ussery, Clarissa Wedman, Matthew Welch
Co-Authors: Andrew Braun
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Christine Brodsky, Dr. Andrew George

Title: Reclaiming the Prairie: Natural Resource Management at Prairie State Park

Abstract: Once widespread from central Canada to Mexico, tallgrass prairie is now one of North America's most imperiled ecosystems. Historically, tallgrass prairie covered roughly 15 million acres of Missouri. Today, less than 60,000 acres remain, comprising small patches dispersed across the state. The largest of these is Prairie State Park, a 1,619 Hectare piece of tallgrass prairie in Missouri. Perhaps the most pressing issue affecting prairie ecosystems in the Great Plains is woody plant encroachment, including species such as eastern red cedar (Juniperus virginiana), sericea lespedeza (Lespedeza cuneata), sumac (Rhus spp.), and blackberry (Rubus spp.). Eastern red cedar is particularly detrimental to native prairies because it outcompetes herbaceous species by depriving them of water, sunlight, and nutrients. Pittsburg State University students recently completed an internship where they helped revive a degraded section of Prairie State Park that was overgrown with eastern red cedar. Now in the second year of this partnership, park staff mentored the students in a variety of practical skills, including mechanical vegetation control, prescribed fire, all-terrain vehicle (ATV) use, personal protective equipment (PPE) protocols, and resource management strategies. Thanks to the combined efforts of park staff and PSU students, the degraded prairie section has been largely restored.

Presenting Student: Jayme Barkley
Co-Authors: Riley Johnson, Alessandro Martins
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Jody Neef

Title: Hyperbranched Polyesters Containing Natural Antibacterial Compounds

Abstract: Bacterial infections and bacterial contamination of food is a growing concern with the rise of antibiotic resistance bacteria. Several approaches such as antimicrobial peptides, silver nanoparticles, imidazolium salts, or carbohydrate polymers have shown promise in combating bacteria. Another approach which has received considerable attention is the use of polyphenols. Polyphenols are known are naturally occurring antibacterial compounds. Here, we are reporting the incorporation of salicylic acid, aspirin, or ibuprofen into a hyperbranched polymer for antibacterial applications.
The synthesis of these materials is a straight forward one-pot, two-step process. (see figure below) Adipic acid was reacted with glycerol triglycidyl ether in refluxing IPA overnight. Salicylic acid, aspirin, or ibuprofen was then added to the flask to react with the resulting hyperbranched polymer at reflux. These materials were characterized by IR and H-NMR spectroscopy. Following characterization, the antibacterial properties of each material was tested with gram-positive and gram-negative bacteria. The test involved addition of the hyperbranched polymer to a membrane. The membrane was added to a petri dish containing Agar followed by addition of the bacteria. The bacteria were then cultured followed by determination of bacterial inhibition.

Presenting Student: Rylan Mason
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Neil Snow

Title: An updated census of the native and non-native plants in Bates County: An under-surveyed region in western Missouri

Abstract: Human health is directly tied to the health of the local environment, which depends partially on what native and non-native plants occupy the land. However, many counties in the USA have had their plant (= floristic) diversity only partially documented. Previous research suggested that Bates County, Missouri, was less surveyed than other counties in the state. Our null hypothesis is that Bates County is not well collected, and (given existing knowledge) that over 300 more plant species could be documented with additional fieldwork. Our research involves seven or more day-long collecting trips annually to survey floristic diversity, including (with permission) areas managed by the Missouri Department of Conservation. Of the approximately 350 specimens collected in the first field season, 28 were documented for the first time in Bates County, corresponding to one in every eight collections being a county record. Among the county novelties were the aggressively invasive understory shrub Amur honeysuckle and pasture and roadside weed Musk thistle. This project will continue through the summer of 2026. Our results after only one collecting season corroborate the null hypothesis that Bates County was only partially documented for its plant diversity. It is well known that plant distributions change through time, and that climate change probably exacerbates such shifts among some species. Our project is providing baseline data for future ecological comparisons for things such as flowering times, the presence of invasive species, and monitoring the occurrences of rare taxa.

Presenting Student: Sara Akhtar
Co-Authors: Sebastian Henry
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Christopher Ward

Title: Transcriptomic Analysis of EGFR and Downstream Pathway Expression in MCF7 and Healthy Breast Epithelium

Abstract: Introduction: Clinical tests utilizing EGFR isoforms as a method of cancer screening have had an unreliable history to date. Our lab is interested in this gene's isoforms and downstream activation. We used an In-silco characterization and assessment of an Invasive Breast Ductal Carcinoma cell line (MCF7) in association with expression patterns of EGFR and associated pathways relative expression.
Purpose: Identify what proteins associated with downstream pathways are up or downregulated in MCF7 compared to the normal breast epithelium.
Methods: RNA-Seq data from publicly available breast adenocarcinoma and normal breast epithelium samples were analyzed using an isoform-level expression pipeline. Reads were aligned with a splice-aware aligner (STAR), followed by transcript assembly and quantification with featurecounts. Differential expression analysis and visualization were performed using Ballgown, allowing transcript-level resolution of EGFR isoforms and pathway-associated genes.
Results: Transcriptomic expressions trended in favor of under-expression, with the log fold change in gene expression of EGFR being nuanced among multiple samples.
Discussion: The breast ductal carcinoma cells show a general trend towards under-expression in the EGFR pathways. However, the expression of EGFR, being comparable to healthy breast epithelium, remains nuanced with increases in CDH2 expression suggesting increased N-Cadherin activity. This suggests that this pathway is not a primary driver in ER+, PR+, HER2- breast cancer. This does not rule out the possibility that isoforms may be elicited in downregulating this response.

Presenting Student: Sebastian Henry
Co-Authors: Sara Akhtar, Auditya Jain
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Christopher Ward

Title: Transcriptomic Analysis of EGFR and Downstream Pathway Expression in A549 and Healthy Lung Epithelium

Abstract:
Introduction: Clinical tests utilizing EGFR isoforms as a method of cancer screening, primarily for lung, breast, and ovarian, have been uncertain. These clinical tests lack specificity and sensitivity. We are interested in intronic single nucleotide polymorphisms (SNPs) in intronic regions. This work is an Insilco characterization and assessment of a lung adenocarcinoma cell line (A549) in association. With expression patterns of EGFR and associated pathways relative expression.
Purpose: Identify associated proteins from downstream pathways that are upregulated or downregulated in A549 compared to normal lung epithelium.
Methods: The expression pipeline was applied to lung adenocarcinoma and healthy lung epithelium from publicly available cDNA short reads. This pipeline involved sequence alignment with a splice-aware aligner (STAR) and feature counting algorithm (feature Counts), and normalization, filtering and plotting with limma. Heteroscedasticity adjustment was performed with Voom.
Results/Conclusion: HRAS, FOS, JUN, and NFKB1 all are overexpressed, and TP53 is under-expressed in A549. This suggests typical cell cycle dysregulation for cancer. However, MAPK3/ERK1 suggests there is overactivity in a MAPK pathway. Under expression in SOS1 and AKT3 illicit the alternative MAPK pathways with careful attention to the JNK pathway. Also, CDH1/CDH2 differences in expression suggest that E-cadherin activity is much higher than N-cadherin activity and that they are abhorrently up and downregulated, respectively.

Presenting Student: Riley Johnson; Jayme Barkley
Co-Authors: Sebastian Henry; Ryan Sorell
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Christopher Ward

Title: Comparing Lysholm Scores: Quadriceps, Hamstring, and Patellar Tendon Autografts in ACL Reconstruction

Abstract: Introduction: Anterior cruciate Ligament (ACL) injuries are common among athletes and active individuals. Following ACL reconstruction with an autograft tendon, functional outcomes are often assessed using a Lysholm Score, an inventory of patient function. Purpose: This study compares autograft tendons-quadriceps tendon (QT), hamstring tendon (HT), or patellar tendon (PT) to determine the relationship between the tendon donor site and average Lysholm Scores.
Methods: a meta-analysis was conducted on studies involving individuals aged 18 and older who underwent ACL reconstruction with HT, QT, or PT. A logic transformation of semi-quantitative outcomes was applied using generic inverse variance in both common and random effects models. Chi-square analyses for intergroup and intragroup comparisons were used. Heterogeneity and tau statistics were generated using both the common effects effect model.
Results/Discussion: Based on the common effect model are as follows: HT 90% [88%;92%], QT 92% [91%;93%], and PT 91% [91%;92%]. These findings suggest that there may be a modest benefit to using the QT as the donor site; all appear to be comparable across the 24-month follow-up period, leading to the conclusion that symptomatic outcomes do not appear to depend heavily on the tendon donor site. Based on the findings of this analysis, metrics other than Lysholm Scores may better guide clinical decision-making when selecting graft tendon donor sites.

Presenting Student: Kinsey Baldwin
Co-Authors: Derek Ross
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Jody Neef

Title: Effect of Ammonium Salts in the Addition of Benzoic Acid to Glycidyl Phenyl Ether

Abstract: Nucleophilic additions to epoxides are an important class of reactions in organic chemistry which have found use in material science, as intermediates, and in the synthesis of biologically important compounds. Many nucleophiles add to epoxides via a SN2 mechanism at the least substituted carbon. However, under acidic conditions addition is at the most substituted carbon via a SN1 mechanism. Included within this class of reactions is the addition of carboxylic acids to epoxides using tetrabutylammonium bromide as the catalyst. These reactions are straight forward and give high yields of the product. However, previous work in our lab using phthalimide as the nucleophile showed a faster reaction rate with tetrabutylammonium fluoride. Due to this result, we were interested in studying the effect of ammonium salts on the addition of benzoic acid to glycidyl phenyl ether. To better understand this reaction and the role of the catalyst, the halide of the ammonium salt was varied (F-, Cl -. Br, and I), in addition to the alkyl groups length (Bu, Pr, Et, Me). Reaction times were determined by IR spectroscopy and the product ratio was determined using proton NMR spectroscopy. The results, reaction times and product(s), of these studies will be reported.

Presenting Student: Olivia Southard
Co-Authors: Olivia Southard, Hannah Posterick, Irene Zegar, Chris Ward, Alessandro F. Martins
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: α -Tocopherol/sorbitol polyglycidyl ether loaded with Magnesium hydroxide composite particles with antimicrobial properties

Abstract: In recent years, researchers have been exploring novel composite particles with antimicrobial properties for pharmaceutical applications. In this study, we loaded alpha-tocopherol, also known as vitamin E (1, 2, and 4 g) and sorbitol polyglycidyl ether mixtures onto magnesium hydroxide and evaluated their color coordinate values, cytotoxicity, and antimicrobial properties. The chemical structure of the composite particles was confirmed through Fourier-transform infrared spectroscopy (FTIR). Additionally, we measured the UV-Vis spectra of magnesium chloride (MgCl2), vitamin E, and sorbitol polyglycidyl ether as precursors for the vitamin E and sorbitol polyglycidyl ether-loaded magnesium hydroxide composite particles. Vitamin E showed the maximum absorbance peak below 350 nm, indicating potential UV protection properties. Color-spectrophotometer test was conducted on samples containing 1 and 2 g of vitamin E. The results showed that the L* values for the composite particles with 1 and 2 g of vitamin E were 97.5 and 96.6, respectively. The a* values for the samples containing 1 and 2 g of vitamin E were- 1 and -0.1, respectively. Therefore, no significant color difference was observed in the powders. The antimicrobial activity of the composite particle containing 4 g of vitamin E was tested against Staphylococcus aureus and Escherichia coli, with inhibition zones of 12.33 mm and 19.67 mm, respectively. We found no statistically significant change in A549 cell response to any of these compounds within the tested range, as determined by the MTT assay. However, there were some morphological and cell density changes when exposed to vitamin E, sorbitol polyglycidyl ether, and magnesium hydroxide. Specifically, the nuclear-to-cytoplasmic ratio increased (cell volume decreased), and cytoplasmic rounding with membrane irregularities occurred. The effect was least pronounced for magnesium hydroxide particles, but there was evidence of dose-dependent changes in the composites.

Presenting Student: Simon Wicks
Co-Authors: Irene Zegar, Chris Ward
Student Status: Undergraduate
Major: Chemistry
Research Advisor: Dr. Mazeyar Parvinzadeh Gashti

Title: Fabrication of zein protein films from corn kernels: Effects of different silicone crosslinking agents on chemical properties

Abstract: Zein is a biocompatible and biodegradable protein extracted from corn kernels, known for its versatile properties and potential applications in food packaging, drug delivery, and biomedical scaffolds. Zein can react with silicone crosslinking agents, which can modify its various properties, including chemical characteristics and antimicrobial activity.

In this study, we fabricated zein films incorporating different concentrations of amine-functional silicones, followed by curing in an oven at 150 C for 2 minutes. The chemical properties of the zein films were evaluated using FTIR spectroscopy.

The chemical evaluation revealed several characteristic peaks of zein:

The peak associated with N-H stretching vibration, indicative of the amide bond present in zein's polypeptide chains, was observed around ~3300-3400 cm^{-1}.

The amide I peak, due to C=O stretching, was observed at ~1640-1650 cm^{-1}.

The amide II peak, corresponding to a combination of N-H bending and C-N stretching vibrations, appeared around ~1550 cm^{-1}.

The amide III peak, associated with C-N stretching and N-H bending, was detected at ~1230-1300 cm^{-1}, reflecting the protein's secondary structure.

The C-H stretching peak (from alkyl groups) appeared around ~2850-2920 cm^{-1}, corresponding to the C-H bonds in the amino acid side chains.

The O-H stretching peak was observed in the range of~3200-3550 cm^{-1}.

Additionally, the antimicrobial activity of the zein films was tested against Staphylococcus aureus and Escherichia coli. We also assessed the cytotoxicity of the films, yielding interesting results.

Presenting Student: Parker Neely, Spencer Jagels
Co-Authors: Dr. Tim Dawsey
Student Status: Undergraduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram Gupta

Title: Siloxane Modification of Thermoplastic Polyurethane Foam (TPU)

Abstract: Having control over the grip or traction of a material allows for it to be applied in a variety of fields. These include sportswear, robotics, medical devices, and packaging. This project involves the modification of one specific material, thermoplastic polyurethane foam (TPU). This modification involves adding a blend of monohydroxyfunctional siloxanes into the polymer to reduce the surface energy and traction of the foam. Formulations containing 0%, 1%, 3%, and 5% siloxane will be prepared to identify the optimal balance between reduced traction and material integrity. The samples will undergo testing to determine the surface tension, composition, friction coefficient, as well as thermal and mechanical properties. These include angle goniometry to test the contact angle of a water droplet on the surface of the foam; ATR-FTIR analysis to determine the composition of the foam; Taber abrasion to for the wear of the foam; and analysis of the thermal stability and glass transition temperature of the foam. An inclined plane will be created to measure the coefficient of friction. Additional testing may be conducted according to ASTM 638 and ASTM 790 to determine the tensile and flexural properties of the foam. The anticipated outcome is to find a correlation between siloxane content and surface energy.

Presenting Student: Avery Dauben
Co-Authors: Alexter Montojo
Student Status: Undergraduate
Major: Electronics Engineering Technology
Research Advisor: Dr. Erik Mayer

Title: Descriptive Effects Pedal

Abstract: The Descriptive Effects Pedal, DEP for short, is a new effect pedal for electronic instruments that uses descriptions of musical sounds to change the output signal of the connected instrument. The DEP will be primarily used with instruments who are electric by nature such as an electric guitar or an electronic keyboard. The device serves to aid those who are aspiring to learn about effects for their instrument, without any sound design or music theory background. The DEP will allow a user to describe the sound of the instrument they want to create by selecting pre-programmed descriptions using the on-board touch screen. These descriptions correspond to digital effects that will take the input sound of the connected instrument and shape it into a sound in which they describe. The digital effects will be added to the signal of the instrument using a microcontroller. The device will have up to three active effects at once. The DEP will have up to seven different effects to choose from. In addition to altering the signal with digital effects, pre- and post-processing circuitry will be used to alter the signal for proper use within the DEP. This sound can either be played through the on-board speakers, or though other connected devices such as a speaker or headphones.

Presenting Student: Jacob Luton
Co-Authors: James Robinson
Student Status: Undergraduate
Major: Electronic Engineering Technology
Research Advisor: Dr. Clark Shaver

Title: INIVEST

Abstract: The INIVEST is a wearable vest that provides full-body tracking and haptic feedback to a user in a virtual reality environment. The purpose of the INIVEST is to provide a more immersive experience to a user whether used in a professional or recreational setting. Full body tracking allows for more complete and realistic motion while haptic feedback provides a greater level of immersion in a virtual world.
The INIVEST works as a standalone wireless device, making it compatible with almost any virtual or augmented reality headset currently on the market. INIVEST combines the technology of full body tracking and haptic feedback into one device, providing a new level of convenience for users. It consists of a vest with the primary tracker, central control unit (CCU), and 16 haptic motors. In addition, there are six modular trackers to track the arms and legs of the wearer.
Tracking is achieved through the use of inertial measurement unit (IMU) sensors which are compatible with the open-source SlimeVR Virtual Reality tracking software. Haptic feedback is implemented with the use of small vibrational motors controlled by the CCU. Power is supplied by a single high capacity lithium-ion battery giving the vest a runtime of over three hours.

Presenting Student: Jhonatan Granadeno
Co-Authors: Jhonatan Granadeno, Jacob Luton, Ty Woolven, Estevan Hernandez, Black, Veatch, Dr. Tao Wu, Dr. Hongsheng He, Dr. Elizabeth MacDonald
Student Status: Undergraduate
Major: Electronics Engineering Technology
Research Advisor: Dr. Erik Mayer

Title: Using the artificial intelligence technique of logic tensor networks to predict aurora borealis visibility

Abstract: Building upon previous research, an Al technique called logic tensor networks is used to predict where to view the aurora borealis. This technique uses a logic-based neural network to create these predictions. The model outputs probabilities of sightings. Classification, a machine learning technique used to sort data into categories, will be used to compare with the logic tensor networks. Work is ongoing to gather and format data collected by satellite and from the Aurorasaurus website to use for training our model. The Aurorasaurus website collects reports from people around the world and stores data such as the date, time, geographical coordinates, and the duration of the sighting.

This site also uses a model that predicts viewing locations, called Ovation Prime. Since the Ovation Prime model gives the probability of sighting the aurora overhead, view lines are used to adjust the probabilities of Ovation Prime to compensate that the aurora may be sighted closer to the horizon. The Ovation Prime model does not accurately predict where the aurora is visible. Thus, logic tensor networks will be used to combine the Ovation Prime model with the reports of sighting to increase the accuracy of the Aurorasaurus predictions.

This research is a continuation of that funded by the NASA Rapid Response Research Grant Appendix F: A Neural-Symbolic Aurora Model Driven by Aurorasaurus Data in Citizen Science and the Kansas National Space Grant College and Fellowship Program - Opportunities in NASA STEM FY 2020-2024. It is currently supported by the NSF ASTER-LSAMP grant at PSU.

Presenting Student: Logan Fidler
Co-Authors: Ty Woolven, Kallie Shannon
Student Status: Undergraduate
Major: Electronics Engineering Technology
Research Advisor: Dr. Clark Shaver

Title: Smoke Savvy Automated Pellet Smoker

Abstract: Smoke Savvy is a user-friendly, high-quality automated pellet meat smoker. Smoke Savvy monitors the average temperature of the meat chamber, the internal temperature of the meat being cooked inside the meat chamber, and the quality of the smoke circulating throughout the meat chamber. In addition to monitoring, Smoke Savvy also controls the internal temperature of the meat chamber and the quality of smoke in the meat chamber. Smoke Savvy controls the temperature of the meat chamber using a PID control system that calculates the pellet feed rate and intake fan speed to maintain the meat chamber temperature at the user's desired setpoint. Smoke Savvy similarly controls the smoke quality, using a PID control system that calculates the intake fan speed and the output damper position to maintain smoke particles in the "blue smoke" level.

Presenting Student: Reece Thurman & Patrick Hilgenberg
Student Status: Undergraduate
Major: Electronics Engineering Technology
Research Advisor: Dr. Clark Shaver

Title: Lizard Lounge

Abstract: The Lizard Lounge is an automated, desert reptile enclosure designed to provide the perfect conditions for a bearded dragon. Bearded dragons are a popular pet that can be temperamental and sensitive creatures that require specific conditions to thrive in captivity. Due to their robust nature, it is common for the neglect of a bearded dragon to go unnoticed by less experienced owners. The Lizard Lounge enclosure comes preinstalled with all the essential features necessary for the care of a bearded dragon, in a convenient package. The climate of the Lizard Lounge is customizable through the Lizard Lounge website, allowing the user to find the perfect settings for their bearded dragon. The user is able to set parameters for a day/night cycle as well as choose the temperature for the basking area during these periods. The Lizard Lounge also includes quality of life detection systems that notify the user when fecal matter is present in the enclosure or the water level is low, allowing for prompt response from the user. Another one of these features is the Roach Dispenser, a live dubia roach feeder that releases roaches into the feeding area. The number of roaches dispensed, and the frequency of feedings is determined by the user.

