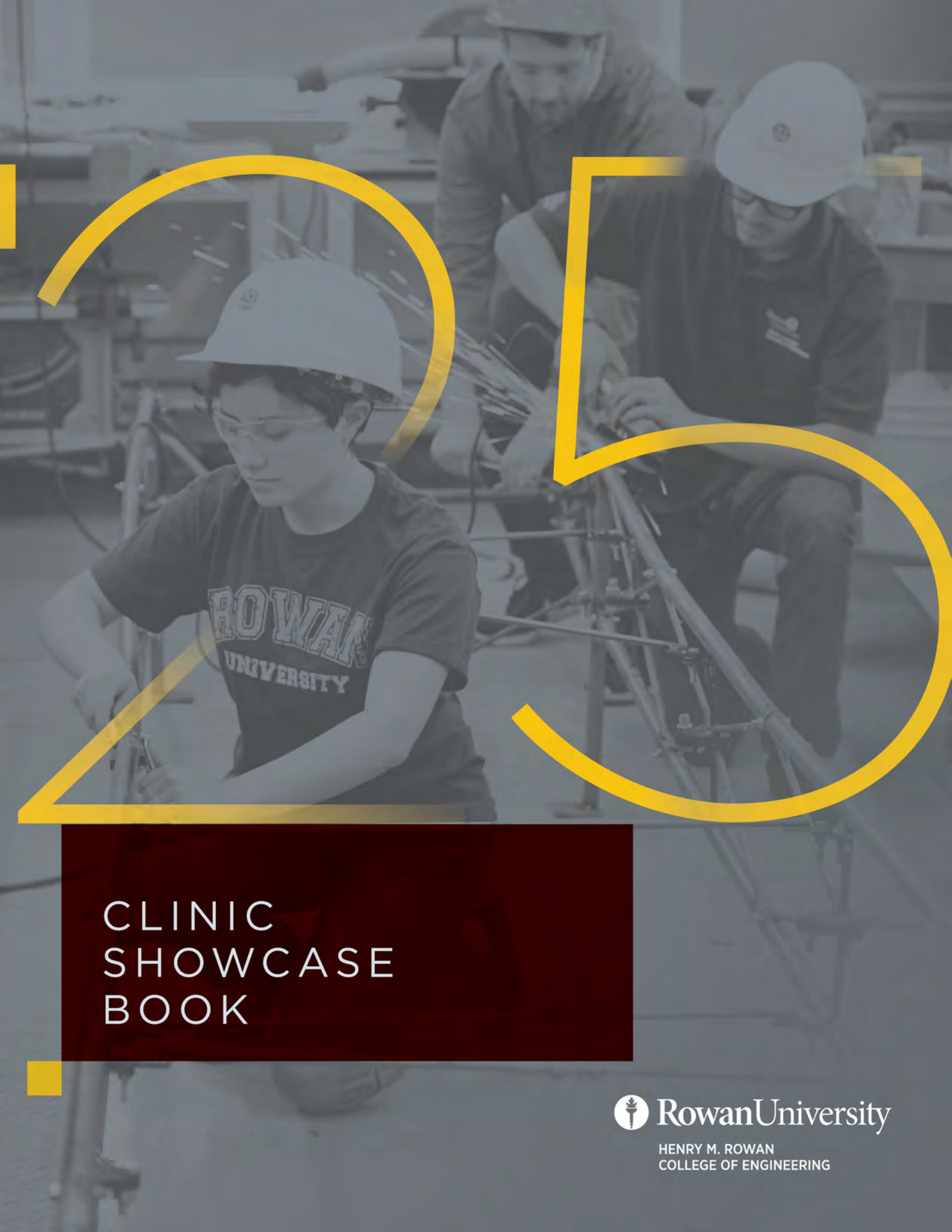

25

CLINIC SHOWCASE BOOK

RowanUniversity

HENRY M. ROWAN
COLLEGE OF ENGINEERING

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BIOMEDICAL ENGINEERING

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Preface

The Engineering Clinic Program is the hallmark of the Henry M. Rowan College of Engineering. Spanning the entire four-year undergraduate experience, Engineering Clinics serve as a vital and continuous component of the curriculum. In the first-year and sophomore clinic sequence, students develop a comprehensive understanding of the art and science of engineering design through an interdisciplinary approach. They skillfully translate engineering fundamentals into problem-solving best practices, culminating in project evaluations and final presentations.

Throughout the junior and senior clinic program, students collaborate in small teams under the guidance of faculty and external sponsors to apply knowledge gained in their coursework to real-world engineering challenges.

Within this 2025 Clinic Book, we proudly present the work of **500 students** across **120 clinic projects**. These students have actively contributed to the betterment of their communities while engaging in rigorous academic study. Each clinic project stands as a testament to the exceptional talent, dedication, and perseverance of our students, the strength of our engineering education, and the caliber of graduates we produce.

We trust that you will derive as much enjoyment from learning about our students and their projects as we have from sharing them with you.

Sincerely,

Giuseppe R. Palmese, Ph.D.
Dean, Henry M. Rowan College of Engineering

Becoming an Engineer

The measure of an engineering program is not only what students know, but who they become through their education. Professional engineers must make decisions with incomplete information, collaborate across differences, and take responsibility for outcomes that extend beyond the classroom. These qualities are developed through experience, reflection, and guided practice—not lectures alone.

The Junior and Senior Engineering Clinics are where this professional formation takes place most fully. In these clinics, students move beyond well-defined problems and into authentic engineering contexts, where constraints are real and tradeoffs must be justified. Working in teams, students learn to negotiate ideas, manage uncertainty, and hold themselves accountable to shared goals. Faculty mentorship is central to this process, guiding students in both technical decision-making and professional conduct.

During the final two years of the engineering program, students transition from learning about engineering to practicing it. Faculty-proposed projects—selected by students based on interest—encourage ownership and motivation. As projects unfold, students must plan, communicate, document, revise, and deliver solutions that meet clearly defined success criteria. In doing so, they develop confidence, resilience, and a sense of responsibility to their teammates and stakeholders. The clinics intentionally integrate technical rigor with communication, project management, and teamwork.

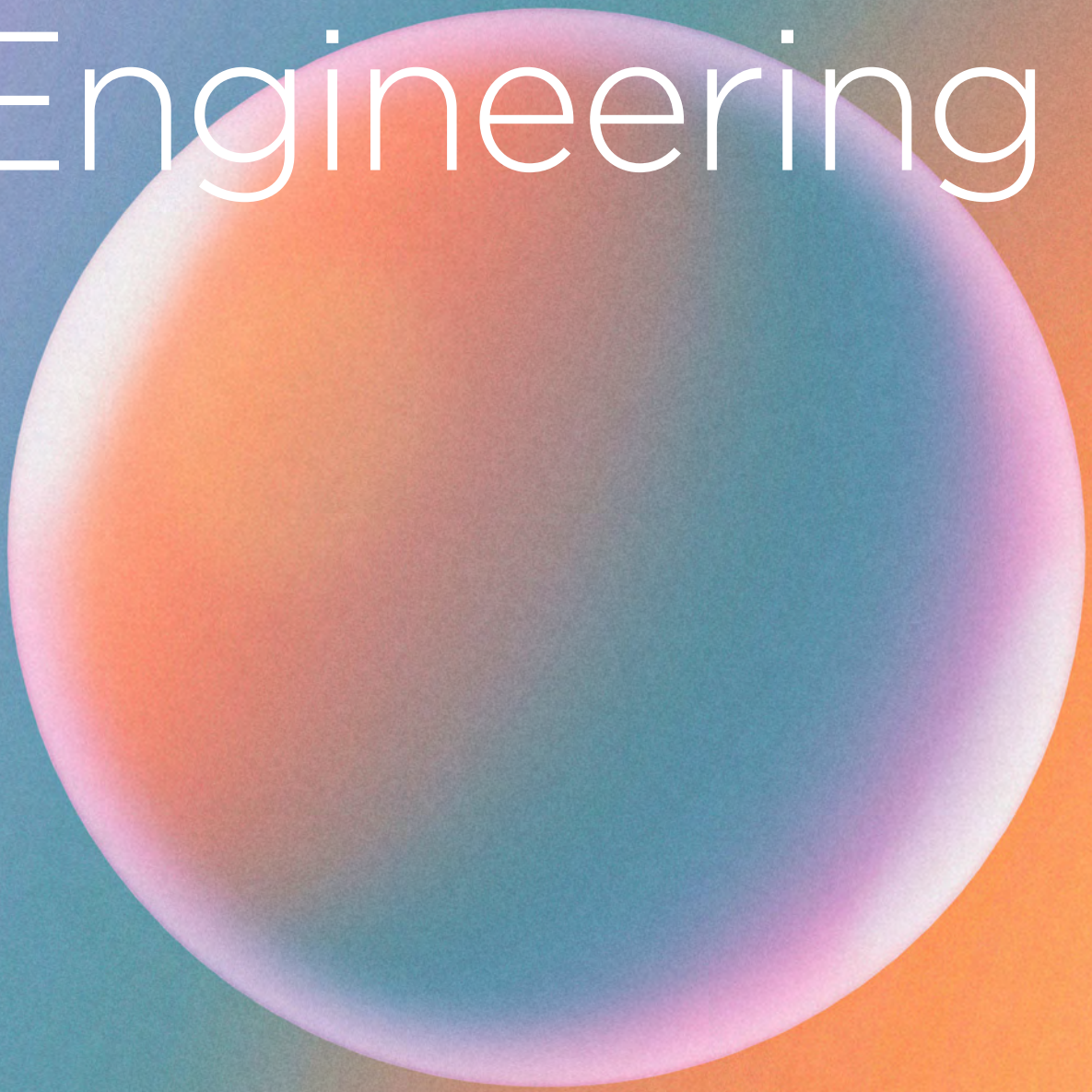
Innovation and inquiry are central to the clinic experience. Each project challenges students to extend existing knowledge or apply it in unfamiliar ways. Students may pursue multiple projects to gain breadth or engage deeply with a single project over time. Through collaboration with faculty, external sponsors, and peers, students build professional relationships and learn to communicate their work to diverse audiences—experiences consistently valued by employers.

The Engineering Clinic program is a defining feature of the Henry M. Rowan College of Engineering. The projects showcased in this booklet represent more than technical accomplishments; they reflect students' growth into thoughtful, capable, and responsible engineers. We take pride in this legacy of engineering formation and in the graduates who carry these lessons forward.