Presenting Student: Addie Ehrlich
Co-Authors: Connor Cravens, Graham Hough, Diego Garcia, Andrew Wisner
Student Status: Undergraduate
Major: Plastics Engineering Technology
Research Advisor: Mr. Dan Spielbusch, Dr. Jeanne Norton

Title: Injection Molding Using 3D Printed Tooling

Abstract: Injection molding has traditionally used steel tooling and inserts to manufacture parts. With the rapid development of 3D printing, injection molding tooling is changing. 3D printing, or additive manufacturing, is a process of making three dimensional objects from a digital file and is the opposite of traditional subtractive manufacturing, or hollowing out a block of material with a milling machine. Plastics manufacturers have utilized 3D printing in order to produce molds at reduced material cost, fabrication time, and energy input. Our preliminary review of current technology allowed us to determine an effective method of replicating this process in the PSU Plastics labs. After designing parts, we modeled inserts for the A- and B-half of the mold in SolidWorks, our computer aided design software. From these designs, and information from the 3D printer, we used a FormLabs Form 3+ printer with High Temp liquid resin to 3D print mold inserts. We encountered material challenges due to material weight causing creep during the printing process. To avoid this issue, we designed inserts to fill in the back of the pocket. After printing, the inserts and spacers were test-fitted into the mold base and sanded to fit snuggly within the pockets. Most of our printed parts have been produced successfully with slight adjustments and reprints of certain component to insure the best fit. Once 3D printed inserts are fitted in the mold base, we will produce parts with 3D printed tooling on the Arburg injection molding machine and evaluate part quality.

Presenting Student: Ashley Heinen
Co-Authors: Alex Benedict, Blaise Dawson, Jake Hooker, Titus Zamanzadeh, Grant Howard
Student Status: Undergraduate
Major: Plastics Engineering Technology
Research Advisor: Dr. Jeanne Norton

Title: The Effect of Post-Processing Conditions on Injection Molded Part Performance

Abstract: Plastics recycling is a growing environmental concern. When choosing recycled plastics for new parts, manufacturers prefer post-industrial material rather than post-consumer plastics because they are less contaminated, allowing for easier reprocessing into new products. Despite the advantages over post-consumer plastics, post-industrial plastic can experience temperature extremes. This investigation focuses on the effect of post-processing conditions on HDPE parts' thermal and mechanical properties. Materials used in this study were two different grades of HDPE material: Virgin HDPE and Crate HDPE. Each material was injection molded into test bars and conditioned after processing. Standard conditioning was one week at ambient temperature, pressure, and humidity. Two elevated temperatures were examined: 70C or 110℃ for 24 hours. Three reduced temperatures were also studied: 4℃ or - 25℃ for 24 hours, and ice bath quenching for one hour. Subsequently, we evaluated samples for thermal and mechanical properties. Mechanical properties included tensile and flexural modulus, ultimate elongation, and Izod impact strength. Tc and Tm were determined via DSC. Virgin HDPE had greater elongation than Crate HDPE under all conditions. Ice bath quenched Virgin HDPE showed greater tensile and flexural moduli. Both 70C and 110C Virgin HDPE had lower flexural moduli compared to other conditions and Crate HDPE. Crate HDPE had lower impact strength than Virgin HDPE overall. Virgin HDPE (70℃) and Crate HDPE (110C) showed improved notched impact strength. Tm was not affected in Virgin HDPE by conditioning, but Crate HDPE showed a 5 to 15% crystallization increase. Overall, post-processing of HDPE does affect important material properties.

Presenting Student: Gavin Johnson
Co-Authors: Grant Howard, Paul Herring
Student Status: Undergraduate
Major: Plastics Engineering Technology
Research Advisor: Dr. Jeanne Norton

Title: Effects of Varied Mold Temperature on Polyethylene Injection Molded Parts

Abstract: The cooling process is the biggest contributor to injection molding cycle time, and it is the most impactful on final part properties. One way to control both cycle time and part properties as a function of cooling is to manipulate mold temperatures. For this study, we molded HDPE from three different sources (control, virgin, and crate) at three different mold temperatures: 15.6 °C (low), 22.2 °C (mid-range) and 49 °C (high). Parts were analyzed for changes in part dimensions, mechanical, and thermal properties. To establish the degree of part shrinkage after injection molding, parts were measured immediately after molding, after one hour, after 24 hours, and after 168 hours. Each material shrank after processing with the greatest shrinkage occurring within one hour of molding. The greatest shrinkage was observed in all materials at the mid-range mold temperature. Parts were also characterized for tensile, flexural, and impact properties. Crate material demonstrated the highest tensile and flexural moduli overall. Mid-range mold temperatures yielded the highest tensile modulus for all materials. Virgin material demonstrated the highest overall elongation while crate material had the lowest elongation. Low-range mold temperature showed the greatest elongation in all materials. No clear trend was observed for impact properties. Differential scanning calorimetry was used to analyze thermal transitions as a function of mold temperature. Crystallization and melting temperatures were not significantly affected. Crate material had the highest percent crystallinity overall. We have demonstrated that mid-range mold temperatures result in optimized part properties for the HDPE materials in this study.

Presenting Student: Jacob Culross
Co-Authors: Quinton Colwell, Sydney Holmes, Jeffrey Horinek, Noah Morfeld, Grant Howard
Student Status: Undergraduate
Major: Plastics Engineering Technology
Research Advisor: Dr. Jeanne Norton

Title: The Effect of UV Degradation on HDPE Part Performance

Abstract: Ultraviolet (UV) degradation poses a significant challenge when selecting plastics for exterior applications. UV radiation causes irreversible changes to polymers through chain scission, potentially reducing molecular weight and widening molecular weight distribution. Molecular-level chain scission results in plastic parts with visible defects and reduced performance. This study focused on gaining an understanding of the effect of outdoor weathering on plastic parts with different colorants. Virgin HDPE was injection molded into test bars without an added colorant (control). Three different colorants were added to HDPE and injection molded into test bars in the following amounts: Yellow, 0.75 wt%; Green, 2 wt%; and Black, 1 wt%. Subsequent to injection molding, samples were weathered in a QUV for 500 hours. After weathering, the weathered test bars were ground up, and the reduced, weathered material was again remolded into test bars. Characterization was performed on all samples (natural vs. color samples) under all conditions (no weathering, accelerated weathering, and remolded after accelerated weathering) to determine the degree of property degradation that had occurred. Mechanical properties were analyzed by tensile, flexural, and Izod impact testing. Thermal properties were analyzed by TGA and DSC. Physical properties were characterized by melt flow indexing, FT-IR spectroscopy, and colorimetry. Slight changes in mechanical, thermal, and physical properties were observed among color samples after weathering. More significant changes in properties were observed in HDPE samples without colorant. We demonstrated that weathering does alter properties, and the inclusion of colorant does reduce the impact of UV degradation on HDPE samples.

Presenting Student: Riley McDaniel
Co-Authors: Zack Frost, Daniel Jackson, Caleb Sims, Chase Terrell
Student Status: Undergraduate
Major: Plastics Engineering Technology
Research Advisor: Mr. Paul Herring, Dr. Jeanne Norton

Title: New Product Development: Injection Molded Flowerpot from Recycled Material

Abstract: The Department of Plastics Engineering Technology at Pittsburg State University aims to advance sustainability of plastics. We designed a new product (a flowerpot) that could be molded using the Engel e-Motion injection molder. All parts were designed to be molded with recycled material. Initially, we gathered information on important considerations when designing flower pots from local industries: size, shape, and other important design details to incorporate into the team's initial designs. The injection molder's capabilities also had to be considered when determining the size of the flowerpot. Design software (Solidworks) was utilized to generate several initial designs. Calculations within the design software were preformed to determine important concerns including cooling time, tonnage requirements, and part cost. Additional software (SigmaSoft) was used to simulate the process of creating the flowerpot inside the injection molder. 3-D printing was used to better visualize the designs. After the final design was chosen, we reached out to mold manufacturers to create the new molding tool for the plastics lab with our final flowerpot design. The mold shop revised the final design and began manufacturing the mold base. Once the mold arrives at Pittsburg State University, we will begin process development studies on the product. The use of hot tip bushing will help eliminate the amount of plastic waste for every manufactured part compared to other designs. After initial mold development studies, we will be able to manufacture these flowerpots for teaching and promotional purposes.

Presenting Student: Gabriel M. McClain
Student Status: Graduate
Major: Biology
Research Advisor: Dr. Andrew George

Title: Breeding Ecology of Prothonotary Warblers on Abandoned Mined Lands

Abstract: The Prothonotary Warbler is a Neotropical migrant songbird that nests in tree cavities in forested wetlands. Despite population declines due to habitat loss in the core of their geographic range, prothonotary warblers may be expanding their range westward into Kansas, where woody encroachment and disturbance from past strip mining have resulted in extensive nesting habitat. The goal of this study is to assess population demographics on mined and unmined lands throughout the breeding season. In 2024, we located territories of prothonotary warblers and banded 4 individuals. Starting in December 2024, we placed 260 nest boxes on 8 mined and 8 unmined sites in SE Kansas and SW Missouri. Over the next two years, we will band all prothonotary warblers on all 16 sites and monitor their nest success. In addition, we are collaborating with several local Audubon chapters to attach geolocators to a subset of prothonotary warblers to study migration and dispersal patterns. Results from this study will allow us to compare occupancy rates, nest survival, and site fidelity across mined and unmined sites to determine the role these heavily disturbed ecosystems play for migratory songbirds.

Presenting Student: Dharmikkumar Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Geraniol-Derived Mechanically Robust, Self-Healable, and Reprocessable Epoxy Vitrimer Based on Dynamic Boronic Esters

Abstract: Covalent Adaptable Networks (CANs) are a pioneering family of polymers that have garnered significant attention in recent years and are characterized by covalent crosslinks that exhibit reversible dynamic alterations by external stimuli. Additionally, unlike traditional thermosets, CANs-particularly vitrimers-exhibit self-healing, reprocessability, shape-memory, and recycling capabilities due to the dynamic feature of covalent crosslinks. Recently, an increasing trend in the global production of thermosets involves rapid consumption of petroleum-based resources, which has become a growing environmental concern. From this perspective, the development of eco-friendly thermosets from bio-based feedstocks is a possible way to overcome these drawbacks. In this context, geraniol is one of the monoterpenoid alcohols, a primary component of several plant oils that become a valuable replacement for petroleum-based resources. In this study, for the first time, a geraniol-derived epoxy vitrimer has been developed by a thermally triggered "thiol-epoxy click" reaction between the geraniol-based epoxy resin and dynamic diboronic ester dithiol (DBDT) cross-linker. The resulting vitrimer exhibits excellent self-healing properties driven by the topology alteration through the dynamic transesterification of boronic ester bonds. The fabricated epoxy vitrimers possess superior thermal stability and significant mechanical properties with the absolute value of glass transition temperature (Tg) of 38.43 °C determined by DMA analysis. Incorporating dynamic boronic ester linkages imparts an enhanced tensile strength of ~19 MPa, enabling the vitrimer to recover its original shape after deformation (shape memory), solvent recycling ability, and excellent reprocessability with the maximum restoration of mechanical strength. Moreover, the vitrimer was further characterized by a remarkably short relaxation time of 9 s at 140 °C and an activation energy of 22.44 kJ/mol.

Presenting Student: Himanshubhai Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Effect of Diamine Cross-linker on the Curing Behavior of Eugenol-Based Epoxy Thermoset

Abstract: With the increasing need for sustainable and high-performance materials, this research focuses on the development of eugenol-based epoxy thermosets as a renewable alternative to fossil-based polymers. Eugenol, a naturally derived phenolic compound, undergoes a multi-step synthesis process, including functionalization with allyl bromide, thiol-ene reaction, and epoxidation to produce an epoxy resin. This study investigate the effect of diamine cross-linkers on the curing behavior and mechanical properties of the thermoset. The study analyzes different diamines, including EDA (ethylenediamine), BDA (butanediamine) and HDA (hexamethylenediamine) assessing their impact on cross-link density, flexibility, and thermal stability. Thermal curing is applied to achieve a stable polymer network, and various characterization techniques are employed, including FT-IR, 1H NMR, DSC, TGA/DTGA, DMA, tensile testing, and gel fraction measurements. The results indicate that the glass transition temperature (T_g) of the cured thermoset ranges from 100 to 110 °C, depending on the diamine used. The thermal degradation temperature ($T_{5\%}$, initial weight loss) is observed to be between 320 °C and 350 °C, demonstrating thermal stability. The tensile strength of the optimized thermoset reaches approximately 7.0 MPa, highlighting its mechanical performance. Additionally, the material exhibits flexibility, enhanced thermomechanical properties, and a well-defined cross-linked structure, making it a candidate for industrial applications in coatings, adhesives, and advanced composites.

Presenting Student: Grant Howard
Co-Authors: Jacob Culross, Paul Herring
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Jeanne Norton

Title: The Effect of Mechanical Recycling on the Properties of HDPE for Commercial Applications

Abstract: Modern plastics manufacturing methods create significant waste including sprues, runners, flash, trim, and out-of-spec parts. To reduce the carbon footprint of the plastic industry, post-industrial waste materials are often reprocessed into new parts. This investigation centered on reprocessing HDPE materials and the effects of mechanical recycling on material properties. Specifically, we focused on the degree of mechanical recycling that HDPE can undergo before a degradation in key material properties is observed. Virgin HDPE material was injection molded into test bars and subsequently reduced with a mechanical grinder. Injection molding was then repeated until the HDPE had been molded and ground ten times. Analysis was performed on virgin-, first cycle-, fifth cycle-, and tenth cycle-regrind, to determine if any degradation had occurred as a result of grinding and remolding. Reprocessed samples were analyzed for changes in thermal and mechanical properties. Degradation temperature was determined by TGA, and Crystallization temperature and melting temperature were analyzed by DSC. Melt rheology was analyzed by melt flow indexing. The tensile properties and impact strength were analyzed by tensile and Izod impact testing, respectively. Slight increases in tensile elongation were observed with an increased number of cycles. Notched impact strength and modulus decreased slightly as the number of cycles increased. Thermal stability, melt flow index, melting temperature, and temperature of crystallization were not significantly affected. Crystallinity calculated from Tm and Tc peak area determined by DSC showed no clear trend between percent crystallinity and the number of processing cycles. We demonstrated the recyclability of HDPE without significant loss of properties.

Presenting Student: Iman Afyouni
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Mn_3O_4 Nanostructures as Cathodes for High-Energy-Density Zinc-Ion Batteries

Abstract: Zinc-ion batteries (ZIBs) are considered advanced battery technology to replace lithium-ion batteries because they are cost-effective, safe, and environmentally friendly energy storage systems. However, finding suitable cathode materials is a challenging task for ZIBs. In this study, pristine Mn_3O_4, nanostructures were prepared using the microwave-assisted solvothermal method and utilized as a cathode for ZIBs. The phase and crystalline properties were analyzed using X-ray diffraction (XRD). Scanning electron microscopy (SEM) was utilized to examine the morphology of the prepared samples. The electrochemical performance was evaluated using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and charge-discharge cycling tests. The CV data measured indicated enhanced redox kinetics of the Mn3O, cathode, signifying its strong charge storage capability. As a result, the Mn_3O_4 cathode exhibits a high initial charge/discharge capacity of 223/173 mAh/g at a current density of 100 mA/g with a Coulombic efficiency of 76%. After 100 cycles, the Mn_3O_4 cathode showed a high reversible capacity of 221 mAh/g. The improved electrochemical properties are attributed to structural stabilization and enhanced ion transport. These findings highlight the potential applications of Mn_3O_4, as an efficient cathode material for next-generation ZIBs, contributing to the development of high-capacity sustainable energy storage solutions.

Presenting Student: Vinash Chaudhari
Student Status: Graduate
Major: Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Exploring Sustainable Biopolyesters: Synthesis from 1,4-Butanediol and Aliphatic Diacids

Abstract: Biobased polyesters were synthesized from 1,4-butanediol and a series of aliphatic dicarboxylic acids, namely succinic acid, adipic acid, and sebacic acid using melt polycondensation. The resulting polymers poly(butylenesuccinate) (PPeS), poly(butylene adipate) (PPeA), and poly(butylene sebacate) (PPeSe) were characterized with intrinsic viscosity, nuclear magnetic resonance (NMR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), dynamic mechanical analysis(DMA) and tensile testing. All the polymers had weight-average molecular weight of over 50,000 g/mol and melting temperature (T_m) ranging from 50 °C to 116 °C, PPeA exhibited a lower melting temperature due to semicrystalline structure and rapid crystallization. The "even-even" effect was observed, contributing to an increased tensile strength of PPeA. All the polymers exhibit good thermal stability, mechanical properties, and tensile properties compared to polyethylene. These biobased and potentially biodegradable polyesters appear to be promising for practical applications like packaging, biomedical materials, and environmentally friendly plastics.

Presenting Student: Arya Darji
Co-Authors: Dr. Daulatabad Narsimulu
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Preparation of Calcium Vanadate Composite as a Cathode for the Aqueous Zinc-Ion Batteries

Abstract:
Aqueous zinc-ion batteries (ZIB) are considered an alternative to lithium-ion batteries concerning safety and low cost. However, finding suitable cathode materials is a challenging task. Herein, we prepared calcium vanadate, $CaV_2O_7@V_2O_5$, composite using microwave-assisted solvothermal synthesis and it was utilized as a cathode for ZIBs. The prepared XRD results confirmed the formation of the composite phase of $CaV_2O_7@V_2O_5$. The measured CV results reveal the redox behavior of the composite cathode. The $CaV_2O_7@V_2O_5$ composite cathode delivered an initial capacity of 175 mA/g and 174.2 mA/g, respectively. The capacity of the $CaV_2O_7@V_2O_5$ composite cathode initially increased up to 50 cycles and then gradually decreased. After, 200 cycles, the delivered discharge capacity is about 287 mA h/g at a current density of 100 mA/g with a Coulombic efficiency of 97.5%. Also, $CaV_2O_7@V_2O_5$ composite cathode showed an excellent reversible capacity of 182 mAh/g and 125 mAh/g at a high current density of 1000 mA/g and 2000 mA/g, respectively. After reversing back to its initial current density of 150 mA/g, the $CaV_2O_7@V_2O_5$ composite delivered a high capacity of 327 mAh/g indicating excellent rate performance. This work provides a new pathway for the fabrication of novel cathode materials for the fabrication of advanced batteries.

Presenting Student: Harsh Panchal
Co-Authors: Ronit Chaudhari, Kemilaben Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Developing FeCo-NC Alloy For Optimizing Electrocatalytic Activity in Water Splitting and Oxygen Reduction

Abstract: The growing need for sustainable energy has driven research into effective electrocatalysts for crucial reactions such as OER, HER, and ORR. This study focuses on the design of a FeCo-NC/CNT alloy catalyst with adjustable Fe/Co ratios to enhance electrocatalytic performance. The catalyst was created through hydrothermal and pyrolysis methods, resulting in a well-defined alloy structure supported by nitrogen-doped carbon. Characterization confirmed the successful incorporation of Fe and Co into the NC/CNT framework, boosting conductivity and increasing active sites.
Electrochemical testing revealed that the $Fe_{0.9}Co_{0.1}$-CNT catalyst had the best catalytic performance of the group, with an OER overpotential of 247 mV, a HER overpotential of 71 mV at a current density of 10 mA/cm^2, with an ORR half-wave potential ($E_{1/2}$) of 0.87 V vs. RHE. Its OER performance is close to that of Iridium Oxide, a benchmark noble metal catalyst, demonstrating its potential as a cost-effective and efficient alternative. The combination of Fe and Co in the NC/CNT matrix significantly improves reaction kinetics and electron transfer. These findings suggest that the FeCo-NC/CNT alloy catalyst could replace costly noble metal-based electrocatalysts in applications like fuel cells, metal-air batteries, and water-splitting systems. This research underscores the importance of tuning metal composition and optimizing structure to develop high-performance catalysts and advance sustainable energy solutions.