Sincerely,

Smitesh Bakrania, Ph.D.
Junior and Senior Engineering Clinic Coordinator

Biomedical Engineering



In-vitro liver models for capturing CYP3A4 expression variability

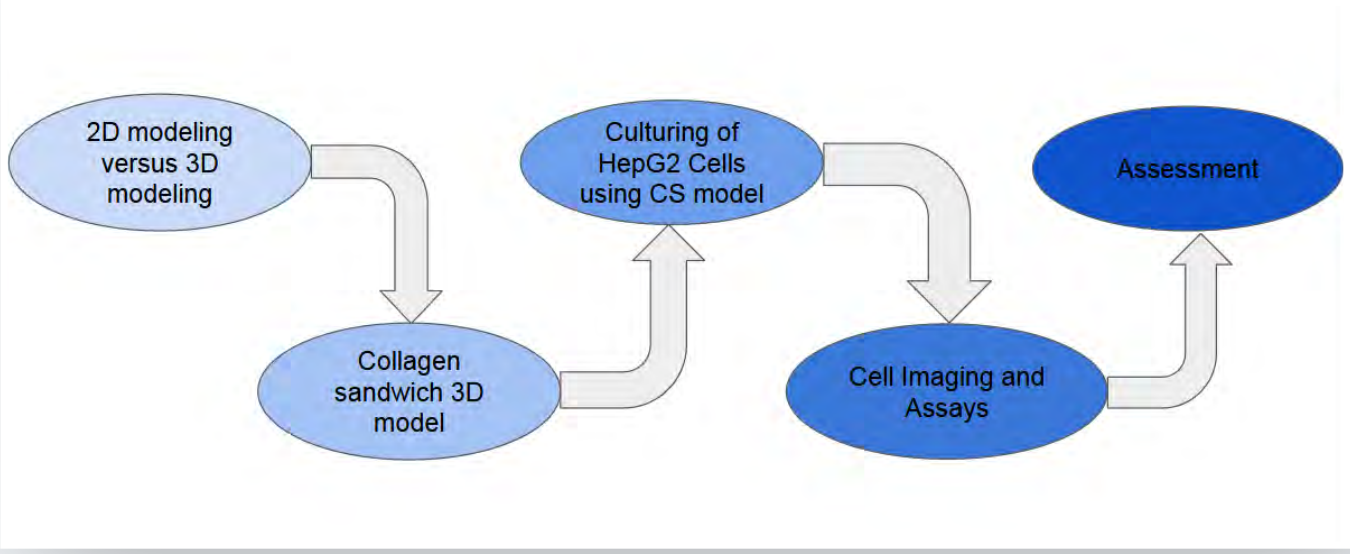
TEAM MEMBERS
Connor Thomas, Elizabeth Pennington

PROJECT MANAGERS
Sophia Orbach

Our clinic project successfully established cell line-based in vitro liver models using HepG2 cells to study the variability of CYP3A4 expression, a crucial enzyme metabolizing roughly half of all drugs. We demonstrated that inhibiting CYP3A4 with DMSO in HepG2 cultures directly correlated with increased toxicity. To enhance CYP3A4 expression and liver-specific functions, we identified sandwich cultures as a promising initial strategy, informed by a thorough analysis of existing protocols. Our approach incorporated biochemical assays to quantify albumin secretion (a marker of liver function) and CYP3A4 gene and protein levels. Immunostaining, employing primary and fluorescent secondary antibodies, enabled the visualization of CYP3A4 protein expression. These comprehensive analyses aimed to evaluate the capacity of HepG2 cells in sandwich cultures to effectively mimic primary hepatocytes in vitro.

Project Snapshot

1. DMSO-mediated CYP3A4 inhibition in HepG2 cells increased toxicity, underscoring its role in drug metabolism.
2. Idealized sandwich culture refines HepG2 liver characteristics based on prior research.
3. Biochemical assays and immunostaining offer a complete view of CYP3A4 expression in vitro.



Resorbable Suture Yarns from Electrospun PCL Nanofibers

TEAM MEMBERS
Grace Molinari

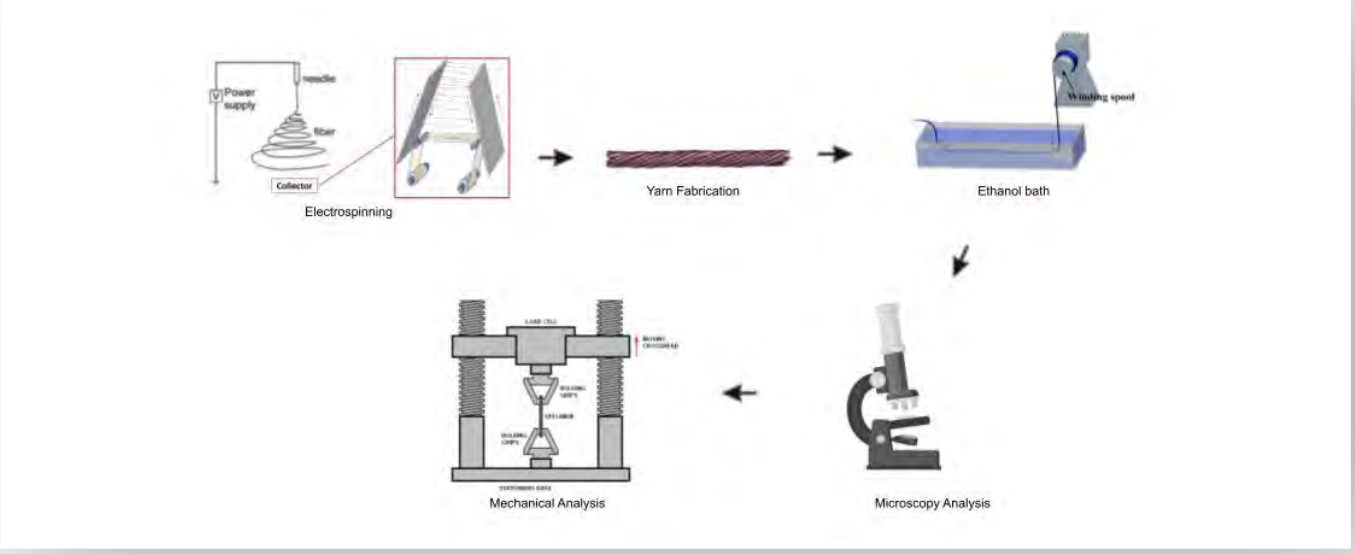
PROJECT MANAGERS
Vince Beachley, Dominique Hassinger

SPONSORS
National Science Foundation

Rotator cuff repair (RCR) faces high failure rates due to nonabsorbable sutures hindering enthesis regeneration. Electrospun nanofibers, with their regenerative and anti-inflammatory properties, offer a potential solution but lack sufficient mechanical strength for load-bearing. Post-drawing and continuous yarn assembly aim to improve tensile strength, yet achieving optimal packing density remains challenging. This research investigates the physical and mechanical properties of PCL nanofiber yarns, focusing on optimizing packing density via wet-spinning in ethanol. The goal is to create nanofiber yarns with comparable diameter and strength to conventional sutures for improved RCR outcomes.

Project Snapshot

1. Focused on rotator cuff repair failures due to nonabsorbable sutures impeding regeneration.
2. Wet-spun nanofibers offer a novel route to address mechanical limits of electrospun ones for load-bearing uses.
3. Research: next-gen suture for mechanical support and active tendon-bone regeneration.



Laser Zone Drawing Parameter Effects on PLA Nanofiber Properties

TEAM MEMBERS
Abigail Popoff

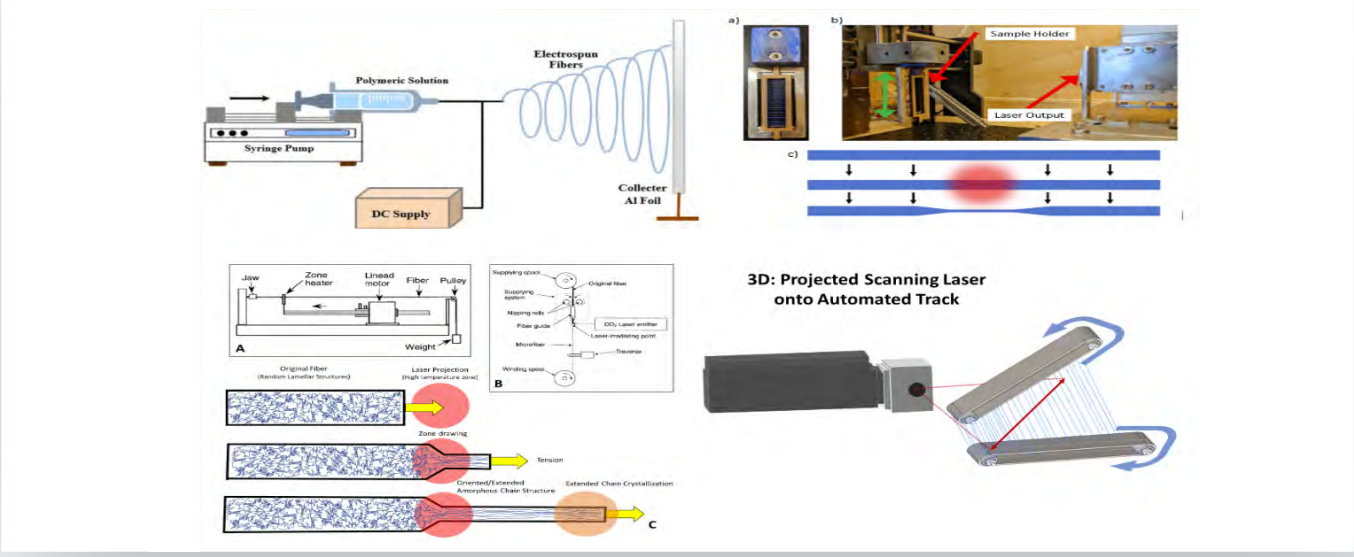
PROJECT MANAGERS
Vince Beachley, Varsha Prahaladan, Mohamad Keblawi

SPONSORS
National Science Foundation

PLA nanofibers are promising for biomedicine, but their mechanical weakness limits load-bearing uses. Laser zone drawing (LZD) can enhance their strength and flexibility. This study optimizes fiber spacing and laser power to improve these properties without thermal damage, using tensile testing and SEM. Scaling LZD for mass production faces challenges like air heating, laser scattering, and uneven heating at fiber crossovers. Addressing these is crucial for consistent, high-performance nanofiber scaffolds. This research aims to advance high-performance biomaterials for tissue engineering and implantable devices in regenerative medicine.

Project Snapshot

1. Optimized laser parameters boost PLA nanofiber strength and flexibility without thermal damage.
2. Mass laser drawing requires understanding multi-fiber interactions: heating, scattering, crossings.
3. Use of high-performance PLA nanofiber scaffolds in critical biomedical applications



Fabricating Advanced Carbon Nanoyarns from PAN Nanofibers

TEAM MEMBERS
Darrian Shufford

PROJECT MANAGERS
Vince Beachley

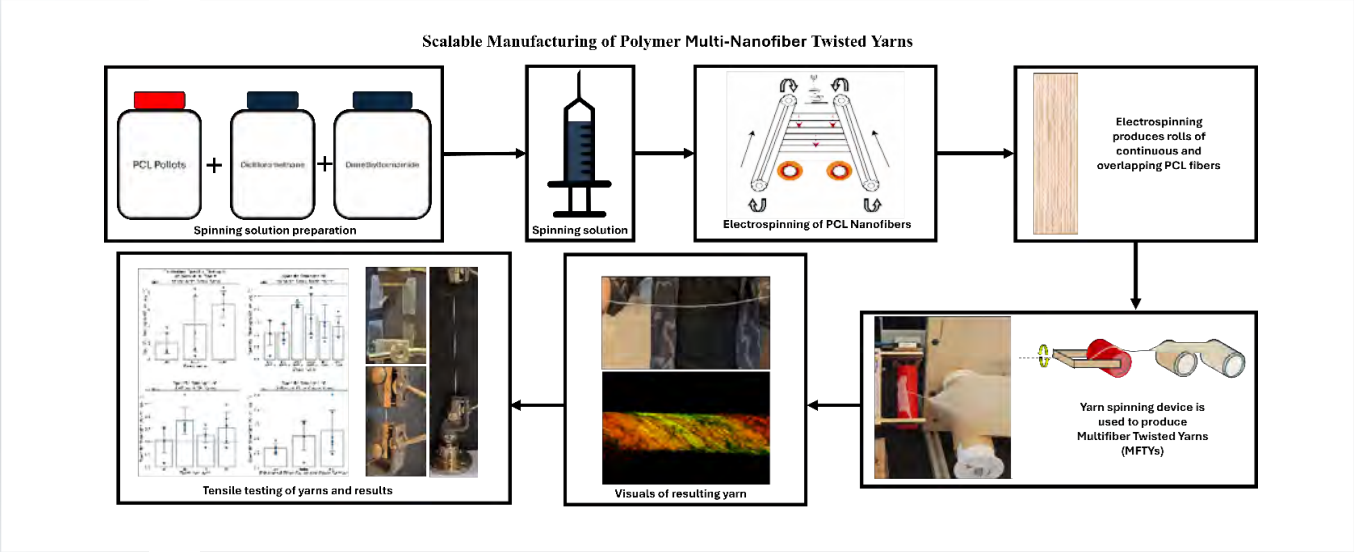
SPONSORS
National Science Foundation

This project aims to create high-performance carbon nanofiber yarns cost-effectively and scalably. We're tackling the fiber alignment challenge inherent in using polyacrylonitrile (PAN) as a precursor. Our innovative continuous process combines parallel track electrospinning for better molecular alignment within nanofibers with roll-to-roll yarn spinning for superior alignment between fibers. By carefully optimizing thermal processing (stabilization and carbonization), we aim to produce continuous carbon yarns with significantly improved strength, uniformity, and electrical conductivity, enabling their use in advanced textiles and electronics.

Project Snapshot

1. Parallel/roll-to-roll spinning enables scalable, cost-effective high-performance carbon yarn production, overcoming CNT spinning limits.

2. Improved fiber and molecular alignment boosts material's mechanical and electrical properties.



Scalable Aligned Nanofiber Production: Parameter Control

TEAM MEMBERS
AnnaMarie McMahon

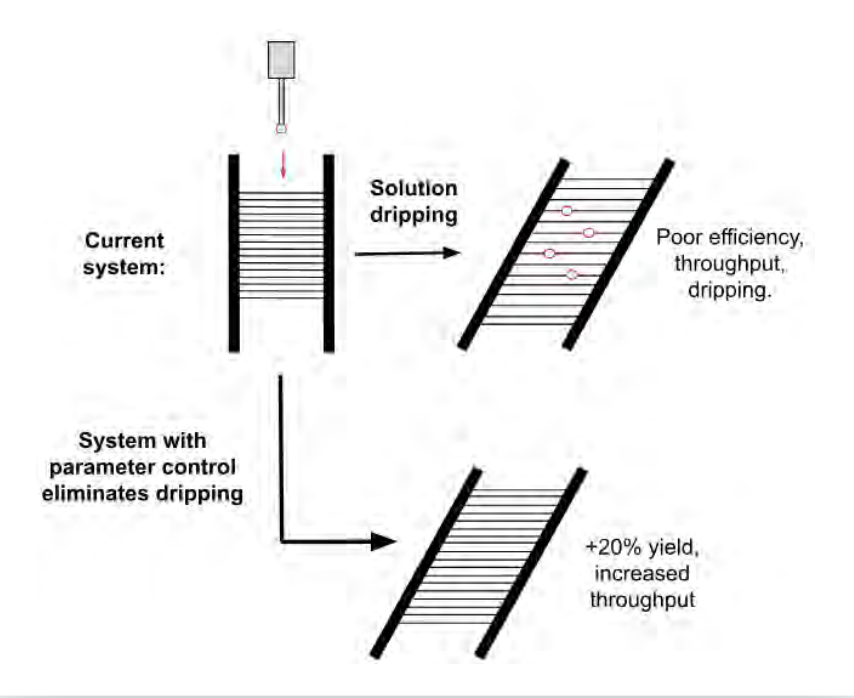
PROJECT MANAGERS
Vince Beachley, Varsha Prahaladani

SPONSORS
National Science Foundation

Polymer nanofibers' high surface area is valuable for applications like smart textiles using piezoelectric properties. However, large-scale aligned nanofiber production via parallel-track electrospinning faces challenges like solution drippage, limiting efficiency. Prior work with 18 wt% PCL achieved 15% efficiency, suggesting a minimum 9.5 kV voltage. This study aims to enhance parallel-track electrospinning reliability by targeting ≥ 35% efficiency and 0.0945 g/hr throughput with zero drippage. Experiments will evaluate 9.5-12.5 kV against 350-900 steps/min track speeds, validated against the 15% baseline. The findings will guide system improvements for scalable aligned nanofiber production.

Project Snapshot

1. Large-scale continuous aligned polymer nanofiber production tackled.
2. Aiming for ≥35% efficiency (2x+), increased throughput, and zero solution drippage.
3. Systematic optimization of voltage and speed for scalable aligned nanofiber manufacturing.



Aligned Nanofiber Hydrogels for Engineered Tissue Regeneration

TEAM MEMBERS
Naeem Aboukirsh

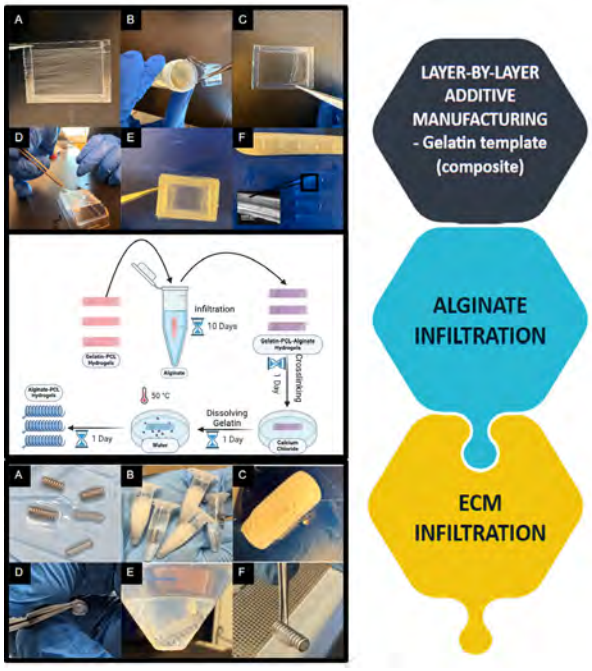
PROJECT MANAGERS
Vince Beachley

Aligned tissue regeneration requires scaffolds with both biochemical and structural cues for cell differentiation, proliferation, migration, and alignment. ECM hydrogels provide tissue-specific signals, but they lack ordered structures to guide alignment. This study addresses that limitation by embedding aligned polymer nanofibers in ECM hydrogels. A novel three-step approach was used: layer-by-layer additive manufacturing of a gelatin-nanofiber template, infiltration with alginate and ECM hydrogel, and removal of sacrificial components. Pepsin digestion confirmed ECM incorporation by selectively dissolving the scaffold, while genipin crosslinking verified collagen presence through a color change. This method integrates nanofibers for mechanical guidance with ECM for biochemical signaling, enhancing aligned tissue regeneration. The scaffold has potential applications in neural and musculoskeletal repair, with future work focusing on nerve-derived ECM and in vivo testing.

Project Snapshot

1. ECM hydrogels' tissue signals merge with aligned nanofibers' order for a comprehensive regenerative scaffold.

2. Layer-by-layer printing with sacrificial components enables sophisticated biomaterial engineering.



Studying 3D Cell Sensing with Soft-Stiff Materials

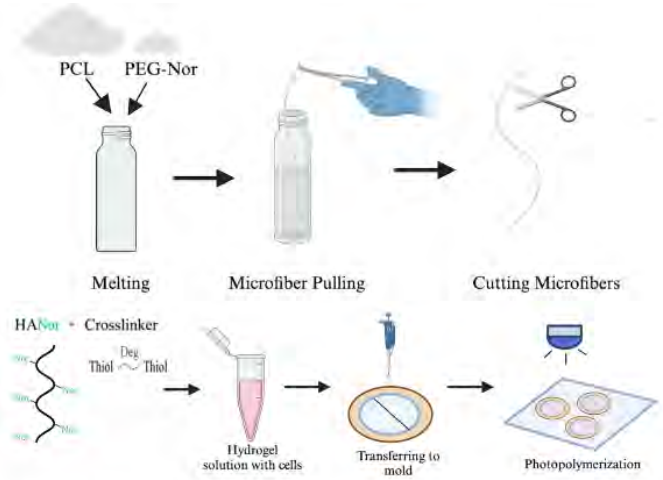
TEAM MEMBERS
Sabriye Yilmaz, Joshua de Guzman

PROJECT MANAGERS
Sebastián Vega, Jay Patel (Emory University)

Aligned tissues like tendons and ligaments struggle to heal after injury, highlighting the need for biomaterials that can direct cell alignment. Researchers hypothesized that cells can sense stiffness differences within a soft-stiff 3D environment and that this could be used to control their orientation. To test this, we embedded mesenchymal stem cells (MSCs) in enzymatically degradable hyaluronic acid hydrogels alongside stiff polycaprolactone microfibers. By varying microfiber diameter and hydrogel network connectivity, they found that these factors indeed regulate MSC alignment and how cells sense the surrounding 3D matrix. This work demonstrates the promise of fiber-reinforced hydrogel composites for engineering aligned tissues.