Presenting Student: Kemilaben Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: M (Mn/Fe/Co/Ni)-N-C Catalysts for Versatile Electrochemical Applications

Abstract: The development of atomically dispersed M-N-C catalysts, where a metal (M) is supported on nitrogen-doped carbon (NC) matrix, is highly desirable for multifunctional electrocatalysis but remains a significant challenge due to size constraints and stability issues. In this study, we synthesized M-N-C catalysts (M = Fe, Co, Mn, and Ni) were synthesized using a Zn-assisted high-temperature treatment and characterized through various techniques. The electrocatalytic activity of the synthesized catalyst was evaluated for the oxygen reduction reaction (ORR), oxygen evolution reaction (OER), and hydrogen evolution reaction (HER) in alkaline media. The findings revealed that Mn-N-C exhibited superior ORR (E1/2 = 0.90 V) and OER (n10 = 283 mV/cm2) performance compared to other catalysts. In contrast, Fe-N-C demonstrated the best HER activity (n10 = 65 mV/cm2). Theoretical studies indicated that the Mn-N-C catalyst's HOMO energy was close to the LUMO of 02, enabling efficient electron transfer from Mn's 3d orbitals to 02's Tt* orbitals, weakening the O-O bond. Meanwhile, Fe-N-C exhibited optimal binding energy for 02 and H2, enhancing its OER and HER performance. This study presents a novel strategy for tuning the electronic and electrochemical properties of M-N-C catalysts, offering valuable insights for catalyst design in energy conversion applications.

Presenting Student: Pradipsinh Dodiya
Co-Authors: Dr. Mayankkumar L. Chaudhary, Dr. Rutu Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Enhancing Thermal, Mechanical, and Chemical Performance of Bio-based Polyurethane Adhesives: The Role of Pentaerythritol Crosslinking in Castor and Soybean Oil Polyols

Abstract: Wood adhesives play a crucial role in construction and manufacturing, but traditional adhesives often rely on environmentally harmful synthetic materials. This project explores a sustainable alternative by synthesizing bio-based adhesives derived from castor oil polyols (COP) and soybean oil polyols (SOP). The goal is to develop an eco-friendly adhesive that offers enhanced bonding strength, thermal stability, and chemical resistance. Incorporating pentaerythritol as a crosslinker increases hydroxyl group availability, resulting in higher crosslinking density. This improvement enhances adhesive strength and thermal stability through the formation of a more rigid polymer network. Tensile strength testing revealed that SOP at 5 wt.% exhibited the highest room-temperature tensile strength (6.14 MPa), while COP at 5 wt.% achieved 5.05 MPa. At 90C, SOP at 10 wt.% retained a tensile strength of 4.73 MPa, outperforming COP at 5 wt.% (4.52 MPa), demonstrating superior high-temperature performance for SOP-based adhesives. The research methodology involves synthesizing polyols from renewable plant oils via epoxidation and ring-opening reactions, followed by their conversion into adhesives using methylene diphenyl diisocyanate (MDI) and pentaerythritol. FT-IR spectroscopy and tensile strength testing were used to evaluate adhesive performance under varying weight percentages and temperatures. To further validate properties, additional tests-including thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), gel swelling tests, and water contact angle measurements- will assess thermal stability, crosslinking density, solvent resistance, and surface hydrophobicity. By developing high-performance bio-based adhesives, this study advances sustainable material innovation, reducing reliance on petroleum-based products while providing durable and robust wood bonding solutions.

Presenting Student: Sagar Jariwala
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Enhanced Mechanical and Thermal Properties of Castor Oil Polyol-Based Polyurethane Adhesives with Additional Crosslinker

Abstract: Polyurethanes (PU) have been promising polymeric materials with many applications, including adhesives. The global PU market is projected to grow from 42.8 billion dollars in 2021 to 61.5 billion dollars by 2026. However, many PU adhesives are sourced from petroleum products. Therefore, to lower the dependence on non-renewable resources and provide sustainable and affordable alternatives. In this work, bio-based polyurethane adhesives were synthesized from modified castor oil-based polyol and tannic acid. Generally, polyurethane reaction depends on the properties of polyol and isocyanates. The most important aspect of these reactions is the OH number of the polyol, which is responsible for the crosslinking and bonding strength of the adhesives. Therefore, to increase the OH value and provide a better reaction platform, an external bio-based crosslinker in the form of tannic acid was incorporated. Its impact on the chemical and mechanical properties of the adhesives was characterized. The same was reflected in the mechanical strength test, in which the tensile of the adhesive increased from 3.71 to 6.05 MPa for the sample without any mass loadings of tannic acid to 10 wt.% tannic acid correspondingly. consider "Differential scanning calorimetry (DSC) analysis indicated a steady increase in the glass transition temperature (T_g) from 0 C to 62 °C as tannic acid content increased from 0 to 20 wt.%. This research will provide sustainable alternatives to petroleum-based adhesives with better thermal and mechanical properties.

Presenting Student: Sauravkumar Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Effect of Diamine and Triamines Crosslinkers on the Adhesive Properties of Soybean Oil-Based Non-Isocyanate Polyurethane

Abstract: Nowadays, polyurethanes (PUs) play a major role in the polymer industry and are more and more popular due to their advantages and unique mechanical and chemical properties in different applications like foams, paint, coatings, elastomers, and adhesives, Bio-based sources have recently gained attention as sustainable alternatives to conventional petroleum-based material. Due to growing environmental concerns and the excessive use of petroleum-based products, this study explores non-isocyanate polyurethanes (NIPUs) as sustainable, low-toxicity alternatives to traditional PUs. To achieve this, as a starting material, soybean oil (SBO) was used, and it was converted into epoxidized soybean oil (ESBO). ESBO was then converted into CSBO using a Parr autoclave reactor in the presence of tetrabutylammonium bromide (TBAB). Then synthesized CSBO was characterized using physicochemical experiments, e.g. FT-IR, Oxirane oxygen percentage (%EOC content), viscosity analysis, gel permeation chromatography (GPC), and also the 1H NMR spectra further verified the formation of CSBO, Following the successful synthesis of CSBO, we used solvent-free and catalyst-free methods to synthesize NIPU. For that, we used two different diamines, namely Isophorone diamine (IPDI) and Meta-xylylene diamine (m-XDA), or one triamine, e.g. Tris(2-aminoethyl)amine (TAA). The NIPU adhesive specimens containing IPDA and m-XDA as curing agents exhibit lap shear strength of 1.1 MPa and 4.97 MPa respectively on the wood coupon. However, TAA containing adhesive sample shows excellent shear strength of 7.62 MPa on stainless-steel metal coupon under the optimized condition. The thermal transition of all fabricated adhesive samples was investigated by DSC analysis which shows higher glass transition temperature (T_g) of 35.12 °C and 34.58 °C for CSBO_IPDA (1:4) and CSBO_TAA (1:2.5) respectively compared to CSBO_m-XDA (1:3.5) specimen (Tg 16.33C) indicating higher cross-linking in the polymer network.

Presenting Student: Siddharaj Vaghela
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: The Iron Vanadate Composite as a High-Capacity Cathode for Aqueous Zinc-Ion Batteries.

Abstract: Aqueous zinc ion batteries are considered an alternative technology for lithium-ion batteries owing to their high safety and low cost. However, finding suitable cathode material (matching with zinc anode) remains a great challenge. Herein, we prepared an iron vanadate-based composite using the solvothermal method associated with further calcination at 500 °C. The as-prepared composite sample is used as a high-capacity cathode for aqueous ZIBs. The measured XRD results confirmed the formation of the FeV_2O_4/V_2O_5 composite phase. The oxidation and reduction peaks in the measured CV results confirmed that Zn^{+2} entered host cathode in multiple stages. The FeV_2O_4/V_2O_5 composite cathode delivered a high initial charge and discharge capacity of 312 mAh/g and 413 mAh/g at a current density of 500 mAh/g with an initial Coulombic efficiency of 75%, After 150 cycles, the FeV_2O_4/V_2O_5 composite cathode showed an excellent discharge capacity of 170 mA h/g. This work provides a new strategy for the preparation of vanadate-based composites for energy storage applications.

Presenting Student: Urvashi Gondaliya
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: Mesoporous Hollow Nested Nanospheres of Ni, Cu, Co-Based Mixed Sulfides for Electrocatalytic Oxygen Reduction and Evolution

Abstract: Nanostructured thiospinel-based transition metal sulfides with high-density active sites hold great application potentials as non-noble electrocatalysts. In this paper, high-performance bifunctional oxygen electrocatalysts of well-designed Ni, Cu, Co-based mixed sulfides, which combine two highly active thiospinels of $NiCu_2S_4$ and $CuCo_2S_4$, have been prepared successfully through solvother mal reaction, calcination, and the following sulfurization. The products of Ni, Cu, Co-based mixed sulfides present unique hollow structures with mesopores, in which several nano particles-assembled hollow nanospheres of 30-50 nm in thickness are nested one by one, forming multishell morphologies. Benefiting from the synergistic effect of combining $NiCu_2S_4$ and $CuCo_2S_4$ and the well-designed hollow structures with large electroactive surfaces/interfaces and efficient mass transportation, the obtained Ni, Cu, and Co-based mixed sulfides exhibit remarkable electrocatalytic activities and excellent long-term durability toward not only oxygen reduction reaction (ORR) but also oxygen evolution reaction (OER). Regarding the overall oxygen-based electrocatalytic performance, the mixed sulfides present an extremely low potential difference (0.73 V) between the ORR and OER in KOH electrolyte, delivering significant superiority to their oxide counterparts and the commercial catalyst of Pt/C, as well as most of the oxygen bicatalysts reported recently. Therefore, the obtained Ni, Cu, and Co-based mixed sulfides hold great promise as low-cost bifunctional catalysts with high efficiency for oxygen-based advanced energy storage systems.

Presenting Student: Varshikkumar Rameshbhai Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Self-healable and Reprocessable Epoxy Vitrimer derived from Epoxidized Hemp Seed Oil and Dynamic Imine Bonds

Abstract: Vitrimers are a class of covalently cross-linked polymers that undergo dynamic bond exchange, enabling self-healing, reprocessability, and recyclability while retaining the mechanical robustness of thermosets. This research focuses on the synthesis and characterization of a fully bio-based vitrimer derived from epoxidized hemp seed oil (EHSO) and vanillin-based imine cross-linkers. The synthesis involves the epoxidation of hemp seed oil followed by curing with dynamic Schiff-base (imine) cross-linkers synthesized from vanillin and aliphatic diamines. The imine bonds introduce network adaptability, allowing topological rearrangement under external stimuli such as heat, thereby facilitating material reconfiguration and repair. To optimize vitrimer properties, a systematic study is conducted on cross-linker structure, catalyst selection, and curing conditions. Characterization techniques such as Fourier-transform infrared (FT-IR) and nuclear magnetic resonance (NMR) spectroscopy confirm the successful synthesis of precursors. Gel permeation chromatography (GPC) and epoxy oxygen content (%EOC) analysis validate network formation, while rheological studies, stress relaxation experiments, and mechanical testing evaluate viscoelastic behavior, self-healing efficiency, and mechanical strength. The developed vitrimer presents a sustainable alternative to conventional thermosets, exhibiting tunable mechanical and thermal properties suited for applications in coatings, adhesives, and composite materials, by integrating renewable feedstocks and dynamic covalent chemistry, this research advances the development of bio-based high-performance polymers, contributing to environmentally friendly material innovations. The findings demonstrate the potential of hemp-seed-oil-derived vitrimers in circular economy frameworks, emphasizing their role in reducing polymer waste and enhancing material sustainability.

Presenting Student: Yashkumar N. Patel
Co-Authors: Rutu Patel, Mayankkumar L. Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Development of Bio-Based Polyurethane Adhesives: Impact of Schiff Base Crosslinkers on Mechanical and Thermal Properties

Abstract: Historically, polyurethanes (PUs) are usually produced with petroleum-derived polyols like urea or phenol formaldehyde, both of which are hazardous to human health and detrimental to the ecosystem. Consequently, industries have lately shown interest in creating bio-based PUs composed of polyol derived from vegetable oil and diisocyanate. In this research, PU-based adhesives are created utilizing soybean oil polyol (SOP) and methylene diphenyl diisocyanate. To enhance the performance of synthesized PU adhesive, Schiff-based diols referred to as VB and VH have been incorporated into the system as crosslinkers, originating from butane diamine, hexane diamine, and vanillin. The successful production of PU has been validated with Fourier transform infrared spectroscopy (FT-IR) spectra. The tensile strength of adhesive samples was evaluated on oak wood specimens. In adhesive samples based on VB, VB-10wt.% exhibited the greatest tensile strength at 4400 KPa compared to all other weight percentages (wt.%), while for VH-based adhesive samples, the maximum tensile strength was recorded for VH-10wt.% at 5000 KPa. In both instances, as the wt.% of Schiff base diol rises, the tensile strength declines to 3800 KPa and 2900 KPa for VB-15wt.% and VH-15wt.% respectively. Additionally, the synthesized PU adhesive samples exhibit thermal stability, as verified by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) assessments. Furthermore, the gel content and degree of swelling tests additionally demonstrate the crosslinking efficiency of the PU adhesive materials.

Presenting Student: Yashkumar Patel
Co-Authors: Dr. Rutu Patel, Dr. Mayankkumar Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Extraction of Cellulose from Paper Towels for Sustainable Bio-Based Polyurethane Adhesives.

Abstract: The increasing consumption of paper towels generates significant waste, necessitating sustainable recycling solutions. This study investigates the extraction of cellulose from wastepaper towels and its application in bio-based polyurethane adhesives. The extraction process includes alkali treatment, bleaching, and acid hydrolysis to obtain recycled cellulose (rCL). The extracted cellulose is then used in polyurethane (PU) synthesis alongside castor oil polyol (COP) and methylene diphenyl diisocyanate (MDI), with performance compared to industrial cellulose-based polyurethane. The obtained rCL and synthesized PU adhesives have been characterized with FT-IR spectra for structural confirmation. In addition, the synthesized PU adhesives demonstrated improved mechanical and thermal properties. At room temperature, tensile testing showed that rCL -5wt.% exhibited a higher tensile strength of 7.37 MPa as compared to 6.36 MPa for CL-5 wt.%, indicating better mechanical strength of PU adhesives with rCL. Differential scanning calorimetry (DSC) analysis showed an elevated glass transition temperature (T_g) of 82.24℃ for the rCL-5wt.% and 72.26 °C for the CL-5wt.% as compared to 68.74 °C for the control sample, indicating improved thermal stability. Gel swell analysis confirmed a lower swelling and higher gel content for rCL-5wt.% as compared to CL-5wt.%, reflecting a denser, more robust polymer network structure with high crosslinking with rCL. These results suggest that recycled cellulose is a viable alternative to industrial cellulose for sustainable polymer applications. The study contributes to eco-friendly material development by promoting waste utilization and reducing reliance on petrochemical-based adhesives.

Presenting Student: Ajay Kumar
Co-Authors: Mayankkumar L. Chaudhary, Rutu Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Isocyanate-Free Polyurethane Coatings with Silicon-Based Compound: A Green Approach for High-Performance Coatings

Abstract: The development of sustainable and environmentally friendly polyurethane coatings has garnered significant attention in recent years. This research focuses on the development of isocyanate-free coatings derived from carbonated soybean oil (CSBO) using a solvent- and catalyst-free approach. The coatings were synthesized by reacting CSBO with ethylenediamine (EDA) and varying weight percentages of 3-aminopropyltriethoxysilane (APTES) which was added to enhance the coating property as it contains silicon in it. to evaluate their mechanical and thermal properties. FTIR confirmed the successful formation of urethane linkages, with a significant reduction in C=O peak intensity after 48 hours of curing, indicating enhanced crosslinking. Mechanical testing revealed that films containing 10 wt.% APTES exhibited the highest tensile stress of 1.29MPa due to optimal crosslink density, which balanced rigidity and flexibility. The best elongation at break was observed at 15 wt.% APTES, attributed to increased molecular interactions that allowed better energy dissipation under stress. TGA indicated that coatings with 15 wt.% APTES had the highest degradation temperature at 7.01 °C, suggesting a well-structured polymer matrix with improved thermal resistance. Tensile adhesion tests on oak wood substrates showed maximum bonding strength at 3.6MPa of 10 wt.% APTES, owing to optimal silane interaction with the substrate, promoting better adhesion. These findings suggest that silicon-modified bio-based polyurethane coatings can serve as sustainable alternatives to traditional isocyanate-based systems while achieving superior mechanical and thermal performance. Also, we are working on some other characterizations such as coating different materials like wood, stainless steel, and glass; after coating, we'll check the effect of watercolors, ink, and chemical resistance on the different coated materials.

Presenting Student: Falgun Gadhiya
Student Status: Graduate
Major: Physics
Research Advisor: Dr. Serif Uran

Title: Development of environmentally friendly high-performance composite materials from soybean oil for electrical applications

Abstract: The high-and low-voltage insulators, transformers, and power transmission cables of the electrical and electrotechnical sectors require durable insulating materials. Yet traditional petroleum-based insulators present environmental concerns and hence a need for sustainable alternatives. Our purpose is to use soybean oil-based polyurethane composites as eco-friendly insulation materials. Soybean-based polyurethanes were highlighted as a cost-effective yet highly performing solution for electrical insulation, standing to gain additional benefits in sustainability and innovation of renewable materials in industrial applications. Composites were prepared through silica (SiO2) filler and cured with isocyanates. We are in the process of testing dielectric strength, resistance, capacitance, and loss factor as a function of temperature, voltage, and frequency. The results will be discussed.

Presenting Student: Falgun Gadhiya
Student Status: Graduate
Major: Physics
Research Advisor: Dr. Serif Uran

Title: to study electron density of the ionosphere

Abstract: The method contains observations of the Electron Density of the lonosphere, Solar activities, etc. In addition, we took out some cases of earthquakes from 01-01-2023 to 20-06-2030 for further studies. The Earthquakes: (1) Machala, South America (2.783°S,79.852°W), 6.8 M on 18-03-23, (2) Afghanistan (36.523°N, 70.943°E), 6.5 M on 21-03-23, (3) Papua New Guinea (4.323°S, 143.166°E), 7.0 M on 02-04-23, (4) Panama (7.567°N, 82.335°W), 6.3 M on 05-04-23, (5) Mexico (49.215°N, 129.618°W), 6.0 M on 13-04-23, (6) New Zealand (29.958°S, 177.831°W), 7.1 M on 24-04-23, (7) Tonga, Fiji (15.628°S, 174.493°W), 7.6. M on 10-05-23, (8) Canillá (15.107°N, 90.805°W), 6.4 M on 18-05-23, (9) Loyalty Island (23.206°S, 17.742°E), 7.7 M on 19-05-23, (10) Japan (35.524°N, 140.522°N), 6.1 M on 26-05-23. For Prediction, we will observe the data of Electron Density which we will get from the GPS, and it will show signs around 1-9 days before the Earthquake. We can consider the observed sign of earthquakes only if the value of other activities is low or negligible. Other activities like dust storms, radioactive pollution, volcanic eruptions, thunderstorms, etc., can also affect the ionosphere's layers, which erase the signs of earthquakes.

Presenting Student: Jaymin Joshi
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Effect of Crosslinker Variations on the Mechanical, Thermal, and Solvent Resistance Performance of Bio-Based Polyurethane Adhesives

Abstract: This research aims to develop sustainable polyurethane adhesives with enhanced mechanical, thermal, and chemical properties by synthesizing two new crosslinkers: DEA, derived from Ethanolamine and Dimethyl benzene-1,4-dicarboxylate, and DPA, synthesized from 3-Amino-1-propanol and Dimethyl benzene-1,4-dicarboxylate. These crosslinkers were reacted with soybean oil polyol (SOP) and methylene diphenyl diisocyanate (MDI) to create adhesive samples with varying concentrations of crosslinkers (5, 10, 15, and 20 wt.% for DEA and 5, 10, 15, 20, and 25 wt.% for DPA), which were then cured at room temperature (RT) and 90C to examine the effects of thermal curing. FTIR analysis confirmed the successful formation of urethane linkages between the crosslinkers, polyol, and isocyanate. Tensile strength testing revealed that the adhesion strength of the adhesives increased with the crosslinker content up to an optimum level, with peak values of 6.77 MPa for DEA-15 wt.% and 6.86 MPa for DPA-20 wt.%, after which the adhesion strength decreased with higher concentrations. Gel swell analysis showed that DEA-based adhesives exhibited minimal swelling in both water and toluene, indicating a stable and well-formed crosslinked network. DPA-based adhesives, while exhibiting slightly lower gel content in toluene, still demonstrated strong solvent resistance, particularly in water, where the swelling degree was notably reduced. Hardness testing and Differential Scanning Calorimetry (DSC) further indicated that crosslinking significantly increased the rigidity and thermal stability of the adhesives, especially in heat-cured samples. These findings suggest that polyurethane adhesives with optimized crosslinker content, tailored for specific applications, offer strong potential for industrial use, particularly in applications requiring good mechanical strength, solvent resistance, and thermal stability.

Presenting Student: Kinal Chaudhari
Co-Authors: Rutu Patel, Mayank Kumar L. Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Optimizing Bio-Based Polyurethane Coatings for Enhanced Mechanical Strength and Hydrophobicity through Glycerol and HMDS Modification

Abstract: This study focuses on the development of durable, eco-friendly bio-based polyurethane (PU) coatings as sustainable alternatives to petroleum-based products. The research aims to reduce environmental impact while maintaining high performance in coating applications. Bio-based PU coatings were synthesized using soybean oil polyol (SOP), glycerol (GLY) as a crosslinker, and methylene diphenyl diisocyanate (MDI). The study was conducted in two phases: first, optimizing the glycerol content to enhance mechanical properties, and second, incorporating hexamethyldisilane (HMDS) to improve hydrophobicity and chemical resistance. In the first phase, PU coatings were prepared with varying weight percentages (wt.%) of glycerol (0, 5, 10, 15, and 20), and mechanical testing revealed that 10 wt.% GLY provided the best mechanical strength. In the second phase, the optimized formulation was further modified by adding HMDS in different wt.% (10, 20, 30, 40, and 50). The results indicated that 10 wt.% HMDS offered the best tensile strength, but higher concentrations of HMDS negatively affected crosslinking and homogeneity, leading to reduced mechanical performance. FT-IR analysis confirmed the formation of urethane bonds, while DSC and TGA analyses demonstrated the thermal stability of the coatings. Additionally, gel content and degree of swelling tests were conducted to evaluate the crosslinking density. The findings suggest that bio-based PU coatings with optimized glycerol and HMDS content can serve as effective, sustainable alternatives for industrial coating applications, offering a balance of mechanical strength, chemical resistance and environmental benefits.

Presenting Student: Anirudh Singh
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: $ZnMn_2O_4$@ZnO Composite as an Anode for Lithium-Ion Batteries

Abstract: As the world moves toward a sustainable energy future, the demand for advanced materials with higher energy densities in storage systems is accelerating. Graphite is used as an anode in conventional lithium-ion batteries because it is inexpensive and environmentally benign. However, the low theoretical capacity of the graphite (372 mA h/g) hinders the fabrication of next-generation batteries. In this work, we report the synthesis of $ZnMn_2O_4$@ZnO composites using the microwave-assisted solvothermal method and further calcined at 500 °C. The sample prepared could be utilized as an anode for lithium-ion batteries. Thermogravimetric analysis (TGA) confirmed the prepared sample's thermal stability. Phase analysis via X-ray diffraction (XRD) showed the formation of $ZnMn_2O_4$@ZnO composite phases. The electrochemical performance of the composite was evaluated using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and charge-discharge cycling tests. The $ZnMn_2O_4$@ZnO composites electrode exhibits a discharge capacity of 741 mA h/g over 100 cycles at a current density of 0.5 A/g, which is higher than the conventional used graphitic anode. The enhanced electrochemical performance is attributed to the synergistic interaction between $ZnMn_2O_4$ and ZnO, which improves both structural integrity and ion transport. These findings highlight the potential of $ZnMn_2O_4$@ZnO composites as high-performance and durable anode materials for next-generation lithium-ion batteries.

Presenting Student: Priyankkumar Patel
Co-Authors: Dr. Chandan Bodhak
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K Gupta

Title: Trade-offs Between Limonene & Geraniol-Based Reprocessable and Non-Reprocessable Epoxy Thermosets: Role of Aliphatic Diamines in Polymer Networks Design.

Abstract: The growing demand for sustainable materials, driven by environmental concerns and the rapid depletion of fossil fuels, has garnered significant attention in bio-based thermosets fabrication. Petroleum-derived thermosetting polymers can be replaced with renewable alternatives such as limonene and geraniol-derived epoxy prepolymers. The present study focuses on the synthesis and characterization of limonene and geraniol-based epoxy prepolymers over a two-step process and their thermally crosslinked thermosets using different aliphatic diamines. Incorporating cystamine, a disulfide-containing diamine, introduced a covalent adaptable network via disulfide metathesis, achieving a reprocessable thermoset with self-healing capabilities, recyclability, and extended lifespan. In contrast, traditional aliphatic diamines produced a permanently crosslinked thermoset with superior mechanical strength, thermal stability, and chemical resistance, ideal for high-performance applications requiring durability with maximum tensile strength of 11.62 MPa and 17.9 MPa for limonene and geraniol derived epoxy thermoset, respectively. Differential scanning calorimetry (DSC) elucidated the curing kinetics and crosslinking behavior, while thermogravimetric analysis (TGA) confirmed excellent thermal stability. Dynamic mechanical analysis (DMA) and tensile testing also demonstrated desirable mechanical properties. The glass transition temperature (Tg) of the limonene- and geraniol-derived malleable thermosets was determined by dynamic mechanical analysis (DMA) at 18C and 25℃, respectively. Above these temperatures, the malleable thermosets exhibited dynamic behavior facilitated by disulfide bond exchange. In addition, the developed materials displayed maximum tensile strengths of 3.1 MPa and 3.66 MPa, highlighting their mechanical robustness and potential for reprocessable applications.

Presenting Student: Riya Patel
Co-Authors: Dr. Ram Gupta
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Effect of Fillers and Flame Retardants on Thermal Stability and Fire Performance of Non-Edible Castor- Oil based Polyurethane Composite

Abstract: Composite materials are widely used in healthcare, automotive, aerospace, and construction due to their high mechanical strength. While petroleum-based epoxy resins are commonly used, researchers are increasingly turning to renewable resources for composite material development. Therefore, vegetable oils (VOs) are the promising alternative for epoxies and polyols derived from petroleum. VOs have an unsaturated double bond that is amenable to chemical modification. This study synthesized bio polyol using castor oil, a non-edible vegetable oil. A ring-opening reaction was used to modify castor oil, producing castor oil polyol (COP). Using FT-IR and GPC, the synthesized COP was described. Three distinct flame retardants (FRs), COP, and TiO_2 as an inorganic filler were used to create composite materials. Melamine phosphate (MP), melamine (MA), and melamine phytate (MPHT) were employed as FRs. Here, bio-based phytic acid was used to create melamine phytate. Compared to all synthetic composite materials, MPHT 3wt% had a greater compression strength of 52 MPa. Additionally, the hardness and tensile strength were 70 and 22 MPa, respectively. Crucially, out of all the manufactured materials, the MPHT 5wt% sample showed the least amount of weight loss, just 2%. Although these composite materials are thermally robust, they degrade significantly at temperatures close to 400 C. Additionally, the composite materials' chemical compatibility in toluene and water was assessed. With advantages including renewable sourcing, less environmental effect, and good mechanical strength, these bio-based composite materials provide a sustainable substitute for conventional petroleum-based products.

Presenting Student: Tanuj Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Soybean Oil-Derived Acrylate/Methacrylateether for High-Resolution Additive Manufacturing

Abstract: The field of additive manufacturing (AM) has seen tremendous growth in its possible applications with the introduction of multi-material 3D printing, which may be used to prototype complex structures and sophisticated geometries which improves the performance and adaptability of printed components in various sectors. Despite these developments, the broad-spectrum of materials for AM are mostly derived from petroleum oil which limits the technologies and economic viability for widespread application. In this context, vegetable oil is a renewable alternate feedstock for 3D printing due to its broad spectrum of applications, affordable price, and potential biodegradability. In this piece of work, we demonstrate the development of soybean oil-based photo-curable resins (ESBO_HEA/HEMA) for application in digital light processing vat photopolymerization. At first, epoxidized soybean oil (ESBO) was converted into acrylated/methacrylated soybean oil (ESBO_HEA/HEMA) by one-pot oxirane ring opening processas an alternative to conventional acrylated epoxidized soybean oil (AESO) generated via acrylation between ESO and acrylic acid. A series of 3D printable DLP inks have been formulated using synthesized resins (ESBO_HEA/HEMA) in the presence of photoinitiator (TPO) and or, reactive diluents (Trimethylolpropane triacrylate). Moreover, the resin's viscosity of all formulated inks was investigated which are in good agreement with DLP 3D printing. Additionally, the impact of reactive diluents (TMPTA) on the thermal (DSC, TGA) and mechanical (DMA, tensile strength, and hardness) behavior of the 3D-printed object was also examined. After adding the TMPTA behavior of the materials is changed. It shows high mechanical properties, which are 4.17 MPa in ESBPO_HEA and 4.10 in ESBO_HEMA. Altogether, this work demonstrates the use of bio-based and inexpensive soybean oil which offered a simple method to prepare potential inks for DLP 3D printing that could be used in the additive manufacturing industry to make architectural models and automotive components which opens new avenues for sustainable 3D printing.

Presenting Student: Vaibhav Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Epoxidized Castor Oil-Based Thermosets with Reprocessable and Non-Reprocessable Properties

Abstract: Castor oil-based polymers have gained significant attention due to their renewable nature, low cost, and ease of processing, making them ideal for various applications, including biofuels and the petrochemical industry. Among these, epoxidized castor oil (ECO)-based thermosets have been extensively studied for their promising mechanical and thermal properties. This study focuses on recent advancements in ECO thermosets synthesized with 4,4- dithiodianiline (DTDA) which has aromatic disulfide bonds and 4,4-ditaminodiphenylmethane (DMPM) which has methylene bridge. FTIR spectroscopy confirmed the successful incorporation of epoxy functionalities into castor oil. The structure-reactivity relationship was examined through differential scanning calorimetry (DSC), which reveals that ECO_DMPM based thermosets exhibit higher glass transition (T_g) range compared to ECO_DTDA due to methylene group. The thermomechanical performance of the cured thermosets was investigated using dynamic mechanical analysis (DMA) shows that ECO-DMPM thermosets have the highest storage modulus, indicating superior mechanical strength and stiffness, compared to DTDA thermosets. Thermogravimetric analysis (TGA). Indicates good thermal stability across all thermosets, with degradation onset temperatures above 350 ^{o}C, though the presence of sulfur bonds may slightly reduce thermal stability. Tensile testing and GEL fraction measurements revealed strong correlations between monomer reactivity and final material properties. Moreover, the study highlighted the non-reprocessable nature of the ECO_DMPM thermosets. distinguishing them from other sustainable polymer systems. Their highly crosslinked structures limit recyclability but enhance their thermal and mechanical stability. The dynamic disulfide bonds in ECO_DTDA enable reprocessability, allowing the thermosets to be reshaped without significant performance loss.

Presenting Student: Shaili Chaudhary

Co-Authors: Dr. Chandan Bodhak

Student Status: Graduate

Major: Material Science

Research Advisor: Dr. Ram K. Gupta

Title: Castor oil-based UV curable acrylate resins for digital light processing (DLP) 3D printing technology

Abstract: Biobased resins are a promising sustainable alternative to traditional petroleum-based polymers in Digital Light Processing (DLP) 3D printing. This study focuses on developing a castor oil-based UV-curable acrylate resin that is renewable. Castor oil was chemically modified with methacrylic anhydride (MAA) via an esterification process to synthesize castor oil-based methacrylate ester (CO_MAA), enhancing its photopolymerization efficiency and crosslinking potential. To comprehensively evaluate the resin's properties, several characterization techniques such as FT-IR and NMR spectroscopy were conducted that confirmed the successful chemical modification. Furthermore, the viscosity measurements of the CO_MAA resins were investigated to gain insight into the printability of the synthesized photocurable resins. Indeed, the dynamic mechanical analysis (DMA) of the UV-cured film of CO_MAA exhibits a glass transition temperature (Tg) of 10.44 °C. Moreover, the thermal properties of the UV-cured object were examined by TGA analysis, demonstrating that the resin can withstand high temperatures before degradation. Tensile testing showed the tensile strength of CO_MAA film is 1.8 MPa, confirming the material's elasticity and mechanical strength. Additionally, gel content and swelling behavior validated the resin's crosslinking efficiency and solvent resistance. The results indicate that this castor oil-derived resin exhibits excellent UV-curability, strong mechanical properties, and high-resolution printability, making it a promising material for DLP 3D printing applications.

Presenting Student: Haley Tallent
Co-Authors: Paige Boydston
Student Status: Graduate
Major: Behavior Analysis
Research Advisor: Dr. Paige Boydston

Title: Vocal Stereotypy Interventions Using Response Interruption and Redirection

Abstract: Vocal stereotypy is the repetitive, nonfunctional, and/or noncontextual vocalizations that are specifically maintained through internal reinforcement (Shawler, et al., 2020). Vocal stereotypy is commonly displayed in individuals with autism spectrum disorder (ASD); however, it may also occur in individuals with or without disabilities. When individuals engage in vocal stereotypy, they may lose learning opportunities, struggle to engage in daily tasks, and may even become stigmatized by their peers. One intervention used to reduce the frequency of vocal stereotypy in individuals with ASD is Response Interruption and Redirection (RIRD). RIRD was first evaluated for effectiveness in 2007 by Ahearn and colleagues. This study sought to contribute to the literature by comparing two types of RIRD (traditional RIRD [TRIRD] and modified RIRD [MRIRD]) on the occurrence of vocal stereotypy in young children with ASD. Following functional analyses to determine the function of vocal stereotypy in participants, the present study used a multielement design to rapidly alternate and compare a control condition to TRIRD and MRIRD, and the resultant impacts on the display of vocal stereotypy. Results from the study indicate the utility in the use of both TRIRD and MRIRD in the reduction of vocal stereotypy in young children with ASD.

Presenting Student: Kamryn O'Dell
Co-Authors: Adam Mortensen, Emmalee Jessip, Tristan Ragland, Cole Shewmake
Student Status: Graduate
Major: Health, Human Performance and Recreation MS
Research Advisor: Dr. David Boffey

Title: Effect of Unilateral and Bilateral Resistance Training on Performance Tests of Collegiate Softball Athletes

Abstract: Strength and conditioning coaches typically have athletes perform either unilateral (UL) and bilateral (BL) lower body training, based on the perception that UL may be more sport-specific, and may enable lighter loads due to different stability requirements. A randomized controlled design was used to assess the effects of UL (n=6) and BL (n=5) on collegiate DII softball athletes. After three weeks of familiarization training, testing was done pre- and post-8 weeks of the athletes' Fall offseason training program. Performance testing consisted of strength (front squat, hex bar deadlift, front rack split squat, rear foot elevated split squat), change of direction (5-0-5 and 5-10-5), jump testing (vertical and horizontal), balance (modified Star Excursion Balance Test), softball-specific sprints (1st and 2nd - base), body composition (Bioimpedance analysis and Ultrasound), and rating of perceived exertion. A two-way ANOVA was run to determine differences between (group; BL vs. UL) and within (time; pre vs. post) on all variables. There were no significant interactions or group effects on any testing variable other than average weekly training volume (UL 63.6% less than BL). Strength tests, vertical jump and body composition increased similarly over time for both groups. Balance increased for UL only, but an ANCOVA demonstrated no significant group differences after controlling for different baseline values. Based on these results, both types of training may be equally effective, demonstrating a transfer of training effect regardless of modality. In addition, UL training may enable a reduced training volume which may be beneficial to athletes.

Presenting Student: Robert Cordova
Student Status: Graduate
Major: Applied Behavior Analysis
Research Advisor: Dr. Paige Boydston

Title: Incremental Rehearsal

Abstract: Repetition is said to be the most important factor in learning (Symonds & Chase, 1992). A common instructional technique that also incorporates repetition is incremental rehearsal (IR), which is often implemented due to its potential efficiency and effectiveness. Previous research has indicated a positive effect on reading fluency, math intervention, and sight word acquisitions using IR teaching procedures; however, there is a stark lack of application of IR to individuals with autism spectrum disorder (ASD). Therefore, the purpose of the study was to evaluate IR as an instructional technique for skill acquisition, specifically within an early intervention setting with young children with ASD. The study used a concurrent multiple baseline design across participants to evaluate rate of skill acquisition and trials to criterion for target mastery with the implementation of IR procedures. Three participants were taught to vocally identify varied stimuli (e.g., flags, safety signs) through a modified IR procedure that used repetition and interspersed trials. Current results suggest that incremental rehearsal is an effective intervention strategy for promoting skill acquisition in children with ASD.

Presenting Student: Danielle Amoikon
Student Status: Graduate
Major: Human Resources
Research Advisor: Dr. Derrel Fincher

Title: HIREVUE: IMPLEMENTATION IN THE FINANCIAL SERVICES RECRUITING PROCESS IN THE MIDWEST USA

Abstract: The implementation of artificial intelligence (Al) tools in recruitment processes has become increasingly prevalent, offering both opportunities and challenges for organizations. This study investigates the biases and ethical concerns associated with the implementation of HireVue in the recruitment processes of financial services companies in the Midwest USA, specifically in Kansas, Missouri, and lowa. The purpose of this study is to explore the impact of HireVue on recruitment processes, focusing on the accuracy and effectiveness of candidate selection, potential ethical considerations, and the ease of use of HireVue in the financial services sector. This research employs a qualitative case study methodology to gather insights from seven experienced recruiters with over ten years of experience. Data is collected through one-hour interviews consisting of ten questions that delve into the recruiters' opinions on HireVue's implementation. The study reveals various biases and ethical concerns associated with HireVue, including issues related to the accuracy of candidate selection and the potential for biased decision-making. Additionally, the ease of use and effectiveness of HireVue in enhancing recruitment processes are evaluated. The findings of this research provide valuable recommendations for the effective implementation of Al tools in recruitment processes, ensuring accurate and unbiased decision-making. Financial services organizations can utilize these insights to optimize their recruitment strategies and address ethical challenges associated with Al-driven hiring practices. Ultimately, this study aims to assist financial services companies in adopting and optimizing Al tools like HireVue to foster a more efficient and ethical recruitment process.

Poster Presentations

Category B

Undergraduate and Graduate Students

Presenting Student: Isha Hill
Type of Presentation: Poster
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: College Attendance: The Great Depression and Effects of the New Deal.

Abstract: This article examines the effects of the Dust Bowl on college attendance amid the Great Depression. The objective is to track college attendance in the Midwest during The Great Depression and determine whether the various work and education programs introduced by President Franklin Roosevelt had a positive impact on continued collegiate enrollment. The "New Deal" enacted by F.D.R. brought the passage of banking reform laws, work and agricultural programs, and emergency relief programs. FDR's second part of the "New Deal" established new agencies to address the lack of economic opportunity, Official agencies like the Civilian Conservation Core, Works Progress Administration, and implementation of social security. These programs brought dramatic changes to the workforce and still attendance rates, following an initial dip after 1929, remained steady at Kansas State Teachers College. This study shows that economic depression and recession did not have an overwhelming effect on college attendance even during one of the greatest man-made agricultural disasters in modern history.

Presenting Student: Jack Brooksher
Type of Presentation: Poster
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: Transformations of the Eighth Century Byzantine Empire

Abstract: In the seventh century, the Byzantine empire suffered numerous crises that resulted in its near total collapse. Conflict with the newly formed Arab Caliphate led to the loss of more than two thirds of its territory. By the eighth century, however, the Empire had stabilized. This research will address the transformations of Byzantine institutions during this period. This study of the administrative transformations of the Empire focuses on the transition from civilian administered provinces to the themata system, which brought the Empire's provinces under military governance. Additionally, this study will explore how the themata system contributed to the creation of a powerful, landed aristocracy from the periphery which vied for political control with a civilian bureaucracy centered in Constantinople. Furthermore, this research will explore the changing role of the Byzantine emperors, who were tasked with defending the territorial integrity of the Empire from powerful foes. This research is intended to contribute to the broader understanding of the Byzantine empire's transition from late antiquity to the early Middle Ages.

Presenting Student: Cooper Rooks
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: The World War's Effects on Black Athletics

Abstract: This article examines the effects that World War I and World War II had on black athletics, specifically the Negro Baseball League. The objective of this paper is to determine if the World Wars had a hand in the decline and subsequent shutting down of the Negro Baseball League. The forming of the Negro Baseball League and its status as a league is set perfectly in between both World Wars, with it forming in 1920 and declining towards the end shortly after World War II. Due to World War I, plans for a league were out on hold and would eventually be created in 1920. The much greater impact is World War II. The war surprising would result in an attendance boom for the Negro Baseball League. Due to Americans having more disposable income due to the war effort, the league was able to grow in popularity. A big factor that could have played a role in the integration of baseball came in 1941, when Franklin D Roosevelt established the Fair Employment Practices Committee. They would push for the inclusion of black players in baseball. Ultimately, this study shows that World War II would have monumental impacts on black culture as a whole. The war would help push for integration in baseball, which would be a catalyst for future integration. This integration would see the decline and shut down of the Negro Baseball League. This would help out black culture and athletics, but the findings in this article suggest that while it helped the overall impact of black integration and culture, baseball went from being a significant part of black business, to having little impact.