Project Snapshot

1. Cells align in 3D by sensing stiffness gradients in a composite biomaterial.
2. Stiff microfiber diameter and soft hydrogel interconnectivity influence MSC alignment.
3. Stiff fibers in soft hydrogels may help regenerate aligned tissues.



$$Conformity\ Index = |cos\ (Angle\ Deviation)| * \left(1 - \frac{1}{Aspect\ Ratio}\right) \quad \text{(Eq. 1)}$$

$$Morpho - mechanoresponse = Conformity * \frac{YAP_{Nuc}}{YAP_{Cyto}} \quad \text{(Eq.2)}$$

Peptide Hydrogels: A New Way to Expand Stem Cells

TEAM MEMBERS
Tyler Torres, Hayley Jankowski

PROJECT MANAGERS
Sebastián Vega, Matthias Recktenwald

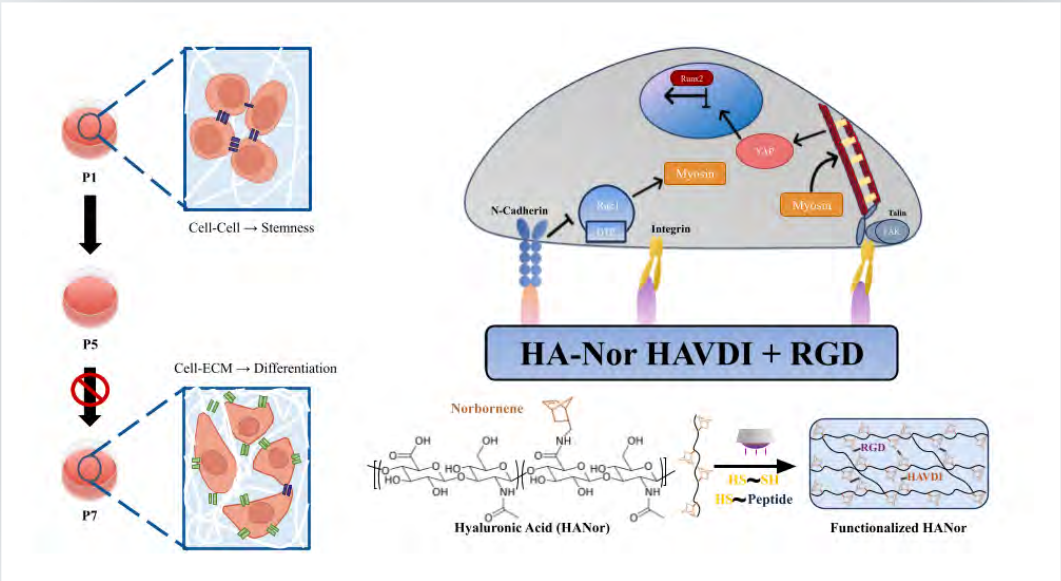
SPONSORS
National Science Foundation

MSCs show promise in regenerative medicine, but standard culture methods drive them towards bone development, limiting their therapeutic use. To address this, we created peptide-modified hydrogels to control differentiation and maintain MSC stemness. Norbornene-modified hyaluronic acid (HANor) hydrogels with RGD and N-cadherin-mimicking (HAVDI) peptides were used to study their effects.

HAVDI surfaces disrupted actin filaments and reduced cellular response to mechanical cues, delaying nuclear entry of YAP and RUNX2, key osteogenic proteins. Higher RGD levels promoted these markers. Importantly, MSCs proliferated on HAVDI surfaces while retaining stem cell properties. This work suggests HAVDI-functionalized HANor hydrogels offer a better approach for large-scale MSC production for cell therapies.

Project Snapshot

1. HAVDI peptides suppressed MSC osteogenesis by disrupting mechanosignaling.
2. HAVDI modification slowed nuclear entry of osteogenic factors AP and RUNX2.
3. HAVDI hydrogels supported MSC proliferation and stemness marker retention.



Designing 3D Hydrogels with DWIVA Peptides for Bone Differentiation

TEAM MEMBERS
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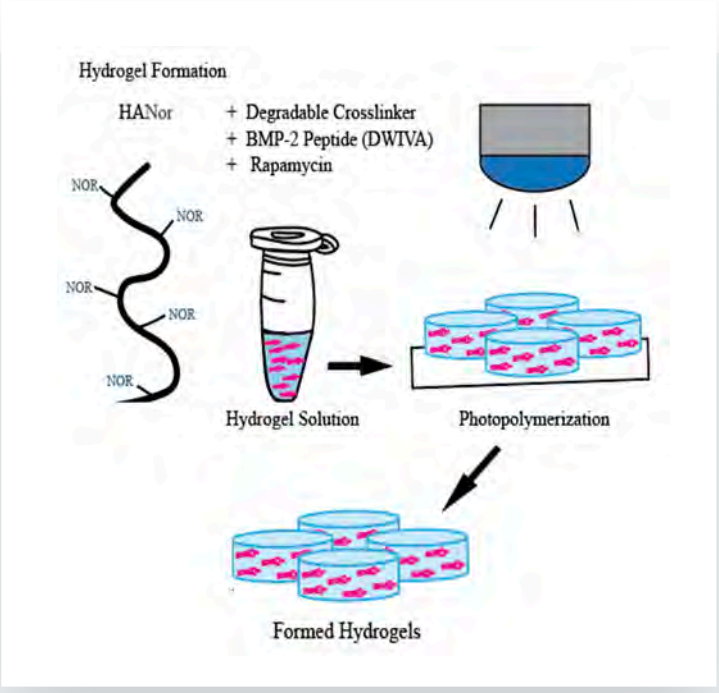
PROJECT MANAGERS
Sebastián Vega, Tae Won B. Kim (Cooper University Hospital), Umu Jalloh

SPONSORS
Foundation Venture Capital Group, New Jersey Health Foundation, The Cooper Foundation

Each year, over 100,000 Americans experience nonunion fractures, emphasizing the need for better treatments. Photopolymerizable hydrogels containing mesenchymal stem cells (MSCs) offer a promising avenue. This study explores hydrogels engineered with osteogenic signals to improve MSC bone differentiation. While bone morphogenetic protein-2 (BMP-2) is effective but has side effects, its wrist epitope, DWIVA, shows promise without these issues. Rapamycin (RAPA) may further support bone differentiation through a similar pathway. This research compares hydrogels functionalized with DWIVA peptides using GCGGG and GCEAAAK spacer sequences and examines the impact of different RAPA concentrations on MSC morphology and bone differentiation. The hypothesis is that GCEAAAK-DWIVA will better enhance MSC osteogenesis compared to GCGGG-DWIVA, with RAPA providing additional benefits in both scenarios to identify the optimal environment for bone regeneration.

Project Snapshot

1. DWIVA, a BMP-2 fragment, offers targeted bone regeneration, potentially reducing side effects.
2. Spacer sequences in hydrogels impact cell-signaling molecule interactions.
3. Rapamycin and DWIVA peptide synergy to boost stem cell bone differentiation in hydrogel.



Developing 3D Hydrogels with KIPKA for Bone Differentiation

TEAM MEMBERS
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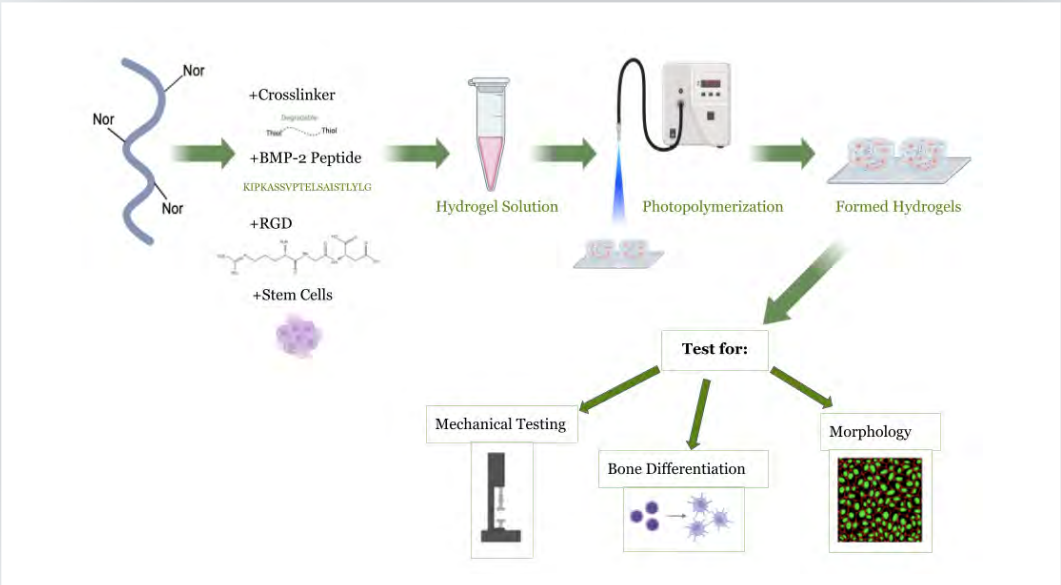
PROJECT MANAGERS
Sebastián Vega, Tae Won B. Kim (Cooper University Hospital)

SPONSORS
Foundation Venture Capital Group, New Jersey Health Foundation, The Cooper Foundation

This study explores a new method for treating long-bone fractures using hydrogels enhanced with KIPKA, a peptide from BMP-2. Current treatments like autografts have drawbacks, and while BMP-2 promotes bone growth, it can cause side effects. 1 Researchers believe KIPKA-functionalized hydrogels could stimulate bone formation with fewer side effects by specifically targeting the Smad pathway. Mesenchymal stem cells (MSCs) within these hydrogels showed good survival and improved 3D matrix sensing, important for bone cell development. The study found YAP moving to the nucleus, increased ALP activity, and substantial calcium deposits, all signs of enhanced bone formation. These results indicate that KIPKA-functionalized hydrogels are a promising approach for bone regeneration by locally boosting BMP-2 signaling and potentially reducing systemic side effects.

Project Snapshot

1. KIPKA peptide, from BMP-2, shows potential in promoting bone formation.
2. KIPKA-functionalized hydrogels boost MSC mechanosensing for 3D bone differentiation.
3. KIPKA's targeted approach may reduce off-target effects seen with standard BMP-2 treatments.



Injectable Hydrogel to Prevent Arteriovenous Fistula Failure

TEAM MEMBERS
Aliyan Aamir, Hartej Hundal, Sania Malik

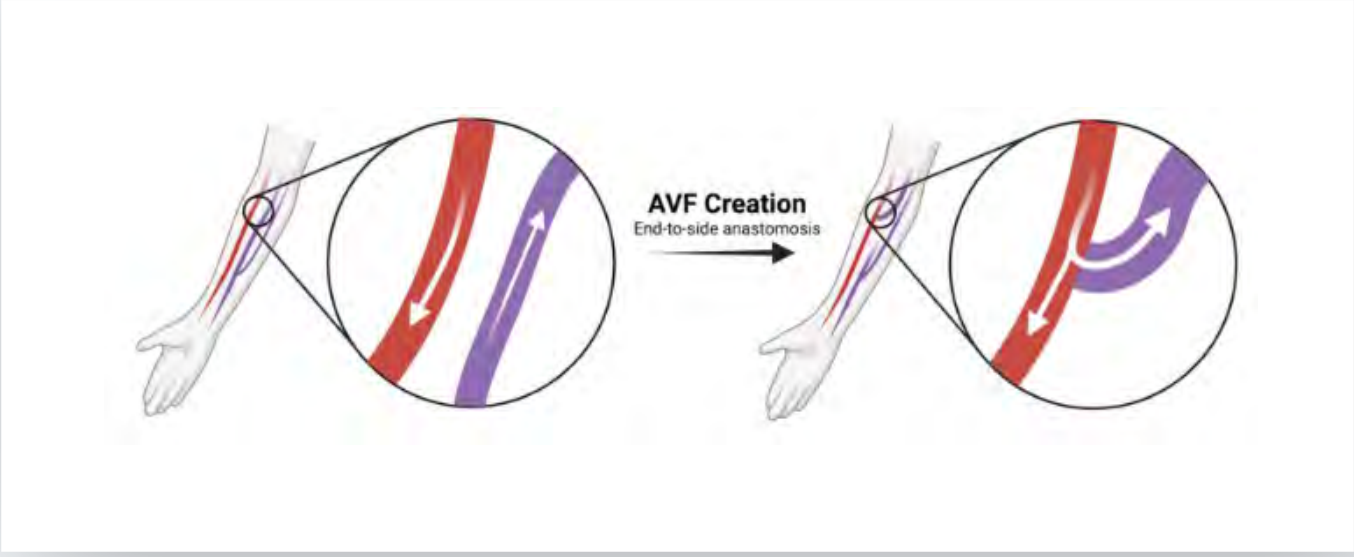
PROJECT MANAGERS
Patrick Hwang, Shahab Edalatian Zakeri

SPONSORS
Foundation Venture Capital Group, New Jersey Health Foundation, The Cooper Foundation

End-stage renal disease necessitates hemodialysis, for which a functional arteriovenous fistula (AVF) is paramount. Unfortunately, high failure rates (around 60%) due to poor vessel dilation and intimal hyperplasia plague AVFs. To combat this, we engineered an injectable bio-polymer hydrogel composed of oxidized guar gum (OGG) and gelatin, cross-linked by Schiff base bonds. This innovative hydrogel is designed to release sildenafil, a vasodilator, gradually to promote AVF maturation. By adjusting the oxidation levels of OGG, we created three distinct hydrogel formulations with varying mechanical properties. Rheological analysis demonstrated that hydrogels with higher OGG oxidation exhibited the greatest mechanical strength (storage modulus). Furthermore, all formulations proved to be easily injectable without causing blockage. This research presents a promising new therapeutic avenue for enhancing AVF maturation and ultimately improving dialysis outcomes for millions of ESRD patients.

Project Snapshot

1. Injectable hydrogel improves AVF outcomes for hemodialysis patients.
2. The hydrogel releases sildenafil, a vasodilator, to enhance vessel dilation and AVF outward remodeling.
3. Oxidizing guar gum yielded injectable hydrogels with tunable mechanical strength.



Piezoelectric electrospun scaffold for cardiomyocyte maturation

TEAM MEMBERS
Beena Baruwal

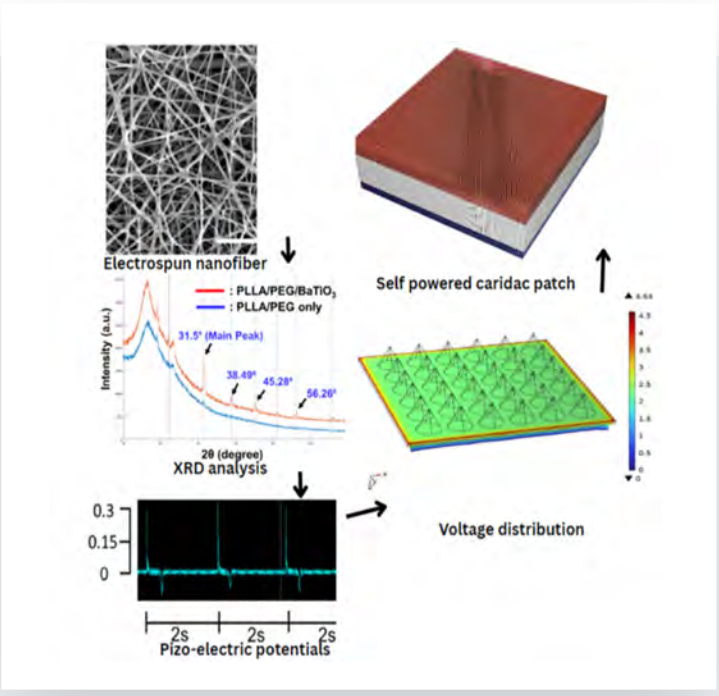
PROJECT MANAGERS
Patrick Hwang, John Ryan Zimmerman

SPONSORS
New Jersey Health Foundation

Myocardial infarction demands innovative regenerative approaches. Our novel piezoelectric electrospun scaffold, composed of PLLA/PEG/$BaTiO_3$ nanoparticles, aims to enhance stem cell therapy by addressing the limited integration of immature cardiomyocytes (CMs) due to insufficient electrical and structural cues. This unique scaffold combines self-powered electrical stimulation from $BaTiO_3$ nanoparticles, aligned topographical cues mimicking native heart tissue, and a biocompatible matrix. Optimized electrospinning (18% PLLA:PEG 8:2 with 5-7% $BaTiO_3$) produced a uniform nanofiber network (SEM) with confirmed $BaTiO_3$ crystallinity (XRD) and piezoelectric functionality. Future steps involve improving fiber alignment, differentiating iPSCs into functional CMs, and validating their maturation on the scaffold under combined electromechanical stimulation. This technology offers a potentially translatable strategy for enhanced cardiac repair by promoting adult-like CM maturation.

Project Snapshot

1. Self-powered electroactive scaffold using piezoelectric nanoparticles.
2. Facilitating cardiomyocyte maturation through electrical & structural cues.
3. Repairing damaged heart tissue post-MI: Clinically translatable solutions.



Myofibroblast Density & Lens Capsule Wrinkling

TEAM MEMBERS
Giavanna Trojan

PROJECT MANAGERS
Mark Byrne, Camilla Vardar

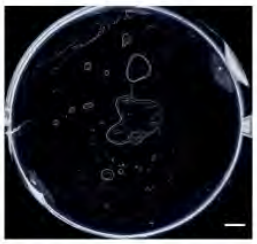
SPONSORS
OcuMedic, Inc.

This study investigated how different concentrations of myofibroblasts on bovine lens capsules correlate with vision loss (reduced transmittance measured by UV-spectroscopy) due to wrinkling, mimicking accelerated posterior capsule opacification (PCO). Immunolocalization confirmed wrinkling-induced loss of transparency from contractile forces. The study also engineered injectable, thermosensitive hydrogels for sustained release of doxorubicin-loaded nanocarriers targeting PCO. Results showed that 25k and 40k myofibroblasts/well caused near-total transmittance loss, 5k and 10k showed significant decreases, while 2k did not significantly reduce transparency. These findings are relevant for designing sustained-release devices to prevent post-cataract surgery complications.

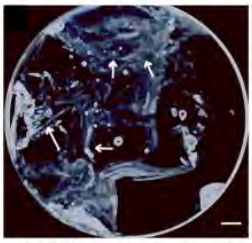
Project Snapshot

1. Novel, injectable, thermosensitive (PLGA-PEG-PLGA) hydrogels were engineered for sustained release of targeted, doxorubicin-loaded nucleic acid nanocarriers (G8:3DNA:Dox).

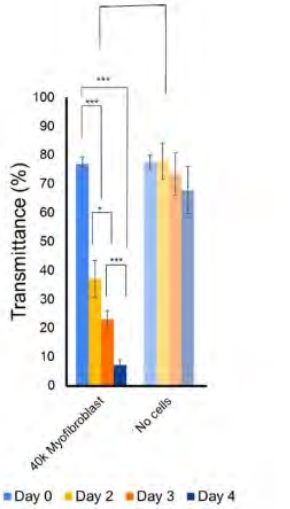
2. The developed hydrogel system's modifiable properties can treat various fibrotic eye diseases.



A: Clear Lens Capsule



B: Wrinkled Lens Capsule from Myofibroblasts



C: Optical Clarity of Lens Capsule Treated with 40 k cells at 600nm

Bromfenac drops vs. extended-release contact lenses for drug delivery

TEAM MEMBERS
Alexa Warren

PROJECT MANAGERS
Mark Byrne, Hope Seybold

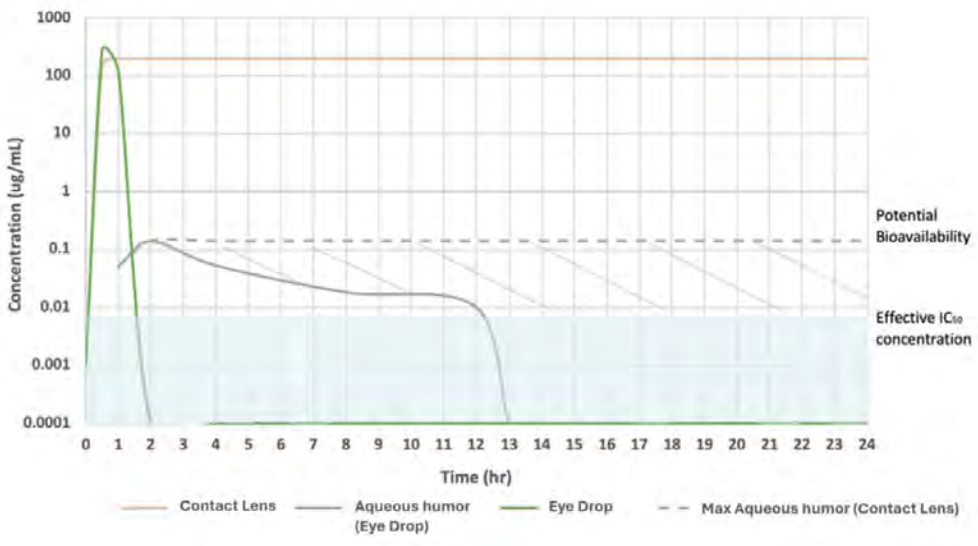
SPONSORS
OcuMedic, Inc.