Presenting Student: Cord Ritter
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: Treatment of Germans at Kansas State Manual Training Normal School

Abstract: When the United States of America declared war on Germany on April 6, 1917, the nation made enemies not only with Germany, but with German culture. Pro-German sentiments were viewed with suspicion and people were looked at as a traitor or a spy. With the suspension of constitutional rights under the Espionage and Sedition Acts, Americans that expressed an opinion against the war effort became criminals overnight. The crusade against the anti-American sentiment enveloped all aspects of life; schools were no longer allowed to teach German, German towns and streets were renamed, speaking German in public became taboo. This wave of Americanization was felt across the nation, including universities and normal schools. The same level of anti-German sentiment was not seen everywhere, and this paper examines Kansas State Manual Training Normal School and how it compares with other schools. Through renaming, German language, harassment, size, and ethnic diversity this paper argues the Kansas State Normal School faced little to no German persecution.

Presenting Student: Jenny Heckman
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: World War II and American Families

Abstract: When people think of the home front during World War II, they likely think of it in terms of how society mobilized to support the war effort through political, military, and economic means. This is because up until the 1970s, historians confined their research to these perspectives which has in turn limited studies of social and cultural aspects on the home front such as wartime family dynamics and the myths that plague them. This paper intends to examine the way the history of the home front has changed over time. For years, historians have pointed to the absence of fathers and husbands as the cause for the degradation of family and family dynamics, suggesting that once they had returned home, families returned to normal and embodied the happy, golden nuclear family romanticized in many forms of media. However, the emergence of women and family historians in the 1970s challenges this traditional view with the inclusion of female and children's perspectives which convey that experiences greatly varied family to family.

Presenting Student: Kenzie Pearson
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: Social History of the Dust Bowl

Abstract: The aim of this research paper is to examine the lives of rural, everyday Kansans who experienced the Dust Bowls of the 1930s. Particularly, this paper seeks to explore both the ordinary, through examining the lives of farmers, rural women and the household, community, and the extraordinary, through the participation and aid of the federal government under President Franklin Delano Roosevelt's New Deal programs, especially those of the AAA and SCS, in the lives of those who lived amidst the natural disaster. In exploring these aspects, this paper hopes to provide a detailed picture of the determination and tenacity of rural Kansans who survived the ordeals of the Dust Bowl and to pass on these virtues to the modern reader living in an age of climate crisis. This paper will be using both primary and secondary sources in the form of monographs and articles to achieve its aim. Furthermore, its presentation will be demonstrated through a poster that aims to display the areas and people in Kansas affected by the Dust Bowl and how they responded. In the end, this paper seeks to explore the social history of the Dust Bowl in Kansas by exploring the everyday lives of farmers, rural women and their households, the dissipating communities of those who stayed, and the impact of the federal government, on those living in extraordinary circumstances and to pass on the qualities learned from these people to the modern reader in an age of climate calamity.

Presenting Student: Makenzie Coomes
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: Normal School Growth: The Case of Pittsburg's State Manual Training Normal Under the Leadership of William A. Brandenburg

Abstract: The Industrial Revolution during the late nineteenth and early twentieth centuries created an incentive to educate American youth. Prior to industrialism, schooling was limited in rural areas as children spent their days contributing to the family income. As demand for education rose, the demand for teachers simultaneously rose. In response, normal schools began to appear throughout the country. Pittsburg's Auxiliary Manual Training Normal School, founded in 1903, was one of several products of the nation's drive for education. Like several others, Pittsburg's Normal was closely intertwined with industrialism. Many normal schools strove to teach industrial education in addition to regular public-school education to encourage students to pursue an industrial career. Opinions about normal schools are ever-changing - some historians praise them for equipping several generations with the skills they needed to sustain America's industrial reputation, while other historians criticize them for prematurely arranging children's careers and lessening the desire or need to go to college. Regardless of their debated moral intentions, most normal schools were widely successful - some more than others. This paper examines the factors that contributed to both normal school success and failure throughout America in comparison with Pittsburg's Normal to determine if Pittsburg's situation differed from others. By examining factors such as enrollment, community, location, and especially leadership, this paper argues that Pittsburg's Normal did in fact encounter outstanding growth and development. Evidence finds that the school's first official president, Dr. William A. Brandenburg, was probable causation for being the catalyst of growth for Pittsburg's Normal.

Presenting Student: Whitten O'Neal
Student Status: Undergraduate
Major: History
Research Advisor: Dr. Kyle Thompson

Title: Distrust: The American Government and her Military

Abstract: The goal of this research paper is to show how the lack of an American standing army led to a lack of efficiency in waging war. In the paper it looks at different ways this is caused throughout many different avenues. This includes matters such as a lack of a fighting force at the beginning of the conflict, a deficiency in military technology and training, as well as lack of a set-in place supply chain to feed and arm these campaigns. There will be different time periods discussed, and conflicts covered such as the War of 1812, Mexican American War, Civil War, and the Spanish American War. These wars have incidence where it can be viewed that the lack of a standing military caused the efficiency of the United States Military. This paper's evidence is primary quotes from historical figures such as the founding fathers and generals who witnessed this firsthand. As well as the research and postings of fellow historians who have looked into this topic. This information will back up and proven with the usage of maps and charts to show the conflicts and the issues with the efficiency of the American way of waging war. In the end this paper aims to explain how the lack of a standing military led to the American fighting forces to be at a disadvantage at the beginning of conflicts in its fledgling years. Which in turn led to failures in these campaigns and loss of life.

Presenting Student: Ethan Dellasega
Student Status: Undergraduate
Major: History, Political Science
Research Advisor: Dr. Kyle Thompson

Title: Kansas Populism: Laying the Groundwork for Progressive Reform

Abstract: By the late 1880s, the agricultural boom in Kansas ended, and growing economic insecurity among farmers caused atemporary shakeup in Kansas politics. Aided by fusion with the Democrats, the People's Party emerged as the main opposition to the Republican Party during the 1890s. Kansas Populists were not an ideologically coherent group. Some Populists despised fusion with the Democrats and conceding any ground on policy. Some historians have labeled Kansas Populists as reactionary, citing nativist and antisemitic rhetoric by some in the movement. Despite these ideological differences and conspiratorial rhetoric, the People's Party was largely a progressive movement. Kansas Populists advocated for many of the reforms implemented during the Progressive Era such as the direct election of senators, women's suffrage, and the income tax. Examining Populist policy and rhetoric shows that Kansas populism was not a regressive movement. Instead, Kansas Populism was an inherently progressive movement that sought to curb the excesses of Gilded Age industrialism. Some Populists believed that the best way to do so was through the nationalization of important utilities like water, electricity, and the railroads. The People's Party largely fell apart by 1900. However, many of the causes for which Populists advocated were taken up by progressives in the Democratic and Republican parties in the early twentieth century.

Presenting Student: Brianna Manley
Student Status: Undergraduate
Major: Elementary Education Unified (K-6)
Research Advisor: Dr. Ashley Shaw

Title: Beyond Boundaries: Preparing General Educators for Inclusive Classrooms

Abstract: The preparedness of general educators for the inclusion of special education students is a crucial aspect of fostering inclusive classrooms. Teacher preparation programs are continuously designed and improved to ensure that every student receives the education they deserve, including students with disabilities or exceptionalities as dictated by the Individuals with Disabilities Education Act (IDEA) of 1975. This study aims to explore the extent of educators' preparedness to work with special education students and identify areas for improvement. Surveys were distributed to general educators, special educators, and preservice teachers to collect data on their training, confidence levels, challenges, and the overall effectiveness of current training programs. Further discussions with these individuals highlighted their experiences with special education students and identified areas of insufficient education. Analysis of the data indicates a significant gap in the training of general educators, with many expressing concerns about their ability to support special education students effectively. Educators who completed a dual licensure program in special and general education reported higher levels of confidence and preparedness compared to their counterparts with minimal specialized training. The findings emphasize the need for more extensive training programs that equip general educators with the necessary skills for inclusive classrooms. Recommendations include offerings additional courses related to teaching special education, embedding new strategies into preexisting classes, increasing the number of universities that offer dual licensure programs, and including ongoing professional development opportunities related to special education within the teacher education program.

Presenting Student: Morgan Leeper
Student Status: Undergraduate
Major: Psychology
Research Advisor: Dr. Laurent Prétôt

Title: Comparing inhibitory control across fishes

Abstract: The ability to suppress predispositions in favor of more appropriate actions, also known as inhibitory control, helps organisms cope with fluctuating environments and is considered a central component of executive functioning. A common test of inhibitory control in animals is the "cylinder" task, in which a subject must detour a transparent cylinder to reach a food reward through side openings, instead of directly reaching for it and bumping into the front of the cylinder (which is regarded as an inhibitory failure). Here, we tested parrotfish-an understudied group of marine herbivores that inhabit coral reefs and seagrass-in a standardized version of the task. As a group, parrotfish performed poorly, failing to retrieve the food without touching the cylinder first in most trials (94%; two-tailed binomial test, $N = 9$, $P < 0.001$). We compared our results with those of Lamarck's angelfish-an omnivorous coral reef fish previously tested in the same procedure. We found that parrotfish showed a tendency towards failing more often than angelfish (two-tailed Fisher's exact test, $P = 0.075$). When examining whether success or failure in the task was associated with decision making, however, we found that parrotfish were more likely to make a choice in the task, regardless of the outcome (two-tailed Fisher's exact test, 90% vs. 70%; $P = 0.002$). We discuss the implications of these findings for our understanding of fish inhibitory control and, more broadly, the field of fish comparative cognition.

Presenting Student: Justin Miles
Student Status: Undergraduate
Major: Business Management
Research Advisor: Darrell Pulliam

Title: Refining Recruitment Strategies at Pittsburg State University: Prioritizing Quality Engagement Over Quantity.

Abstract: Every year thousands of prospective students visit Pittsburg State University and interact with its staff. This study aims to explore how the university can redefine its recruitment strategies to prioritize quality engagement over quantity. Specifically, I will examine how personalized follow-ups and meaningful interactions can enhance prospective students' experiences, ultimately positioning PSU as a top destination for higher education in the region. This project will focus on the university's technology department as a case study with a goal of developing a model that can be mirrored across all university departments seeking more effective engagement with prospective students. This analysis will assess current recruitment strategies, identifying potential gaps where interactions may lack depth or fail to leave a lasting impact. It will also explore how factors like mentorship opportunities, campus visit personalization, and alumni involvement could strengthen connections with prospective students. This research will use a series of different research methods focusing on quantitative data and a series of surveys gathering information from Pittsburg State University staff. By prioritizing quality over quantity in recruitment efforts, Pittsburg State University has the potential to attract and retain more students through intentional, high- value interactions that foster stronger connections between the institution and prospective students.

Presenting Student: Hope Rainey, Jada Ortiz
Student Status: Graduate
Major: Communication
Research Advisor: Dr. Alicia M. Mason

Title: Advancing Al-Generated Inoculation Messaging: A Comparative Study of ChatGPT-40, Microsoft Co-Pilot, and Gemini

Abstract: A 2023 exploratory study examined ChatGPT-4's ability to analyze, adapt, and independently generate inoculation messages through a 10-week training initiative. This initiative assessed whether ChatGPT-4 could identify key structural elements (e.g., forewarnings, preemptive refutations), enhance message features (e.g., linguistic style, length), customize messages for specific audiences, and replicate the inoculation message design process on novel issues. Twenty-four previously published inoculation messages were used to train ChatGPT-4 through various prompting techniques, including sequential, active, iterative, and chain-of-thought prompts. While the Al demonstrated originality in its responses, structural weaknesses were evident, such as difficulty producing clear, accessible language and advanced education-level comprehension requirements. Additionally, ChatGPT-4 struggled to develop explicit forewarnings and limited its messages to two refutations. Open Al was unable to craft threat components with consistency leading Mason and colleagues (2024) to observe that "inoculation strategies are more than merely information and transmission, but rather tools for carefully crafted appeals which are psychological arousing in order to generate threat and threat awareness in message recipients," (p. 7). The current investigation attempts to replicate the 2023 study using ChatGPT-4o and expands the focus of inquiry to two additional generative Al platforms -- Microsoft Co-Pilot and Gemini, Findings, discussion, practical significance, and limitations are offered.

Presenting Student: Halle Panter
Student Status: Graduate
Major: Psychology (Behavior Emphasis)
Research Advisor: Dr. Paige Boydston

Title: Interdisciplinary and Comprehensive Evaluations to Increase Service Access for Children Impacted by Autism Spectrum Disorder

Abstract: Identification and treatment of autism spectrum disorder (ASD) in rural communities continues to lag when compared to opportunities in urban areas (e.g., Antezana et al., 2020), with the average age of diagnosis being delayed in both rural communities and in households with limited income (Mandell et al., 2010). Though many factors may contribute to the deficiency of available services, lack of qualified diagnosticians in rural locations presents as a major barrier to families accessing evaluations. Early intervention services have been found to significantly improve symptomology of ASD in children diagnosed prior to three years of age (e.g., Gabbay-Dizdar et al., 2021), yet a diagnosis is required prior to accessing care. Rural areas may benefit from interdisciplinary ASD evaluation and diagnostic mechanisms that increase access to care. The purpose to the present project is to pilot an interdisciplinary evaluation model using faculty and students at a university located in a rural area of the country. The evaluation model includes multiple disciplines engaging in a multi-department collaboration for both collegiate student training and community support, creating a comprehensive evaluation process to support children suspected of having ASD but who are unable to access timely diagnostics and treatment due to geographic location. The study aims to identify socially valid training and evaluation measures by comparing self-report data from participants to self-report data from individuals obtaining the same service in a less intensive or comprehensive model. Initial data indicate preference for interdisciplinary training settings.

Poster Presentations

Category C

Undergraduate and Graduate Students

Presenting Student: Bethany Blessent, Evan Foulke, Israel Hunt, Caroline Kunshek, Aridai L
Student Status: Undergraduate
Major: Graphic Communications
Research Advisor: Dr. Jason Reid

Title: Improving Information Accessibility: A Student-Led Usability Study at PSU

Abstract: A moderated usability study was conducted to identify and address potential usability problems on the Pittsburg State University Graphic Communications website. Participants were guided through a series of tasks designed to explore key elements, such as enrolling in a major, viewing program areas and student work, finding faculty information, and locating financial assistance. Throughout the testing sessions, participants were encouraged to "think out loud," allowing the researcher to capture immediate reactions, pain points, and navigation choices. The findings revealed insights into user expectations, the clarity of the site's primary functions, and potential barriers in the enrollment process. Common areas of confusion included discovering emphasis area details and scholarship information, as well as locating tuition costs and frequently asked questions about admission. Additionally, the testing highlighted the importance of well-structured navigation menus and clearly labeled links. Recommendations derived from the study focus on simplifying the user path to key information, enhancing the layout of content, and ensuring a consistent visual hierarchy. These insights aim to improve overall user experience, ensuring that prospective students, faculty, and community members can efficiently locate and engage with relevant content.

Presenting Student: Brayden Green
Co-Authors: Claire Schmidt, Mark Ziegler, Hieronymus Koenig, Katelyn Doering, Braylen Wesley
Student Status: Undergraduate
Major: Graphic Communications
Research Advisor: Dr. Jason Reid

Title: Empathy in Action: Shaping Pizza PittStop Through User Insights

Abstract: This study examines the user-centered design process behind our Pizza Pittstop, a conceptual food delivery application, with a focus of speed, reducing wait times, convenience, and user satisfaction. The research employs a multi-phase method: conducting in-depth user interviews, synthesizing findings into an empathy map, and developing a user persona that encapsulates core motivations and pain points. Building off user insights we empathize with them to create a user story and journey maps to articulate potential challenges and opportunities for improvement. Problem statements are defined to guide hypothesis formation, followed by a clear value proposition and goal statement. The investigation also encompasses a competitive audit and report, benchmarking Pizza PittStop's proposed features against established industry standards. Additionally, design solutions are conceptualized through sketches, user flows, and a wireframe prototype developed in Figma. The project seeks to illustrate how the integration of user research and iterative design methodologies can result in more accessible, enjoyable, and reliable meal ordering experiences. This research emphasizes the significance of empathetic engagement and evidence-based decision-making in the development of a platform that effectively meets both the functional and emotional needs of users within the framework of contemporary dining practices.

Presenting Student: Emeri Ekstrand
Co-Authors: Alli Casner, Walter Reyes-Mojica, Kaidyn Perryman, Jack Bruntz
Student Status: Undergraduate
Major: Graphic Communications
Research Advisor: Dr. Jason Reid

Title: Enhancing the Usability and Experience for the Pittsburg State University Website

Abstract: This study was created in order to enhance the usability and overall user experience of the Pittsburg State University's official website by pinpointing potential problems located throughout the site that may inadvertently deter prospective students from the University, while creating potential frustration and confusion for current students while using the college's website. We specifically investigated the home page layout and information, the scholarship application process, Gus Portal, Gus Classic, accessing of transcripts and the process of transferring credits to the university from other establishments. Through moderated usability sessions we identified recurring pain points and thematic user frustrations, such as outdated pages, insufficient site navigation, and broken links. We found that while the original redesign resolved some issues, it also introduced new navigational concerns and did not fully address critical functionality. Using Figma, we expanded upon our previous research by creating user flows and redesigned targeted portions of the site, focusing on clearer labeling, quicker navigation, as well as dispelling broken links and outdated information. Our proposal aims to reduce frustration and confusion, increase user engagement, and streamline navigation for both new and current PSU community members. We aim to spark discussions on collaborative efforts to regularly enhance the website's performance to increase user satisfaction and overall ease.

Presenting Student: Kamron Blair
Co-Authors: Billie Newlin, Trey Cook, Joel O'Donnell, Maria Blancarte, Matt Guild, Elijah Pence
Student Status: Undergraduate
Major: Graphic Communications
Research Advisor: Dr. Jason Reid

Title: Crafting Better Meal Ordering Experiences: The Pizza PittStop Case

Abstract: The following is about Pizza PittStop, which is a food ordering application concept to improve meal ordering. The project is driven by user-centricity, aiming to gain maximum convenience, efficiency, and general customer satisfaction, The process is started with intensive interviews of customers to identify their needs and issues, and followed by designing an empathy map to gain better insight into users' perceptions. Then, we built personas of customers summarizing different needs and issues of target market. For identifying where to improve, user stories and user journey maps were crafted, recording key touchpoints where ordering of meals could be optimized. Problem statements were written to summarize hypotheses about where and how to improve in order to ultimately form a clear value proposition and goal statement for the application. A competitive audit was also conducted, analyzing strengths and weaknesses of meal delivery services to inform Pizza PitStop's development of features.
The process of design involved brainstorming and iterating concepts in sketches, user flows, and Figma wireframes. The concepts were critiqued to ensure they were serving users and providing a cohesive experience from start to finish to end. The aim of this research is to demonstrate how iterated design and user-based research can significantly influence meal ordering to make it inclusive, user-friendly, and responsive to modern diners.

Presenting Student: Sterling Bridgmon
Co-Authors: Brennan Popp, Annabella Beachner, Shae Gilstrap
Student Status: Undergraduate
Major: Graphic Communication
Research Advisor: Dr. Jason Reid

Title: Enhancing User Experience and Engagement at Pittsburg State

Abstract: In this study, we aimed to improve the user experience of the Pittsburg State University (PSU) website by analyzing problem areas that deter prospective and current students. We specifically investigated scholarship application processes, the usability of existing GUS and Classic portals, and the steps needed to access transcripts. Through moderated usability sessions and affinity diagrams, we identified recurring pain points and thematic user frustrations, such as outdated pages in the redesign and insufficient site navigation. We found that while the redesign resolved some issues, it introduced new navigational concerns and did not fully address critical functionality. Using Figma, we developed user flows and redesigned targeted portions of the site, focusing on clearer labeling, streamlined navigation. Our proposals aim to reduce frustration, increase user engagement, and streamline tasks for both new and current PSU community members. We seek to spark discussions on collaborative efforts to continually enhance the website's performance and user satisfaction.