Inflammation is a frequent complication after cataract surgery, commonly treated with topical NSAIDs like bromfenac sodium eye drops. However, drug delivery through eye drops is hindered by natural barriers and rapid tear turnover, leading to low bioavailability and inconsistent therapeutic levels. This meta-analysis compared two in vivo studies using New Zealand White Rabbits. The first assessed bromfenac sodium levels in eye tissue following topical administration. The second investigated drug release over one week from novel extended-wear contact lenses developed by our group. Drug concentrations were evaluated against the IC50 for COX-2 inhibition. Bioavailability was estimated using the trapezoidal rule. The findings highlight the enormous potential of drug releasing lenses as a platform strategy, and offers a new dropless NSAID clinical strategy for post-cataract, uveitis, post-LASIK, and corneal abrasion treatment.

Project Snapshot

1. Eye drops fail to maintain therapeutic drug levels in ocular tissues half the time.

2. Lens-treated eyes achieve sustained, therapeutically relevant bromfenac release for 8 days.



McdB LLPS structural analysis: key condensation domains identified

TEAM MEMBERS
Heather Tejeda

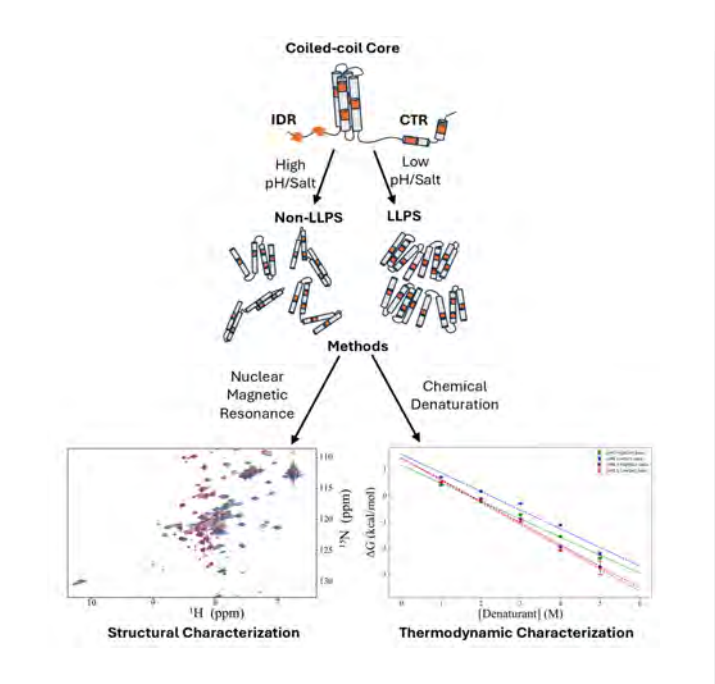
PROJECT MANAGERS
Nathaniel Nucci, Anthony Vecchiarelli (UMichigan)

SPONSORS
National Science Foundation, The American Chemical Society Petroleum Research Fund, U-RISE@Rowan

Liquid-liquid phase separation (LLPS) is vital for cellular organization and bacterial microcompartments; its dysregulation is linked to neurodegenerative diseases. McdB, a model LLPS protein with disordered and coiled-coil regions, exhibits pH- and salt-dependent phase separation, but the structural basis is unclear. We used tryptophan fluorescence, CD, and NMR to show that McdB's core domain transitions from a defined state at low pH to a less structured state at high pH, with non-cooperative unfolding in both. Understanding these structural changes will aid in the design of engineered LLPS systems.

Project Snapshot

1. McdB structural changes drive liquid-liquid phase separation (LLPS), key in cell organization and disease.
2. McdB core domain unfolds at high pH, correlating with LLPS behavior.
3. Insights for engineered LLPS systems: structural features and phase separation.



Low-Cost Platform to Assay Bacterial Biofilm Formation in Flow

TEAM MEMBERS
Lesslie Montiel

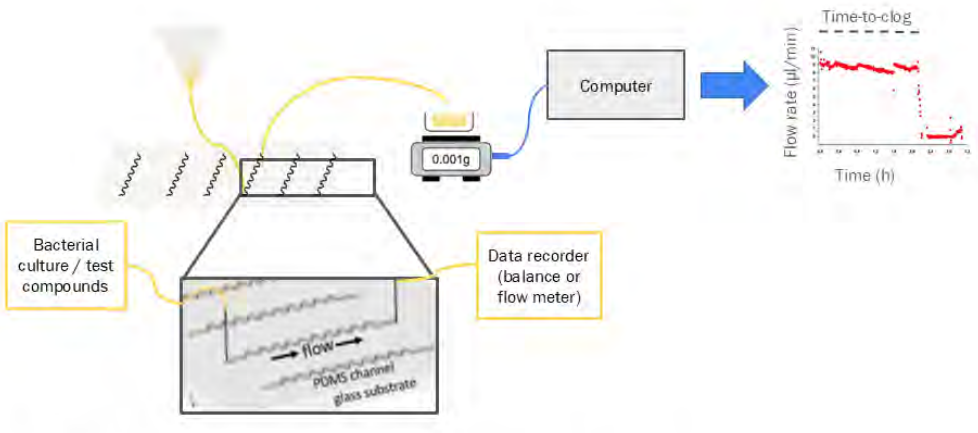
PROJECT MANAGERS
James Grinias, Christopher Piccolo

SPONSORS
National Institutes of Health

Biofilms of antibiotic-resistant bacteria like Pseudomonas aeruginosa are a major threat, especially for immunocompromised individuals. Initial bacterial attachment, often via lectins, is key to biofilm development. Current adhesion study methods lack the ability to mimic dynamic in vivo conditions. To overcome this, the microchip flow bacterial biofilm assay (MFBA), a novel microfluidic platform, was developed. Using 3D-printed molds, PDMS microfluidic devices with parallel serpentine channels were created. Gravity-driven flow delivers continuous nutrients. Biofilm growth impedes flow, which is tracked by a droplet counter array controlled by an Arduino Mega. The MFBA enables the identification of a "time-to-clog" marker, providing a quantitative measure of biofilm formation under flow.

Project Snapshot

1. MFBA mimics body environment, enabling continuous flow biofilm adhesion studies, better than static assays.
2. Droplet counter enables real-time biofilm monitoring via flow rate changes from clogging.
3. "Time-to-clog" marker aids drug discovery for anti-biofilm adhesion strategies.



The Microchip Flow Bacterial Biofilm Assay (MFBA) and Time-to-clog Marker

Salinomycin analogs for triple-negative breast cancer therapy

TEAM MEMBERS
Rowan Elgendy

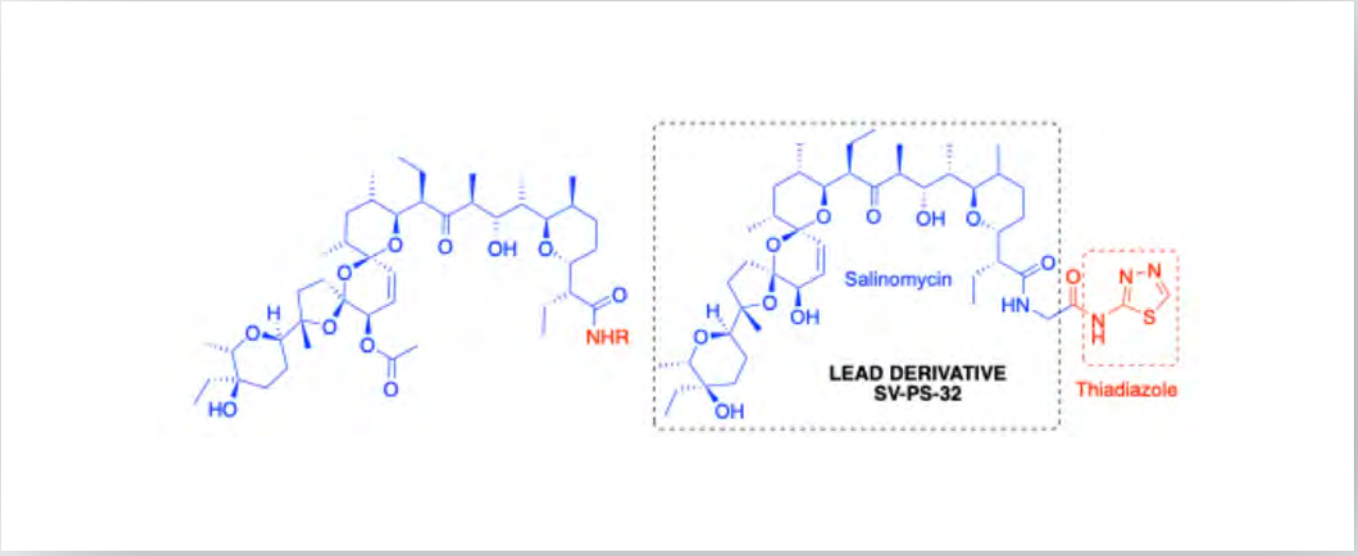
PROJECT MANAGERS
Subash Jonnalagadda, Christopher Matarazzo, Manoj Pandey (CMSRU)

SPONSORS
New Jersey Health Foundation, Tharimmune, LLC, Channel Therapeutics

Biofilms of antibiotic-resistant bacteria like Pseudomonas aeruginosa are a major threat, especially for immunocompromised individuals. Initial bacterial attachment, often via lectins, is key to biofilm development. Current adhesion study methods lack the ability to mimic dynamic in vivo conditions. To overcome this, the microchip flow bacterial biofilm assay (MFBA), a novel microfluidic platform, was developed. Using 3D-printed molds, PDMS microfluidic devices with parallel serpentine channels were created. Gravity-driven flow delivers continuous nutrients. Biofilm growth impedes flow, which is tracked by a droplet counter array controlled by an Arduino Mega. The MFBA enables the identification of a “time-to-clog” marker, providing a quantitative measure of biofilm formation under flow.