Presenting Student: Sid Ruckman
Co-Authors: Amelia Byers, Dominic Santiago, Dagan Sappington
Student Status: Undergraduate
Major: Graphic Communications - Graphic Design
Research Advisor: Dr. Jason Reid

Title: Redefining Convenience: A User-Centered Journey for Pizza PittStop

Abstract: This research study examines the design process behind a conceptual user-centered food delivery application called Pizza PittStop. This research focuses on efficiency, convenience, and user satisfaction within online food ordering and delivery services. The investigation uses a multi-phase method that consists of user interviews, building an empathy map, and creating a user persona to represent core motivations and pain points. Building on these phases, a user story and journey maps were created to show potential problems, solutions, and opportunities of improvement. This investigation was led with a problem statement to build a hypothesis statement, a clear value proposition, and a goal statement for the Pizza PittStop app. With careful research and consideration, the app's proposed features and offers were established and compared to similar companies and applications. Lastly, the Pizza PittStop designs are ideated through sketches, user flows, and a wireframe prototype created in Figma. This project aims to demonstrate user-based research to make the app more convenient, reliable, and clear during meal ordering experiences. This research experiment presents the importance of evidence-based decision-making and empathetic engagement when creating an application that will provide users' functional and emotional needs in the context of online food ordering habits and delivery methods.

Presenting Student: Devin Sebastian
Co-Authors: Leen Jarwan, Sydney Angell, Eliab Mark, Parker Letts
Student Status: Undergraduate
Major: Graphic Design
Research Advisor: Dr. Jason Reid

Title: A Student-Led Usability Study of the Pittsburg State University Website

Abstract: In this study, we aimed to improve the user experience of the Pittsburg State University (PSU) website by analyzing problem areas that deter prospective and current students. We specifically investigated scholarship application processes, the usability of existing GUS and Classic portals, and the steps needed to access transcripts. Through moderated usability sessions and affinity diagrams, we identified recurring pain points and thematic user frustrations, such as outdated pages in the redesign and insufficient site navigation. We found that while the redesign resolved some issues, it introduced new navigational concerns and did not fully address critical functionality. Using Figma, we developed user flows and redesigned targeted portions of the site, focusing on clearer labeling, streamlined navigation. Our proposals aim to reduce frustration, increase user engagement, and streamline tasks for both new and current PSU community members. We seek to spark discussions on collaborative efforts to continually enhance the website's performance and user satisfaction.

Presenting Student: Gwyneth Eshelman
Co-Authors: Emeri Ekstrand, Drake Miller, and Haley Burkhart.
Student Status: Undergraduate
Major: Graphics
Research Advisor: Dr. Jason Reid

Title: User-Centered Design: The Journey for Pizza Pittstop

Abstract: The study examines the user-friendly design process behind the proposal for a concept of a pizza restaurant application. By employing a multi-step process, interviews with classmates were arranged to understand the wants and needs of individuals who use a food ordering app. By compiling the information brought together by the interviews, an empathy map was created to identify the most important information. By virtue of the empathy map, a user persona was created to outline the problems and positives individuals experience during the use of a food ordering application. Applying the created persona, a user story was made to bring some personality and backstory to the persona. Journey maps were then created to focus on the processes of the application while associating emotions and creating improvements to those processes. In order to determine a specific overarching goal, the most important problems were identified within the user story and journey map so that a solution could be crafted specifically to solve them. These issues allowed for the crafting of a hypothesis statement to determine the final most important goal. Design solutions were formulated through sketches, user flows, and a wireframe prototype created in Figma. The finished research project was designed to understand the importance of empathy and understanding of individual and group needs to create a cohesive design. This study highlights the need for both empathy and data in designing a platform that meets the practical and emotional needs of the individuals using it.

Poster Presentations

Category D

Undergraduate and Graduate Students

Presenting Student: Colby Riddle
Co-Authors: Levi Carrico, Erin Young, Kyle Baumbauer, Sree Chintapalli
Student Status: Undergraduate
Major: Biology
Research Advisor: Dr. Anuradha Ghosh

Title: Understanding the role of gut microbiota in the development visceral hypersensitivity – A literature review

Abstract: Persistent abdominal pain is one of the most impactful symptoms across various gastrointestinal disorders. Increased sensitivity to bowel distention, termed visceral hypersensitivity (VH), is a primary driver of chronic abdominal pain. Differences in microbial colonization are associated with disease, but how bacteria drive pain and the potential therapeutic targets remain poorly understood. This review illustrates applications of microbiome-based diagnostics referring to currently available literature and also describes the aims of the proposed research. Using metagenomic analysis, the role of microbial communities in many infectious diseases can be ascertained including response to cancer immunotherapy and transplant safety. Investigating the effects of microbiota on VH will supplement our current understanding of how these milieus change over a given treatment regime. This background knowledge leads to our first specific aim: to study how the composition of the gut microbiome evolves temporally when VH is induced in both male and female mice by sequencing the collected fecal material and comparing using 16S metagenomics. Future research may be focused on developing precise methods for manipulating the microbiome and creating targeted treatments for specific conditions. This frames our second specific aim: to study the microbiota after treatment with broad spectrum antibiotics or spermidine-supplemented diet employing molecular diagnostics such as multiplex qPCR technique to detect selected bacterial species (e.g. Bacteroides, Enterococcus, Dorea, Clostridium and/or Ruminococcus). The ultimate goal of this research project is to systematically assess the impact of altered microbial colonization on the host and examine novel therapeutic approaches to restoration/stabilization of the microbial response.

Presenting Student: Benjamin Zeman
Student Status: Undergraduate
Major: English Creative Writing Emphasis
Research Advisor: Dr. Phil Rudd

Title: Innovation and Perspective in Fantasy; Dissecting Six of Crows

Abstract: Herein shall be found a grammatical analysis of the prose within the New York Times best-selling YA novel from Leigh Bardugo, Six of Crows. It is presumed that by some facet of this analysis, the component that allowed her to succeed in an extremely saturated market may be discerned. Forty-six sentences, chosen at random, from the work are arranged and displayed among charts and figures to allow for effective analysis of the prose. Word choice, active versus passive voice, and average sentence length will be taken into account. In order to ensure fair representation, the data was taken from each tenth page randomly, such that sentences from the work's beginning, middle, and end may be presented with equal representation. Findings indicate that most sentences are of moderate length, with two or three clauses. Many are only one clause, but some stretch out to the lofty heights of five or six. Most sentences found to be in the active voice, but a few are worded passively. This is consistent with most fiction. Given that the prose itself is unexceptional, it is the opinion of this writer that whatever produced Bardugo's success lies outside the structure of individual sentences.

Presenting Student: Sydney Hart
Student Status: Undergraduate
Major: English Emphasis in Creative Writing
Research Advisor: Dr. Chris Anderson

Title: Sentence Style Analysis of Edgar Allan Poe's Short Stories

Abstract: How people use grammar and writing has changed over the years. Someone who wrote around 1800 would not use the same technique as they use today, yet their writing is still understandable. This study uses modern grammar techniques to investigate the sentence structure and writing style used by Edgar Allan Poe in his short stories. The Reed-Kellogg system, the sentence traditional diagramming as seen and used in the undergraduate course English Grammar and Usage (ENGL202), and the textbook Grammar by Diagram by Cindy L. Vitto were used to help visualize Poe's writing style and understand his writing. This system helps break up the data to better understand Poe's sentence style and the types of sentences Poe utilizes. For data collection, I used The Essential Tales and Poems of Edgar Allan Poe, published by Sweet Water Press. Analyze the sentences and their type, pattern, moods, tense, and voice was completed using a table to map them out. The study shows that Edgar Allen Poe mostly uses complex indicative in the past perfect tense and active voice. Poe's most used sentence pattern is pattern seven, Subject + Transitive Verb + Direct Object. Most of Poe's stories are set as tales being told by a character about their past, being put in the first-person point of view.

Presenting Student: Vinash Chaudhari
Student Status: Graduate
Major: Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Regulating Lignin-Based Epoxy Vitrimer Performance by Fine-Tuning the Lignin Structure

Abstract: Lignin is the second most abundant lignocellulosic biomass, and as a natural polymer, it shows great potential in preparing functional materials to meet the demand for green/sustainable development. Unfortunately, the inherent heterogeneity of lignin largely limits its applications. Furthermore, the effect of the lignin structure on the performance of the final materials has seldom been investigated. In this work, a totally biobased dynamic cross-linked vitrimer with up to 70% lignin content was successfully prepared from epoxidized fractionated lignin and sebacic acid without additional chemical modifications. The lignin structure effect on the performance of the resultant lignin-based epoxy vitrimers (LEVs) was systematically investigated. The experimental results show that the phenolic hydroxyl content and the ratio of flexible to rigid linkages in lignin have strong correlations with the tensile strength, toughness, self-repair ability, and reprocess ability of the resultant LEVs. Meanwhile, the molecular weight and the S/G ratio of lignin show strong correlations with the thermal properties of the resultant materials. This study not only presents a fundamental study regarding the relationships between lignin properties, and the resultant LEVs have great potential applications as advanced packaging materials for light-sensitive commodities due to the inherent UV resistance of lignin.

Presenting Student: Sahithi Priya Gunda
Student Status: Graduate
Major: Communication
Research Advisor: Dr. Alicia Mason

Title: Bridging Emotional Bonds in Friendships: A Qualitative Study on Face-to-Face Vs. Mediated Communication at Pittsburg State University

Abstract: The growing digital communication technologies have enabled people to get together in person as well as digitally. It has become nearly impossible for people to abandon digital communication technologies, as they provide an alternative to traditional face-to-face interactions for staying connected. Text messaging, social media apps, instant messaging, and video calls are different mediated forms of communication people use. The study explores face-to-face and other mediated communication in the context of friendships to observe and analyze the differences in convenience, emotional bonding, satisfaction, the usage of non-verbal cues, and the ambiguity element of communication. The researcher incorporated a qualitative research design involving in-depth interviews with five participants at Pittsburg State University, including three staff and two students. The participants were asked open-ended questions regarding the preference for communication in friendship, emotional connection and satisfaction, the non-verbal cues to understand each other, and how ambiguity in communication may be perceived when interacting face-to-face versus mediated channels. Moreover, the study investigates the amount of awareness of non-verbal cues, like body language and facial expressions, besides the way these are conveyed as opposed to face-to-face communication. The findings of this study are expected to reveal how communication channels influence emotional bonding in friendships, the amount of satisfaction participants feel in their interactions, and the impact of non-verbal cues and ambiguity in communication. By comparing face-to-face and mediated communication, the research will contribute to a better understanding of how modern communication technologies shape interpersonal relationships and how individuals pursue the complexities of digital and face-to-face interactions. This research acknowledges the challenges individuals face in communication in the digital era and the study of interpersonal relationships in an increasingly mediated world.

Presenting Student: Kapan Aksana
Student Status: Graduate
Major: English
Research Advisor: Dr. Rudd Philip

Title: Sentence Analysis of B. Sokpakbayev's My Name is Kozha

Abstract: This study analyzes the sentence structure in the English translation of My Name Is Kozha by B. Sokpakbayev, which was translated by Catherine Fitzpatrick. The focus is to identify and categorize sentences based on the ten basic sentence patterns and analyze the writing style used in the translation. This research's main target is to provide a better understanding of the structure of the translated text and its stylistic characteristics. This research focuses on examining the writing style of B. Sokpakbayev in his novel, specifically looking at the English translation by C.Fitzpatrick. This analysis involves traditional sentence diagramming to classify sentences according to the ten basic patterns. This method helps to break down the structure of each sentence and observe how different patterns appear throughout the book. The results show which sentence patterns are most used, the usage of active and passive voice and how they contribute to the readability and style of the translation. This study helps to understand the sentence structure of the translated work and its stylistic features. It also highlights the importance of sentence patterns in shaping the tone of a literary text. Understanding these patterns can help readers and translators better appreciate the structure of translated literature.

Presenting Student: Anirudh Singh
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram Gupta

Title: Facile synthesis of loaf-like $ZnMn_2O_4$ nanorods and their excellent performance in Li-ion batteries

Abstract: Binary transition metal oxides have been attracting extensive attention as promising anode materials for lithium-ion batteries, due to their high theoretical specific capacity, superior rate performance and good cycling stability. Here, loaf-like $ZnMn_2O_4$ nanorods with diameters of 80-150 nm and lengths of several micrometers are successfully synthesized by annealing MnOOH nanorods and $Zn(OH)_2$ powders at 700 °C for 2 h. The electrochemical properties of the loaf-like ZnMn204 nanorods as an anode material are investigated in terms of their reversible capacity and cycling performance for lithium-ion batteries. The loaf-like $ZnMn_2O_4$ nanorods exhibit a reversible capacity of 517 mAh/g at a current density of 500 mA/g after 100 cycles. The reversible capacity of the nanorods still could be kept at 457 mAh/ g even at 1000 mA/g. The improved electrochemical performance can be ascribed to the one-dimensional shape and the porous structure of the loaf-like $ZnMn_2O_4$ nanorods, which offers the electrode convenient electron transport pathways and sufficient void spaces to tolerate the volume change during the Li^+ intercalation. These results suggest the promising potential of the loaf-like $ZnMn_2O_4$ nanorods in lithium-ion batteries.

Presenting Student: Arya Darji
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: High-Capacity Calcium Vanadate Composite with Long-Term Cyclability as a Cathode Material for Aqueous Zinc-Ion Batteries

Abstract: Rechargeable aqueous zinc (Zn)-ion batteries (AZiBs) have been emerging as a complementary technology to lithium-ion batteries in energy storage applications sowing to their safe operation, low cost, and eco-friendly features. However, the development of AZiBs for commercialization is still in its infancy and is hindered by the unstable cathode. Herein, a calcium vanadate/vanadium oxide (CaV_3O_7/V_2O_3) composite (treated as CaVO) was prepared by a facile solvothermal synthesis and investigated as a cathode material for AZiBs. As a result, the CaVO composite cathode exhibited a high reversible capacity of 321.8 mAh/gover 300 cycles at 1 A/g and maintained a reversible capacity of 268 mAh/g over 600 cycles at 2A/g. Interestingly, the CaVO composite cathode showed excellent operating stability over 3000 cycles, even at a high current rate of 10A/g. The assembled Zn/CaVO battery delivered outstanding energy densities of 329 and 315 Whk/g at power densities of 206 and 414 Wk/g, respectively. In addition, an insight into the energy storage mechanism in Zn/CaVO composite rechargeable aqueous batteries was systematically elucidated using structural and morphological analyses. The CaVO composite cathode serves as an excellent Zn^{2+} host owing to the presence of Ca-ion pillaring, which results in good reversibility and excellent rate performance.

Presenting Student: Bhumikaben Makawana
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Dual Metal-Loaded Porous Carbon Materials Derived from Silk Fibroin as Bifunctional Electrocatalysts for Hydrogen Evolution Reaction and Oxygen Evolution Reaction

Abstract: Developing electrocatalysts with high efficiency and long-term stability for hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) is significant to massively generate hydrogen energy by water splitting. In this work, cobalt and tungsten dual metal-loaded N-doped porous carbon electrocatalysts derived from silk fibroin were successfully prepared through facile carbonization and chemical activation by KCl and applied as efficient electrocatalysts for HER and OER. After chemical activation, the resulting catalysts present a unique hierarchical porous structure with micro-, meso-, and macropores, which can expose more implantation sites for catalytic active metals and will in turn promote the efficient diffusion of the electrolyte. The catalyst under the optimized condition (CoW@ACSF) has a specific area of 326.01 m^2/g. The overpotential at a current density of 10 mA/cm^2 of CoW@ACSF is 138.42 ± 10.39 mV toward HER and 492.05 ± 19.04 mV toward OER. Furthermore, the overpotential only increases 101.2 mV toward HER and 66.00 mV toward OER after the long-term stability test of chronopotentiometric test over 10 h, which confirms the excellent stability of the CoW@ACSF, owing to its unique carbon shell structure. This work gives an insight into the design and engineering of silk fibroin-derived carbon materials for electrocatalysis toward HER and OER.

Presenting Student: Harsh Panchal
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Universal Strategy of Bimetal Heterostructures as Superior Bifunctional Catalysts for Electrochemical Water Splitting

Abstract: Utilizing earth-abundant metals to design economical and efficient electrocatalysts for cathodic hydrogen evolution reaction (HER) and anodic oxygen evolution reaction (OER) is critical for acquiring clean hydrogen energy by the electrochemical overall water-splitting system. In this work, we reported a facile and universal strategy toward developing a suite of bimetallic heterostructures, representing as highly efficient catalysts of the HER/OER process. By hybridizing transition-metal sulfides (CoS_2, NiS_2, FeS_2, and CuS) with highly active MoS_2 nanosheets, all heterostructural catalysts achieved largely improved bifunctional activity originating from the special interfacial interaction as well as synergetic catalytic effects. As a result, the optimal CoS_2@MoS_2/CC and NiS_2@MoS_2/CC heterostructures displayed the lowest overpotentials at 10 mA/cm^2, which only required 31 and 225 mV for HER/OER, respectively. After assembling for water splitting, the electrolyzer exhibited a very small cell voltage of 1.58 V to reach 10 mA/cm^2.
This result is better than a lot of reported non-precious metal catalysts. Our strategy experimentally confirms the feasibility of the heterostructure to enhance the bifunctional performance of advanced electrocatalysts for electrochemical water splitting.

Presenting Student: Juliben Hingrajiya
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: Self-Healing and Recyclable Castor Oil-Based Epoxy Vitrimer Based on Dual Dynamic Bonds of Disulfide and Ester Bonds

Abstract: To develop a more sustainable and environmentally friendly epoxy resin, castor oil (CO)-based epoxy vitrimers based on dynamic ester bonds and disulfide bonds were prepared through epoxy-carboxylic acid, epoxy-amine, and free-radical polymerization reactions using epoxidized methacrylated castor oil as the epoxy prepolymer, glycerol methacrylate as the reactive diluent, and itaconic acid (IA) and 4,4'-dithiodiphenylamine (AFD) as the curing agents. The curing kinetics, curing degree, mechanical properties, thermal stability, and recycling characteristics of the EMCO-GMA-IA-AFD epoxy vitrimers were investigated. When the molar ratio of IA to AFD was 5:5, the EMCO-GMA-IA-AFD5:5 vitrimer exhibited a balanced comprehensive performance with a storage modulus of 1715 MPa, a tensile strength of 16.8 MPa, and a Tg of 44.6C. Meanwhile, the dynamic ester bonds and disulfide bonds within the system endowed the EMCO-GMA-IA-AFD vitrimer with self-healing ability and recyclability; the activation energy of reversible exchange reactions reached 89.29 kJ/mol, and the self-healing efficiency reached 94.6%. In addition, the EMCO-GMA-IA-AFD vitrimer was chemically degradable. Overall, this work provides a promising and feasible route for the preparation of sustainable CO-based epoxy with superior comprehensive properties.

Presenting Student: Hemanth Reddy Pallaka
Student Status: Graduate
Major: Materials Science
Research Advisor: Dr. Ram K. Gupta

Title: Boosting Li-S Battery Performance by Regulating Microstructures of Porous Hollow Carbon Nanospheres from Lignites

Abstract: Li-S batteries with high energy density are considered to be some of the most promising energy storage devices. However, the shuttle effect, sluggish kinetics, and volume expansion problems of lithium polysulfides (LiPSs) have severely limited their industrial applications. In this work, porous hollow carbon nanospheres (HCNSs) with tunable microstructures were designed by replacing resorcinol with an ethanol-soluble portion (ESP) from lignites rich in heteroatoms and alkyl side chains and employed as cathodes for Li-S batteries. The results show that the specific surface area, defect, and heteroatoms significantly increase after introducing ESP, thus promoting the adsorption and conversion of LiPSs. S@HCNS-30 exhibits the best electrochemical performance with a high initial discharge specific capacity of 1253.2 and 782.7 mAh/g at 0.1C and 2C, respectively, and a low decay rate of 0.075% per cycle after 500 cycles, which is much superior to S@HCNS from pure resorcinol and many other coal- or biomass-derived carbon materials. In addition, a high discharge-specific capacity of 659.9 mAh/g was achieved under challenging conditions of a depleted electrolyte (E/S = 10 uL-mg-1) and high areal density (5.3 mg/cm^2). This work not only contributes to the high-value utilization of lignites but also provides a facile approach for high-performance cathodes for Li-S batteries.