Project Snapshot

1. Salinomycin potently inhibits breast cancer stem cells, exceeding Paclitaxel for targeted TNBC therapy.
2. Salinomycin’s unclear anticancer mechanism offers novel therapeutic pathway research.
3. Rational drug design of salinomycin analogs enables SAR studies for improved anti-TNBC agents.



Investigating Piezoelectric Properties in Resorbable Vascular Grafts

TEAM MEMBERS
Isabella Frangiosa

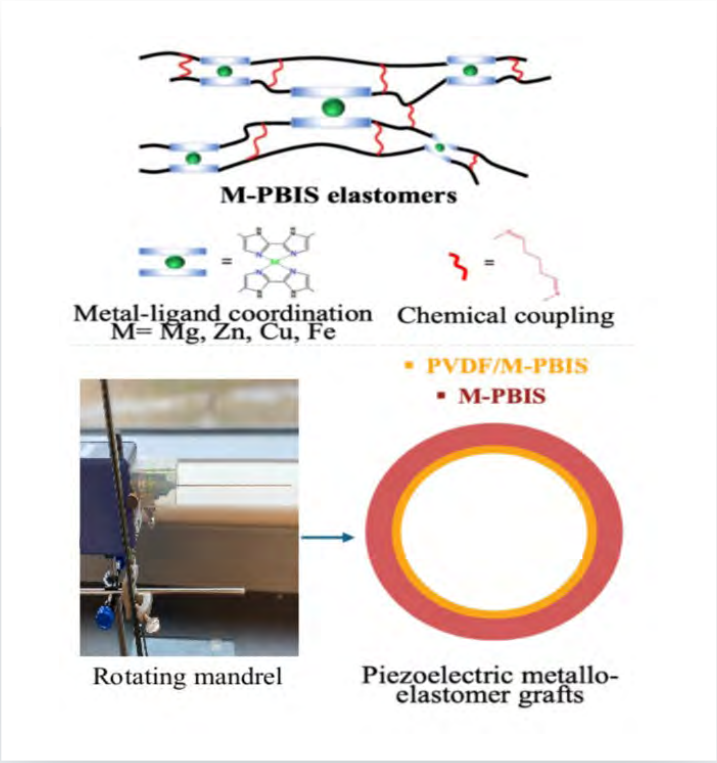
PROJECT MANAGERS
Ying Grace Chen, Emily Kopchick

Cardiovascular disease demands better treatments than current non-degradable vascular grafts, which often fail in small vessels due to complications. 1 Bioresorbable grafts offer hope by encouraging the body to regenerate arteries, but their complex creation and performance issues hinder widespread use. Our research explores a novel approach: incorporating piezoelectric properties into resorbable metallo-elastomer vascular grafts. 2 We hypothesize that the electrical signals generated by these grafts under blood flow will mimic the natural vascular environment, boosting cell activity crucial for repair. Our study aims to understand how this piezoelectric stimulation improves endothelial cell alignment, maturation, and anti-thrombotic characteristics within these new grafts. 2 We are developing biocompatible metallo-elastomers with adjustable degradation and mechanical properties, fabricating grafts via electrowriting, and will evaluate the piezoelectric effects in living organisms.

Project Snapshot

1. Research addresses low patency in small vascular grafts, a major clinical challenge with limited solutions.

2. Novel resorbable metallo-elastomers with piezoelectricity



Resorbable Metal-Elastic Vascular Graft with Cell Reservoir

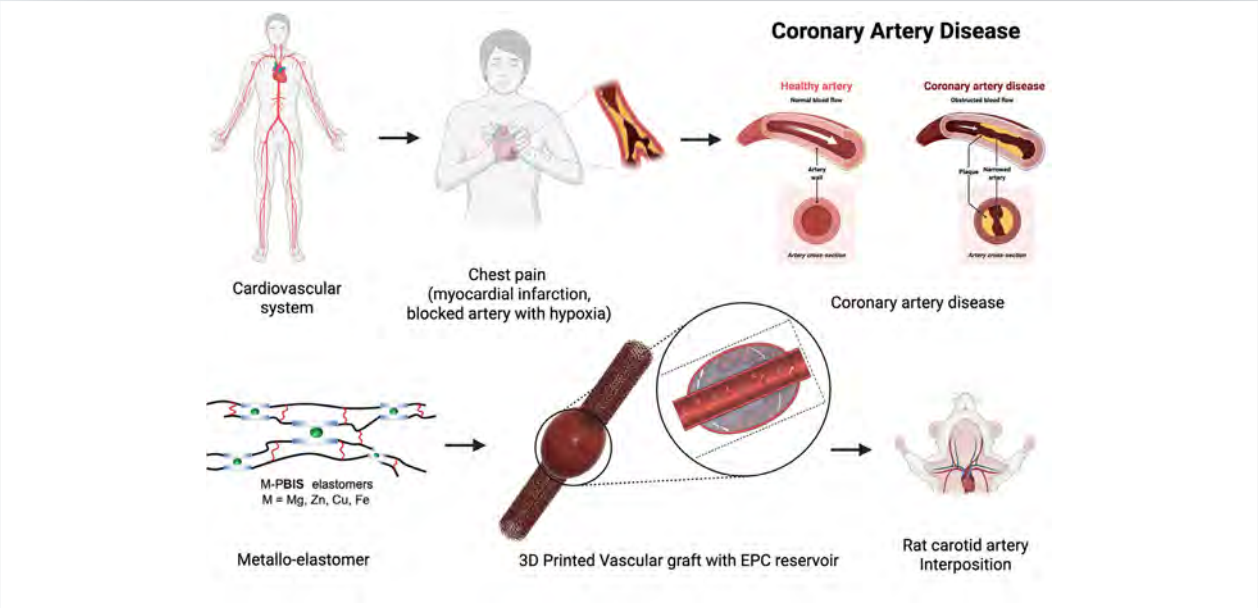
TEAM MEMBERS
Michael DeMelas

PROJECT MANAGERS
Ying Grace Chen, Yusuf Asad

Cardiovascular diseases necessitate improved vascular grafts due to the limitations of current synthetic options in small-diameter vessels. This study introduces biodegradable metallo-elastomers for fully resorbable grafts with tunable properties. The hypothesis centers on the host body acting as a bioreactor, enabling graft remodeling as degradation aligns with new tissue growth. The research involves synthesizing and characterizing these novel materials, creating porous scaffolds, and integrating an endothelial progenitor cell (EPC) reservoir within the graft's albumen. In vivo testing using a rat carotid artery model will evaluate remodeling and regeneration. The ultimate aim is a bioresorbable graft that mirrors autograft performance, overcoming their donor limitations through host-driven regeneration.

Project Snapshot

1. Biodegradable metallo-elastomers offer a promising route for fully resorbable vascular grafts.
2. Host bioreactor concept synchronizes graft breakdown with new vessel growth.
3. EPC reservoir seeks to improve synthetic graft integration and long-term function.



Utilizing a Novel 3D Printed Elastomer for Enhanced Myocardial Repair

TEAM MEMBERS
Jacob Buler, Aaryan Deshpande

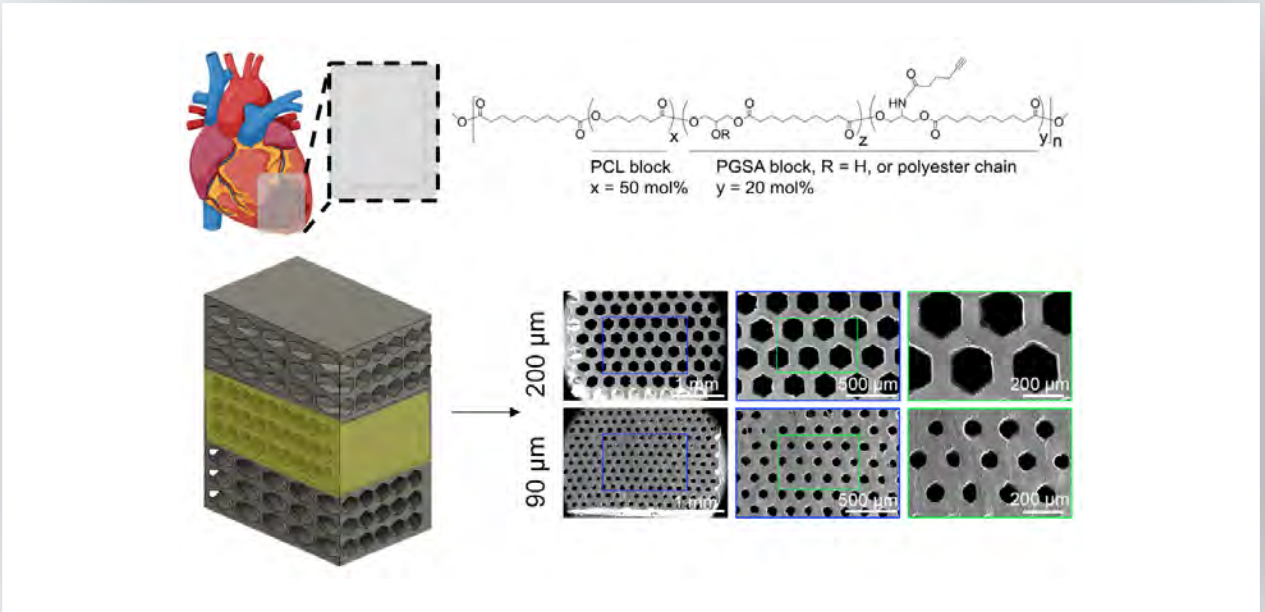
PROJECT MANAGERS
Ying Grace Chen, Narangerel Gantumur

Myocardial infarction damages heart muscle due to limited regeneration. We introduce a novel 3D-printed cardiac patch scaffold for improved repair. Utilizing digital light processing, this approach allows personalized treatment. The PCL50-PGSA20 (PA) elastomer combines PCL's strength, PGS's elasticity and biocompatibility, and alkyne-serinol's customizability, making it ideal for biomedical applications. DLP printing enables reliable scaffolds tailored to physiological needs. This material forms 90$_3$m pores, stretches to 100%, and promotes endothelial cell proliferation, indicating its potential in biomaterial development.