Presenting Student: Himanshubhai Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Curing Behavior and Thermomechanical Performance of Bioepoxy Resin Synthesized from Vanillyl Alcohol: Effects of the Curing Agent

Abstract: In order to reduce the dependency of resin synthesis on petroleum resources, vanillyl alcohol which is a renewable material that can be produced from lignin has been used to synthesize bioepoxy resin. Although it has been widely reported that the curing reaction and properties of the cured epoxies can be greatly affected by the molecular structure of the curing agents, the exact influence remains unknown for bioepoxies. In this study, four aliphatic amines with different molecular structures and amine functionalities, namely triethylenetetramine (TETA), Tris(2-aminoethyl)amine (TREN), diethylenetriamine (DETA), and ethylenediamine (EDA), were used to cure the synthesized vanillyl alcohol-based bioepoxy resin (VE). The curing reaction of VE and the physicochemical properties, especially the thermomechanical performance of the cured bioepoxies with different amine functionalities, were systematically investigated and compared using different characterization methods, such as DSC, ATR-FTIR, TGA, DMA, and tensile testing, etc. Despite a higher curing temperature needed in the VE-TETA resin system, the cured VE-TETA epoxy showed a better chemical resistance, particularly acidic resistance, as well as a lower swelling ratio than the others. The higher thermal decomposition temperature, storage modulus, and relaxation temperature of VE-TETA epoxy indicated its superior thermal stability and thermomechanical properties. Moreover, the tensile strength of VE cured by TETA was 1.4-2.6 times higher than those of other curing systems. In conclusion, TETA was shown to be the optimum epoxy curing agent for vanillyl alcohol-based bioepoxy resin.

Presenting Student: Iman Afyouni
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Structural transformation and electrochemical study of layered MnO_2 in rechargeable aqueous zinc-ion battery

Abstract: Layered MnO_2 is a very attractive cathode material for zinc-ion batteries (ZIB) due to its large interlayer distance, high discharge capacity, low cost, and environmental benignity. However, layered MnO_2 exhibits capacity fading. Therefore, detailed studies of the structural transformation and electrochemical mechanism of layered MnO_2 during cycling are urgently required for performance improvement. In this contribution, we have utilized in situ synchrotron, ex-situ X-ray diffraction, and ex-situ synchrotron X-ray absorption spectroscopy analyses to evaluate the structural transformation of a layered MnO_2 during Zn-ion insertion. We found that during initial cycles, the electrode was able to maintain its layered structure; however, after prolonged cycles, it completely transformed into an irreversible spinel structure. We also observed the manganese dissolution from the electrode into the electrolyte during continuous cycling. The formation of the irreversible spinel phase and manganese dissolution are responsible for capacity fading. Our findings provide an understanding for further improvement of layered MnO_2 as cathode material for next-generation ZIB systems.

Presenting Student: Jaydipkumar Chaudhari
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Bio-based light-healing isocyanate-free polyurethanes derived from carbonated soybean oil and coumarin

Abstract: In response to environmental concerns and restrictions on isocyanate-based materials, researchers and the coatings industry are focused on developing eco-friendly isocyanate-free polyurethanes. This article introduces a novel class of environmentally-friendly, initiator/catalyst-free, UV-curable, self-healing non-isocyanate polyurethanes (NIPUs) synthesized from bio-based carbonated soybean oil (CSO) and non-toxic coumarin. The synthesis of these polymers is based on using a photo-reactive coumarin that undergoes a reversible [2 + 2] cycloaddition upon exposure to the wavelength of UV light. UV-curable three coumarin-terminated isocyanate-free polyurethane prepolymers were synthesized using CSO and three different amines and epoxy coumarin. Subsequently, a set of cross-linked NIPU polymers were obtained with exposure of365 nm UV irradiation. The photo-reversible nature of these polymers was investigated in response to various wavelengths of UV radiation. Additionally, their self-healing ability and the thermal and mechanical properties of NIPU coatings were studied using optical microscopy, thermogravimetric analysis, differential scanning calorimetry, and a universal testing machine. The outcomes demonstrate that this polyurethane has the potential to provide a sustainable alternative to isocyanate-based materials. Two examples of stimulated healing are given, that of healing a scratch and the other being the healing of a sample that has been mechanically stressed to failure in a tensile mode.

Presenting Student: Jaymin Joshi
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: High-Strength, Self-Healing, Recyclable, and Catalyst-Free Bio-Based Non-Isocyanate Polyurethane

Abstract: Non-isocyanate polyurethanes (NIPUs) from renewable resources have attracted wide attention because of their remarkable benefits to sustainable development and green production. In this work, a strong, self-healing, and catalyst-free NIPU(ECMP)was prepared based on the hyperbranched bio based cyclic carbonate (Ec-MTDA) synthesized through catalytic carbonization of 1,8-menthanediamine (MTDA) and CO2.The hyperbranched and rigid structures of ECMP enable improved mechanical properties that ahigh tensile strength of up to 34.9 MPa can be achieved. Benefiting from the dynamic trans esterification reaction between the carbamate and hydroxyl groups, ECMP presents favorable self-healing, reprocessing properties, and shape memory. Notably, 91% of the original tensile strength can be recovered after self-healing behavior. In addition, abundant polar groups provide excellent adhesion properties for ECMP with a high shear strength of 7.09 MPa. This study provides a promising strategy for the design of bio-based NIPUs, which broadens their applications in printing, furniture, packaging, and other industries.

Presenting Student: Kemilaben Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Metal-Organic-Framework-Derived Atomically Dispersed Mn-N-C Electrocatalysts Boosting Oxygen Reduction Modulated by Anion Exchange of Permanganate

Abstract: Mn-N-C materials have received increasing interest in recent years because of their low Fenton reactivity and ORR activity comparable to those of their Fe-N-C and Co-N-C counterparts. In this contribution, an atomically dispersed Mn-N-C electrocatalyst with a prominent oxygen reduction performance was constructed by employing a cationic Cd-MOF as a precursor that can facilely and accurately introduce MnO-4 anions through anion exchange. The best-performing Mn-N-C catalyst displays a 0.96 V (vs RHE) Eonset (onset potential) and a 0.87 V (vs RHE) E1/2 (half-wave potential) in an alkaline solution, which exceed those of the benchmark Pt/C catalyst. In particular, the maximal power density of the self-made zinc-air battery reaches 200 mW.cm-2, surpassing that of most reported Mn-N-C materials.

Presenting Student: Ketankumar Gelot
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Catechol Containing Polyhydroxy urethanes as High-Performance Coatings and Adhesives

Abstract: Green routes for the synthesis of high-performance isocyanate-free polyurethane coatings and adhesives are intensively searched for. In this article, we report a solvent- and isocyanate-free formulation for novel poly(hydroxy urethane) glues bearing strongly adherent catechol groups. These adhesives are prepared by the polyaddition of a CO_2 sourced tricyclic carbonate, hexamethylene diamine, and a catecholamine (dopamine). The role of the catechol functions on the PHU curing and on the final PHU properties are investigated. Although the dopamine slows down the curing of the formulation, this catecholamine added at only 3.9 mol % impressively improves the mechanical and adhesion performances of PHU. The lap shear adhesion of our product surpasses those of PHU that do not contain the catechols. We also demonstrate that the catechol-bearing PHU glues are competing with the adhesion performances of commercial PU glues, at least when a thermal curing is implemented to overcome the low reactivity of cyclic carbonate with amines. The use of renewable feedstocks, the solvent-free process, the atom economy polyaddition reaction, and the absence of any toxic reagent benefit the sustainability of the final product.

Presenting Student: Kinal Chaudhari
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Self-Healable, Degradable, and Reprocessable Lignin-based Polyurethane Elastomer for a Flexible Strain Sensor

Abstract: Flexible strain sensors have attracted great attention for their important application potential in soft robots, wearable devices, electronic skin, and human-computer interaction. However, there are still challenges such as the loss of service life due to external forces and the production of electronic waste that need to be solved.
Herein, a self-healable, degradable, and reprocessable lignin-based polyurethane (LPU) elastomer was synthesized for a flexible strain sensor. Owing to the formation of a crosslinking network by lignin and the reinforcement role of unreacted lignin, the tensile strength and elongation at break of the LPU elastomer reached 2.72 MPa and 712%, respectively. The plentiful hydrogen and disulfide bonds endowed the elastomer with not only good self-healing capability but also superior reprocessing performance. Importantly, the elastomer was able to be completely degraded within only 2 hours in a 1 mol/L NaOH water/ethanol solution.
The LPU elastomer-based flexible strain sensor with liquid metal (LM) as the conductive material was successfully applied to detect various human motions and could restore its sensing function with the healing of the substrate and reconnection of the LM conductive layer. Moreover, the LM in the discarded sensor could be easily recycled to prepare the sensor after the degradation of the LPU substrate. The functional and environmentally friendly bio-based elastomer will greatly promote the sustainable development and application of flexible electronics.

Presenting Student: Pradipsinh Dodiya
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K Gupta

Title: Advanced Dual-Cross-Linking Strategy for Upgrading Formaldehyde-Free Olefin Adhesives

Abstract: Adhesives are extensively used in industry and construction, with formaldehyde-free options gaining popularity due to their enhanced safety and chemical stability. However, their water resistance remains a significant limitation. In this study, a simple and efficient strategy based on a physicochemical dual cross-linking synergistic net work was proposed to develop a new formaldehyde-free adhesive (IBMP-BT). The unique structure, featuring stable chemical cross-linking formed by amidation and a network of multiple hydrogen bonds, enables enhanced water resistance, strength, and toughness of the adhesive. The dry shear strength and toughness of the IBMP-BT adhesive reached 2.03 MPa and 0.600 J, respectively, representing improvements of 89.7% and 255.03% compared to those of the unmodified adhesive. The wet bonding strength of the lBMP-BT adhesive was 1.16 MPa,
Significantly exceeding the requirements of China's national standards. This innovative network design allows olefin copolymer store place traditional formaldehyde-based products, leading to the creation of high-performance adhesives.

Presenting Student: Sagar Jariwala
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Biodegradable High-Molecular-Weight Poly (pentylene adipate-coterephthalate): Synthesis, Thermo-Mechanical Properties, Microstructures, and Biodegradation

Abstract: Poly (pentylene adipate-co-terephthalate) (PPAT) is a promising biobased and biodegradable polymer that can replace polyethylene in flexible packaging films where biodegradability is desired. High-molecular-weight (100K-145 KDa) aliphatic-aromatic polyester PPAT was successfully synthesized, and the effects of reaction conditions on molecular weight were reported. PPAT polyesters were characterized for polymer compositions, number-average unit length, thermal transitions, and rheological properties. PPAT compression-molded films were characterized for crystallinity and tensile properties to correlate micro- and macroproperties. PPAT compression-molded films exhibited up to a 76% higher tensile modulus than compression-molded films from poly (butylene adipate-co-terephthalate) (PBAT), making PPAT films potentially comparable with compression-molded films from linear low-density polyethylene (LLDPE). PPAT is biodegradable in soil and freshwater environments with estimated 90% biodegradation times of 504-580 and 604-845 days, respectively, while PBAT takes 971 days in soil and 395 days in freshwater.

Presenting Student: Sauravkumar Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Improvement on high rate performance of LiFePO4 cathodes using

Abstract: In this work, the electrochemical properties of the LiFePO4 cathode using graphene as a conductive agent were revealed. Compared to the conventional LiFePO4 electrodes with carbon black as a conductive agent, the graphene sheets can establish a more effective conductive framework due to their layered structure and excellent electronic conductivity, leading to better electrochemical rate performance. Furthermore, the obverse of increasing graphene content is continued gains in high-rate performance of the LiFePO4 electrodes. The electrodes with 30 wt.% graphene show high capacities up to 103.1 mAh/g and 68 mAh/g during discharging with extremely high rates of 30 C and 50 C, respectively. Besides, good cycling performance at high rate is also achieved. The electrodes with 30 wt% graphene display a capacity retention higher than 80% after 1000 cycles at 30 C. These results not only indicate that the graphene could be a promising candidate as a conductive agent, but also provide a new insight for designing LiFePO4 electrodes with brilliant high-rate performance via a simple method.

Presenting Student: Siddharaj Vaghela
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: $NiMn_2O_4$ Nanosheet/Carbon Nanotube Composites for Aqueous Zinc-Ion Batteries

Abstract: Due to the continuous depletion of lithium resources and the security risks of organic electrolytes such as combustion and explosion, there is an imminent requirement to develop a type of energy accumulation system to adapt to the progression and progress of society. Zinc-ion batteries using aqueous electrolyte have the advantages of high safety, low cost, and environmental friendliness, which make them an ideal alternative to lithium-ion batteries as a next-generation energy storage system. Among the zinc-ion battery cathode materials, manganese-based materials and carbon materials occupy the main positions, respectively. Among them, nickel manganate ($NiMn_2O_4$) nanosheets and carbon nanotubes (CNTs) as active materials have received extensive attention. The CNTs could provide electronic conductive channels and $NiMn_2O_4$ nanosheets supply more active points for electrochemical reactions. The carbon shell with a porous structure also improves the electron transport and ionic conduction processes, so that the nickel manganate/carbon nanotube ($NiMn_2O_4$/CNTs) nanocomposites obtained a high specific capacitance of 333.6 mAh/g at a current density of 0.2 A/g. After 500 cycles at a current density of 0.5 A/g led to a high specific capacity of 73.6 mAh/g, it was shown that the material exhibits excellent comprehensive electrochemical properties. This synergistic strategy of combining structural design and electrochemical activation in $NiMn_2O_4$/CNTs nanocomposites can be a reference for other manganese-based cathode materials.

Presenting Student: Varshikkumar Rameshbhai Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Sustainable Epoxy Vitrimers from Epoxidized Soybean Oil and Vanillin

Abstract: Epoxidized soybean oil (ESO)-derived epoxy thermosets often suffer from poor mechanical properties and lack of reprocessability. This study presents a sustainable epoxy vitrimer synthesized by curing ESO with vanillin-derived Schiff base (VSB) as a dynamic hardener and 1,2-dimethylimidazole as an accelerator. The phenolic hydroxyl groups in VSB exhibit high reactivity with ESO's epoxy groups, with a curing activation energy of 108.9 kJ/mol. By adjusting the feed ratio of ESO and VSB, the vitrimer's mechanical properties can be tailored from soft to tough and hard materials. The dynamic Schiff base bonds impart the vitrimer with excellent reprocessability, weldability, reconfigurability, and programmability, facilitating recycling and reshaping of cured materials. The vitrimers also exhibit superior thermal stability with an onset decomposition temperature of around 400C. This study highlights the potential of ESO-derived epoxy vitrimers as viable alternatives to traditional epoxy thermosets, offering sustainability, tunable mechanical properties, and enhanced functionality.

Presenting Student: Vishalbhai Gamot
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Recent Advances in Biopolymer-Based Hydrogel Electrolytes for Flexible Supercapacitors

Abstract: Growing concern regarding the impact of fossil fuels has led to demands for the development of green and renewable materials for advanced electrochemical energy storage devices. Biopolymers with unique hierarchical structures and physicochemical properties, serving as an appealing platform for the advancement of sustainable energy, have found widespread application in the gel electrolytes of supercapacitors. In this Review, we outline the structure and characteristics of various biopolymers, discuss the proposed mechanisms and assess the evaluation metrics of gel electrolytes in supercapacitor devices, and further analyze the roles of biopolymer materials in this context. The state-of-the-art electrochemical performance of biopolymer-based hydrogel electrolytes for supercapacitors and their multiple functionalities are summarized, while underscoring the current technical challenges and potential solutions. This Review is intended to offer a thorough overview of recent developments in biopolymer-based hydrogel electrolytes, highlighting research concerning green and sustainable energy storage devices and potential avenues for further development.

Presenting Student: Yashkumar N. Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: One-Pot Solvent-Free Synthesis of Imine-Based Epoxidized Soybean Oil Vitrimers for Sustainable Adhesives

Abstract: The traditional methods for synthesizing imine based epoxidized soybean oil (ESO) vitrimers often rely on organic solvents, leading to issues such as incomplete raw material conversion, increased production costs, and environmental concerns, contradicting the principles of green and sustainable chemistry. To overcome these challenges, we propose an innovative one-pot, solvent-free approach for synthesizing imine linked ESO vitrimers via a melt reaction utilizing ESO, vanillin, and diamines. In this system, three distinct reactions can occur: phenolic hydroxy-epoxy, amino-aldehyde, and amino-epoxy. Our findings indicate that the first two reactions occur more readily and rapidly than the third, facilitating the successful synthesis of the vitrimers. We employed three different diamines to tailor the chemical structure and control properties of the ESO vitrimers; aromatic diamines produced rigid vitrimers with high strength but low ductility, while aliphatic diamines yielded flexible vitrimers with lower strength but higher ductility. All vitrimers exhibited rapid high-temperature stress relaxation and excellent reprocess ability and thermal stability. Notably, these vitrimers demonstrated impressive adhesive properties, achieving lap shear strengths between 4.0 and 6.7MPa when applied to various substrates, including wood, steel ,and aluminum . Moreover, the dynamic mine bonds enable exceptional recyclability, removability, and reusability, with recycled ESO vitrimers even surpassing their virgin counterparts in mechanical and adhesive performance, underscoring the significance of this work in advancing sustainable adhesive materials with enhanced functionality and circularity.

Presenting Student: Yashkumar Patel
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Underwater Bonding with a Bio-Based Adhesive from Tannic Acid and Zein Protein

Abstract: Here, we present several adhesive formulations made from zein protein and tannic acid that can bind to a wide range of surfaces underwater. Higher performance comes from using more tannic acid than zein, whereas dry bonding requires the opposite-more zein than tannic acid. Each adhesive works best in the environment for which it was designed and optimized. We show underwater adhesion experiments conducted on different substrates and in various water types, including seawater, saline solution, tap water, and deionized water. Surprisingly, the water type does not significantly influence performance, but the substrate type does. An additional unexpected result was the bond strength increasing over time when exposed to water, contradicting general observations with glues. Initial adhesion underwater was stronger compared to benchtop adhesion, suggesting that water helps improve adhesion.
Temperature effects were examined, indicating maximum bonding at around 30 C, followed by another increase at higher temperatures. Once the adhesive was placed underwater, a protective skin formed on the surface, preventing water from immediately penetrating the rest of the material. The shape of the adhesive could be easily manipulated, and once in place, the skin could be broken to induce faster bond formation. Data indicated that underwater adhesion was predominantly induced by tannic acid, which facilitated cross-linking within the bulk material and adhesion to the substrate surfaces. The zein protein provided a less polar matrix, helping to retain the tannic acid molecules. These studies introduce new plant-based adhesives for underwater applications and contribute to creating a more sustainable environment.

Presenting Student: Dharmikkumar Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: Self-Healing Polyurethane Elastomers Based on a Disulfide Bond by Digital Light Processing 3D Printing

Abstract: A type of polyurethane elastomer with excellent self-healing ability has been fabricated through digital light processing 3D printing. First, a type of polyurethane acrylate containing disulfide bonds is synthesized and then compounded with reactive diluent and photoinitiators to get a photopolymer resin. Due to the good fluidity and high curing rate, the photopolymer resin can be applied in DLP 3D printing, and various 3D objects with complicated structures, high printing accuracy, and remarkable self-healing ability have been printed. The tensile strength and elongation at break of the polyurethane elastomer are 3.39 ± 0.09 MPa and 400.38 ± 14.26%, respectively, and the healing efficiency can get to 95% after healing at 80℃ for 12 h and can be healed for multiple times. With the ease of fabrication and excellent performance, the polyurethane elastomers from DLP 3D printing have great potential applications in flexible electronics, soft robotics, and sensors.

Presenting Student: Josh Ortolani
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram Gupta

Title: Synergistic Long-Term Protection of Inorganic and Polymer Hybrid Coatings for Free-Dendrite Zinc Anodes

Abstract: Constructing an artificial solid electrolyte interface protective layer on the surface of the zinc anode is an effective strategy for addressing dendrite growth, passivation, and the hydrogen evolution reaction in aqueous zinc-ion batteries. This study introduces a robust interlayer composed of a polyvinyl butyral matrix decorated with SiO_2 particles (PS). Adsorption of water by Si-OH on the surface of SiO_2 leads to excellent hydrophilicity and accelerates the desolvation of ions. A highly stable and hydrophilic PS coating enhances ion migration and possesses ultralong protection ability, ensuring uniform ion deposition and a lower nucleation barrier. Anodes protected by the PS coating achieve long-term cycling stability of >4000 h at 2 mA/cm^2 in symmetric cells. The assembled PS-Zn//NH4V4010 full cells exhibit superior electrochemical performance, demonstrating their potential for practical applications in rechargeable zinc batteries.

Presenting Student: Priyankkumar Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: From Glassy Plastic to Ductile Elastomer: Vegetable Oil-Based UV-Curable Vitrimers and Their Potential Use in 3D Printing.

Abstract: Current UV-curable resins based on acrylate or methacrylate monomers are mostly derived from nonrenewable petroleum feedstocks, and the cured resins are not easily repairable or reprocessable due to the stable cross-linked network. In this work, bio-based UV-curable di methacrylate compounds are synthesized via a reaction of the vegetable oil-derived dimer acid with glycidyl methacrylate. The length and flexibility of the chain segment between the two methacrylate groups are manipulated to tune the properties of the cross-linked polymer materials. The UV-cured materials exhibit a tensile strength of up to 9.2 MPa and an elongation at break of up to 66.4%. At elevated temperatures (>160 ^{o}C), the thermally induced dynamic trans-esterification reaction (DTER) between hydroxyl groups and ester bonds in the network structure provides repairability to the material. The use of the UV-resin for three-dimensional (3D) printing is demonstrated. The printed objects exhibit unique welding and shape-changing properties owing to the thermally induced DTER. This work integrates the concepts of UV curing, vitrimer preparation, 3D printing, and bio-based polymers, demonstrating a feasible approach for the sustainable design of polymer materials.

Presenting Student: Riya Patel
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K Gupta

Title: Insight into the synthesis and thermomechanical properties of "short-long" type biobased aliphatic polyesters

Abstract: A series of biobased "short-long" chain aliphatic polyesters having high molecular weight were successfully synthesized using dimethyl sebacate and diols with different carbon chain lengths via a two-step melt-polycondensation method by using titanium butoxide as a catalyst. The diols chain length and its odd-even effect on the structure-property relationship, crystallinity, and thermomechanical properties of the polyesters were systemically investigated. The synthesized polyesters displayed weight-average molecular weight between 23,600 to 72,900 g/mol and a maximum intrinsic viscosity of 0.933 dL/g. With increasing the diol chain length, the molecular weight of the polyesters increased linearly, except for poly (butylene sebacate) (PBS). Altogether, the "odd-even" effect of the diol chain on the crystalline (Tc)/melting temperature (Tm), and melting/ crystallization enthalpies of the polyester's were observed. Poly (pentylene sebacate) (PPeS) has the highest weight-average molecular weight of 72,900 Da, Tm of 55.4C, degradation temperature (Td, max) of about 404C, and highest storage modulus (E0 at 25 C) of 661 MPa compared to other short-chain polyesters. PBS and PPeS showed the appearance of sharp intensity peaks from XRD diffraction patterns, indicating higher crystallinity in the material, in accordance with crystallization enthalpies (AHc) values from the differential scanning calorimetry (DSC) thermograms. These fabricated bio-based polymers with 100% bio-content, low melting temperature range, rapid crystallization, and high thermal stability suggest good processability and can offer an alternative option to nonrenewable thermoplastic polyesters for potential applications.

Presenting Student: Tanuj Patel
Co-Authors:
Student Status: Graduate
Major: Polymer Chemistry
Research Advisor: Dr. Ram K. Gupta

Title: 4D Printing of Biocompatible Scaffolds via In Situ Photo-crosslinking from Shape Memory Co-polyesters.

Abstract: The complexity of surgical treatments for large-area soft tissue injuries makes placing large implants into injury sites challenging. Aliphatic polyesters are often used for scaffold preparation in tissue engineering owing to their excellent biodegradability and biocompatibility. Scaffolds with shape-memory effect (SME) can also avoid large-volume trauma during the implantation. However, the complexity and diversity of diseases require more adaptable and precise processing methods. Four-dimensional (4D) printing, a booming smart material additive manufacturing technology, provides a new opportunity for developing shape memory scaffolds. With the aim of personalized or patient-adaptable soft tissues such as blood vessels, we developed a feasible strategy for fabricating scaffolds with fine architectures using 4D printing crosslink able shape memory linear copolyesters using fused deposition modeling (FDM). To overcome the weak bonding strength of each printed layer during FDM, a catalyst-free photo-cross-linkable functional group derived from biocompatible cinnamic acid was embedded into the linear copolyesters as in situ crosslinking points during FDM printing. Under ultraviolet-assisted irradiation, the resulting 4D scaffold models demonstrated excellent SME, desirable mechanical performance, and good stability in a water environment owing to the chemical bonding between each layer. Moreover, the excellent biocompatibility of the scaffold was evaluated in vitro and in vivo. The developed composite scaffolds could be used for minimally invasive soft tissue repair.

Presenting Student: Ajay Kumar
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Novel Biobased Non-Isocyanate Polyurethanes from Microbially Produced 7,10-Dihydroxy-8(E)-Octadecenoic Acid for Potential Packaging and Coating Applications.

Abstract: In this study, a green and sustainable strategy was opted for the synthesis of a novel biobased non-isocyanate polyurethane (NIPU) or polyhydroxy urethane (PHU). NIPU or PHU was synthesized from microbially converted hydroxy fatty acid-based cyclic carbonate and diamine cross-linker. Initially, oleic acid was biotransformed into 7,10-dihydroxy-8(E)-octadecenoic acid (DOD) using Pseudomonas aeruginosa. The cell-free approach was chosen for DOD production due to its high yield and productivity. Afterward, DOD was modified into DOD-based tricyclic carbonate by a two-step method. The prepared monomeric material was characterized using Fourier transform infrared (FTIR) spectroscopy, 1 H nuclear magnetic resonance (1 H NMR), and 13C NMR analyses. A series of DOD-based PHUs (DOD PHUs) were synthesized with different amine contents, and their structures were studied by FTIR and 1 H NMR analyses.
The morphological, mechanical, and thermal properties of DOD PHU were further analyzed. The tensile strength and elongation at the break of the prepared DOD PHU were in the range of 2-6 MPa and 39-76%, respectively. The glass transition temperature of the material was in the range of 4-27 C. Thermogravimetric analysis exhibited that thermal stability increases with the increase in amine content. The gel content was in the range of 73-100%, suggesting that the polymers are highly cross-linked. In addition, the synthesized DOD PHU displayed excellent ultraviolet and water resistance properties. The green synthesized DOD PHU depicts suitability for a wide range of applications, particularly in the coating and packaging industries.

Presenting Student: Shaili Chaudhary
Student Status: Graduate
Major: Material Science
Research Advisor: Dr. Ram K. Gupta

Title: Fully Biobased Self-Healing and Recyclable Covalent Adaptable Networks Prepared via a Catalyst-Free Aza-Michael Reaction

Abstract: In the present scenario, petroleum resource-based thermoset materials have become an environmental threat due to their permanent cross-linked structure that limits their recyclability. To overcome this problem, the development of covalent adaptable networks (CANs) containing dynamic covalent bonds has emerged in recent years that can be recycled under suitable conditions. However, the development of fully biobased as well as recyclable CANs following a green synthetic protocol is yet a great challenge and a dream toward a sustainable environment. With this goal, here, we report the development of fully biobased CAN films from acrylated castor oil (a low-cost vegetable oil derivative) and cystamine (a biobased diamine) via a catalyst-free aza-Michael reaction using disulfide linkage as the dynamic covalent bond. The CAN films show excellent thermoself-healing behavior and recyclability for at least 10 cycles while maintaining their material properties. In addition, the CAN films can be catalytically degraded, which can be further reprocessed to reconstruct the films. Furthermore, the CAN films are hydrophobic in nature, indicating that these biobased recyclable CAN films are useful for protective surface coating applications. Therefore, as a proof of concept, we further demonstrate the anticorrosive properties of a film having a maximum water contact angle of 102.4°, analyzed by a polarization method, electrochemical impedance, and a salt spray fog test under a corrosive environment. This work provides an economical as well as environmentally friendly route to develop multifunctional materials for a sustainable future.

Poster Presentations

Category E

High School Students

Presenting Student: Abhirama Sonny
Student Status: High School
Major: Biomedical Health Science
Research Advisor: Dr. Marissa Sparacin

Title: Deep Learning Powered Classification and Analysis of Standard Heart Views in Ultrasound Imaging for Enhanced and Quicker Cardiac Diagnosis

Abstract: Cardiovascular diseases (CVDs) account for approximately 17.9 million deaths annually, emphasizing the need for more efficient and accurate diagnostic tools. Echocardiography, the primary imaging modality for cardiac assessment, relies on manual interpretation, introducing variability and diagnostic delays. This project leverages deep learning to enhance echocardiographic analysis and automate key diagnostic tasks. A Convolutional Neural Network (CNN) and a Vision Transformer (ViT) were trained on 1.4 million echocardiogram videos, achieving a validation accuracy of 93.7%. The models extract critical cardiac parameters, including Ejection Fraction (EF), End-Systolic Volume (ESV), End-Diastolic Volume (EDV), Tricuspid Annular Plane Systolic Excursion (TAPSE), and many more, with mean absolute errors (MAE) of 3.1%, 4.5 mL, 6.8 mL, and 1.2 mm, respectively, compared to human annotations. To improve interpretability, a Retrieval-Augmented Generation (RAG) model integrates domain-specific knowledge to generate structured diagnostic reports. A vector search algorithm retrieves similar cases from an annotated database, allowing a comparison of patient metrics against historical trends. Additionally, a Large Language Model (LLM) enables interactive querying, helping clinicians refine differential diagnoses and contextualize findings. This approach demonstrates the potential of artificial intelligence to streamline echocardiographic analysis, reduce diagnostic variability, and improve accessibility to cardiovascular disease detection. The primary goal is to help general health professionals, who may lack cardiology expertise, interpret ultrasound images during emergencies while also assisting cardiovascular specialists in making diagnoses. This approach highlights the potential of artificial intelligence in echocardiographic analysis.

Presenting Student: Kaidyn James
Co-Authors: Jeff Horinek
Student Status: High School
Major: Undeclared
Research Advisor: Dr. Jody Neef

Title: Catalyst Selectivity in the Addition of Hydroxybenzoic Acids to Glycidyl Phenyl Ether

Abstract: Epoxides are an important class of reagents in organic chemistry which react with a variety of nucleophiles. Strong nucleophiles add to epoxides at the least substituted carbon via a SN2 mechanism. However, under acidic conditions nucleophilic addition is at the most substituted carbon via a SN1 mechanism. Included within this class of reactions is the addition of carboxylic acids or phenols to epoxides using tetrabutylammonium bromide as the catalyst. These reactions are straight forward and give high yields of the product. However, previous work in our lab showed a faster reaction rate of benzoic acid addition to an epoxide with tetrabutylammonium fluoride. Due to this result, we were interested in the effect of catalyst on the selectivity of the reaction. To glycidyl phenyl ether was added 4-hydroxybenzoic acid, 3-hydroxybenzoic acid or salicylic acid using a tetrabutylammonium halide (F, Cl, Br, or I) catalyst. After the reaction, the products were analyzed by IR spectroscopy and the product ratio was determined using proton NMR spectroscopy. The resulting IR spectra and ratio of products from these studies will be reported.

Presenting Student: David Mendez
Student Status: High School
Major: Undeclared
Research Advisor: Mrs. Audrey Dickey

Title: Effect of Music on Children's Development

Abstract: This research explores the cognitive, emotional, and social benefits of music in the development of children, examining how music influences memory, intelligence, creativity, and emotional regulation. Music's impact on the brain begins at a young age, with prenatal exposure shaping early emotional connections and language development. As children grow, musical engagement enhances cognitive functions such as spatial reasoning, problem-solving, and hand-eye coordination, fostering both fluid and crystallized intelligence. This research highlights how learning to play instruments strengthens neural pathways and improves skills such as categorization, motor coordination, and academic performance, especially in math. Music's role in emotional development is significant, offering a means of self-regulation and enhancing social interactions. Music therapy is also discussed as a tool for improving cognitive, behavioral, and social skills, with particular emphasis on its benefits for children with special needs. While there are potential negative effects, such as rumination when listening to sad music, the overall benefits of musical education and exposure far outweigh these drawbacks. This research further emphasizes the role of music in enhancing creativity, confidence, and communication skills. Ultimately, this research argues that early and consistent exposure to music provides children with valuable tools for academic success, emotional well-being, social development, and personal growth, offering a comprehensive foundation for lifelong growth and learning.

Presenting Student: Ethan Hamilton
Student Status: High School
Major: Undeclared
Research Advisor: Karisa Boyer

Title: How Light Pollution Affects Four Aspects of Early Scarlet Globe Radishes (Raphanus sativus)

Abstract: Light pollution is excess light at night, typically from urban areas, that is spilled into the sky and can not only impact the ability of people to view stars but influence human and ecological behaviors. This experiment was conducted to examine the effects of blue LED light pollution on the average leaf length, plant height, stem thickness, and the discoloration of the radish leaves. This is because the agricultural effects of high levels of light pollution are understudied. This research was conducted by creating a dark environment with curtains under a grated table in a greenhouse and dividing the underside into four sections, each having two gardening buckets with six seeds. The experiment was carried out over a 40 day period post germination, with measurements taken every third day. Data for the plant height, stem width, and leaf pigmentation were not statistically significant, though leaf pigmentation data had a p-value slightly above 0.05 ($p=0.07878$). Leaf length data were statistically significant ($p=0.00001$), with the group set at 40 lux blue light pollution having the longest leaves, which indicates that higher intensities of blue light pollution can negatively impact the growth of plants and have economic significance in the field of agriculture with lower quality plants.

Presenting Student: Maya Craven
Student Status: High School
Major: Undeclared
Research Advisor: Karisa Boyer

Title: Evaluating Sheep Wool Pellets as a Sustainable Alternative for Water Conservation in Drought-Prone Areas

Abstract: Water consumption is an increasingly critical concern in the world today. 70% of global water consumption falls under the agricultural category, and this is a huge issue in drought-prone areas. Sheep have to be sheared periodically and for small farms, the amount of wool obtained is not economically valuable. However, pellets can be made from the wool. This study was conducted to test how sheep wool pellets affect the amount of water consumption in the Rapid Cycling Brassica rapa, which can not only bring about a reasoning to use sheep wool pellets but also create a way to maintain water retention in the soil of drought-prone areas, decreasing the amount of water consumption. This experiment used 72 Brassica rapa plants, broken down into 3 groups: 24 plants were planted in a 0% sheep wool pellet, 100% soil mixture, 24 were planted in a 5% sheep wool pellet mixture, 95% soil, and 24 plants were planted in a 10% sheep wool pelle mixture, 90% soil. The experiment, including the germination process, was conducted over a 14 day period with measurements taken every third day. Results found from the experiment were positive but not statistically significant, meaning there is still a visible correlation between the two variables.

Presenting Student: Hannah Sargent
Student Status: High School
Major: Pre-Vet
Research Advisor: Karisa Boyer

Title: The Effect of Grain-Free vs Grain-Inclusive Dry Dog Food on Triiodothyronine Levels in Mice

Abstract: Grain-Free foods are becoming an issue in veterinary science today (Bentley, personal communication, Sep. 6, 2024). Grain-free dog foods have been known to cause conditions such as hyperthyroidism (a disorder characterized by the overproduction of thyroid hormones and glands) and dilated cardiomyopathy (a disease of the cardiac muscle that is the leading cause of heart failure in dogs) in dogs to worsen (Weintraub, 2024; Quest, 2022; Webster, 2020). Thyroid hormones are known for maintaining vital bodily functions such as metabolism and growth (Cleveland Clinic, 2022). This novel experiment, utilizing BALB/c mice as model organisms, tested to see if these Grain-free foods have any effect on the specific thyroid hormone, Triiodothyronine (T3) which is specifically in control of an animal's metabolism. The hypothesis of this project was that if the mice are fed a diet composed of 100% Grain-Free dry dog food, then their levels of Triiodothyronine will decrease. An ANOVA test was run to analyze the results of the ELISA kits that were used to test the concentration of the T3 hormone. Because the p-value of the results of this ANOVA test was over 0.05, it meant that the data was not statistically significant, supporting the null hypothesis of this study.

Presenting Student: Christian Cavener
Student Status: High School
Major: Applied Mathematics and Business
Research Advisor: Karisa Boyer

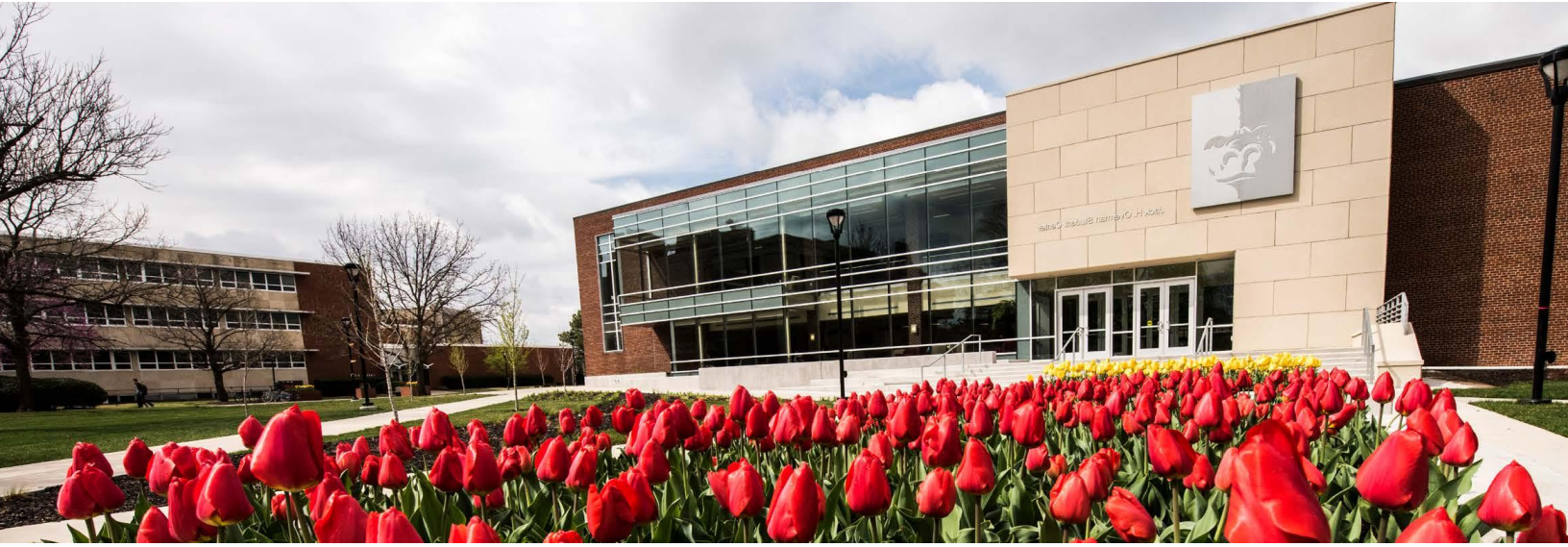
Title: A Novel Analysis of the Redshift Dependence of the Masses of the Supermassive Black Holes of a Sample of Quasars

Abstract: A type of active galactic nucleus is the quasar, or quasi-stellar radio source. Quasars are integral to understanding the formation and evolution of galaxies. This research was conducted by utilizing data from Grier, C. J. et al. 2019 and the Sloan Digital Sky Survey and leveraging a suite of analytical methods. The research focus of this paper was to determine the nature of the quantitative relationship between the redshift of a sample of quasars and the masses of the supermassive black holes of these quasars and thereby determine how a quasar's supermassive black hole mass evolves as the quasar ages over time. The hypothesis of the paper was that there will be an identifiable quantitative relationship between quasar redshift and quasar supermassive black hole mass. With a correlation coefficient of approximately 0.27, the quantitative relationship between the two variables was weak but positive. However, the quantitative relationship between quasar redshift and quasar supermassive black hole mass was statistically significant with a p-value of approximately 0.000008. Because of how there was a roughly linear relationship between these two variables, linear regression as opposed to non-linear regression was run. Only about 7% of the variation in quasar supermassive black hole mass could be explained by quasar redshift.

Presenting Student: Ty Matthiesen
Student Status: High School
Major: Undeclared
Research Advisor: Karisa Boyer

Title: Escherichia coli Serotype O157:H7 Colonization Quantification With Varying Rates of Microplastic Particles In The Spring River Watershed Groundwater

Abstract: Microplastics are a rising concern within the scientific community, polluting oceans and waterways around the world. This experiment was conducted to assess if microplastic particles can be causally linked to increased growth of Escherichia coli in the wild. To assess this, four sample groups were created with increasing amounts of microplastic particles per group. To quantify bacterial growth, absorbance readings were taken and Trial 1 samples were plated on Tryptic soy agar (TSA). In order to give this project real-world applications, groundwater from the Spring River Watershed was used. The hypothesis was, if E. coli was grown in constant conditions with increasing proportions of microplastics then sample groups with greater microplastic counts would reflect greater colony counts. A test trial was conducted to determine constants for the experiment such as total volume (mL) of groundwater, total volume (mL) of Tryptic soy broth (TSB), and incubation temperature and time. The experimentation period was broken down into two 72-hour trials. The data from this experiment suggests that a causal relationship between microplastics and increased bacterial growth does exist. Statistical analysis from the E. coli growth on TSA plates calculated a p-value of 4.09483E-108 which is statistically significant.



Pittsburg State University

1701 S. Broadway Street, Pittsburg, KS 66762

Office of Research and Sponsored Programs

213 Russ Hall

e-mail: research@pittstate.edu

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