Project Snapshot

1. PA elastomer combines PCL, PGS, and alkyne-serinol for versatile biomedical uses like cardiac patches.

2. DLP 3D printing creates custom cardiac patches, offering personalized myocardial infarction repair.



Investigating glial phagocytosis in neurodegenerative disease

TEAM MEMBERS
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PROJECT MANAGERS
Maggie Panning Pearce, Graham H. Davis,
Kirby M. Donnelly (Saint Joseph's University)

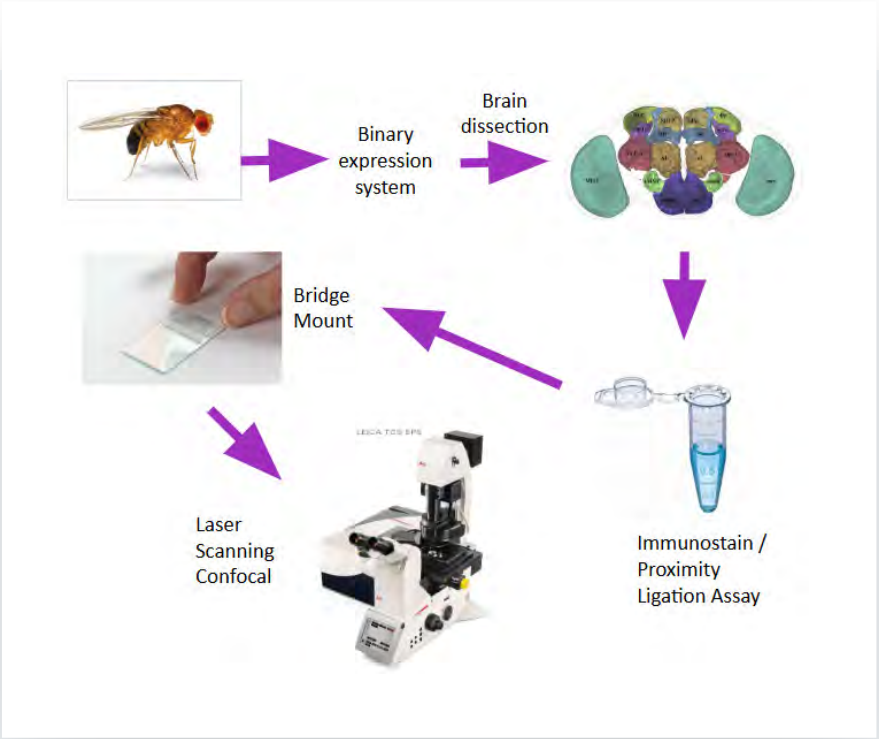
SPONSORS
National Institute of General Medical Sciences,
National Institutes of Health

Neurodegenerative diseases like Alzheimer's and Huntington's, characterized by toxic protein aggregates and neuron loss, lack cures. Evidence suggests prion-like spread of misfolded proteins between cells contributes to disease. Our lab showed glial receptor Draper/MEGF10 mediates mutant huntingtin (mHTT) spread in Drosophila. Draper loss increased mHTT buildup, and neuronal mHTT triggered aggregation in neighboring cells, indicating glial involvement. This mechanism may be shared across neurodegenerative diseases, including tau pathology in AD. We are investigating how misfolded human tau spreads between fly brain cells using co-expression and proximity ligation assays to understand its role in disease progression.

Project Snapshot

1. Prior Drosophila findings show Draper/MEGF10 glial receptors mediate mHTT spread, suggesting glia actively propagate toxic aggregates.

2. Drosophila assays with tagged tau and proximity ligation aim to reveal misfolded tau's cell-to-cell transmission in tauopathies.



Optimizing LNPs for siRNA delivery in immunotherapy

TEAM MEMBERS
Jacqueline Resensburger

PROJECT MANAGERS
Rachel Riley, Liza Guner

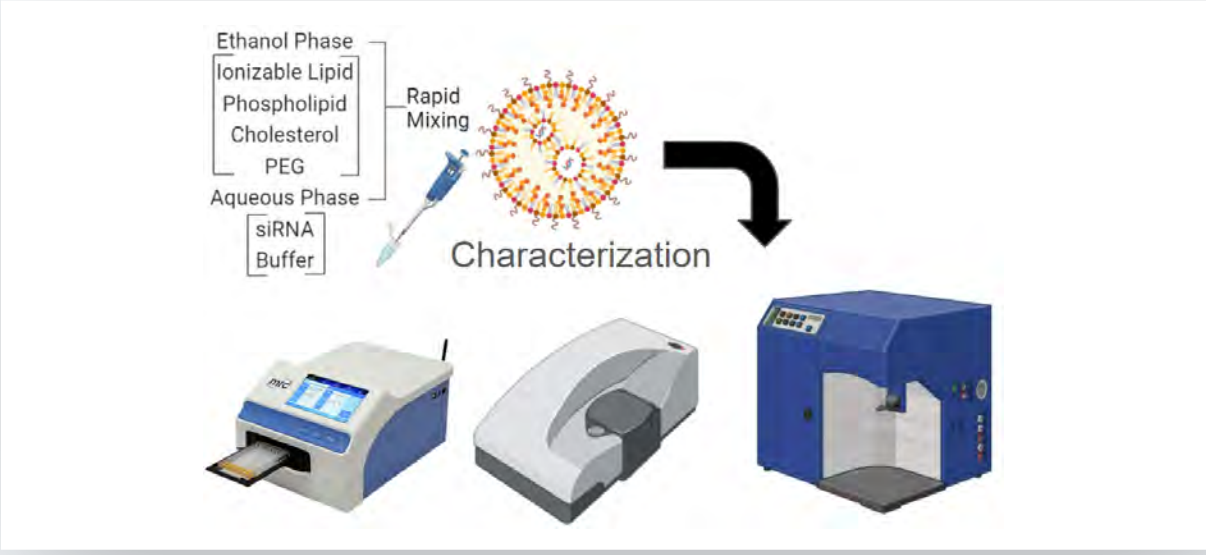
SPONSORS
The New Jersey Department of Health,
New Jersey Commission on Cancer Research

Pediatric acute myeloid leukemia (AML), despite a 70% survival rate, carries a significant relapse risk of 25-35%, highlighting the limitations and invasiveness of current treatments like bone marrow transplantation and chemotherapy. My clinic project aims to develop a novel, non-invasive therapeutic approach using lipid nanoparticles (LNPs) to deliver silencing RNA (siRNA) targeting the Wilms' Tumor 1 (WT1) gene, a key driver of AML cell growth. By inhibiting WT1 expression, we hypothesize a reduction in cell proliferation and survival. My role involves formulating various LNPs by adjusting ingredient ratios in ethanol and aqueous phases. These LNPs are characterized for size via dynamic light scattering and siRNA encapsulation efficiency using Ribogreen assays. In vitro studies on AML cells will assess LNP uptake through flow cytometry and visualize WT1 knockdown, potentially paving the way for precise and improved pediatric AML treatment.

Project Snapshot

1. The development of a non-invasive, targeted therapy using LNPs offers a significant advantage over current highly invasive treatments for pediatric AML.

2. Silencing the WT1 gene, a known oncogene in AML, presents a precise strategy to inhibit cancer cell growth and potentially reduce relapse rates



Immunomodulatory LNPs for reproductive health therapies

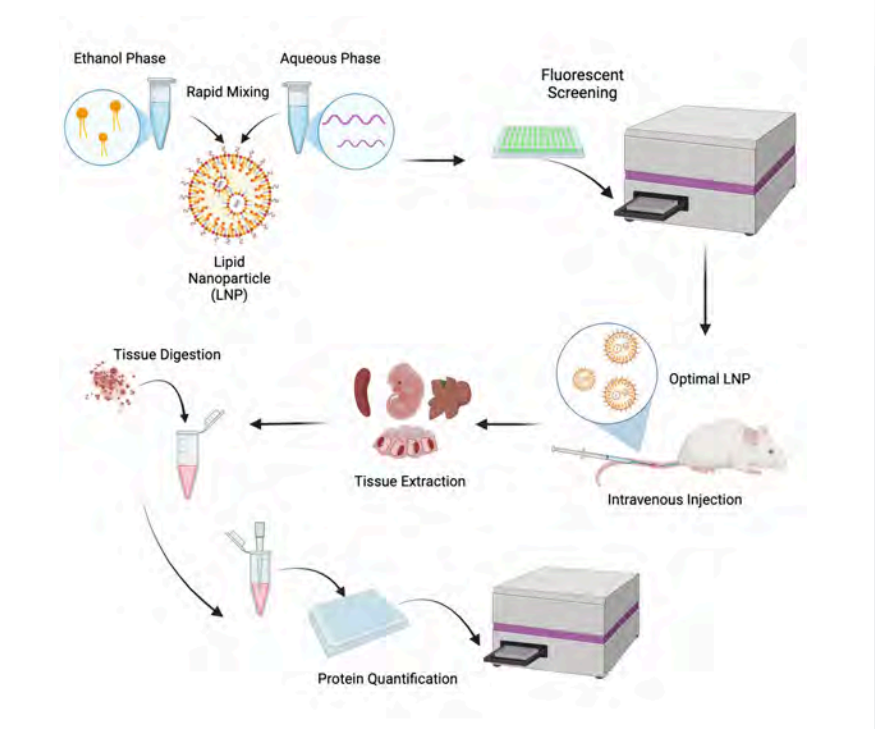
TEAM MEMBERS
Nia Bellopede

PROJECT MANAGERS
Rachel Riley, Samuel Hofbauer

Our lab is developing lipid nanoparticles (LNPs) to address pregnancy complications like preeclampsia and cancers like endometrial cancer. Preeclampsia, marked by high blood pressure, is linked to aberrant placental inflammation. We are engineering LNPs for localized immunomodulation at the maternal-fetal border. For endometrial cancer, a leading cause of female cancer deaths with downregulated p53, we're creating LNPs to inhibit MDM2, an upstream driver, aiming to restore p53 expression and induce tumor cell death. In my clinic project, I quantified nucleic acid delivery using ELISAs and characterized LNP libraries to understand how nanoparticle design impacts in vivo delivery to cells and tissues. This work is crucial for the progress of both projects, supporting the development of LNP platforms for treating preeclampsia and endometrial cancer.

Project Snapshot

1. LNP library design and analysis linked structure to targeted nucleic acid delivery in vivo.
2. ELISAs quantified delivered nucleic acids, crucial for assessing LNP efficacy in preeclampsia and endometrial cancer projects.



New ionizable lipids boost mRNA delivery via LNPs

TEAM MEMBERS
Diya Patel

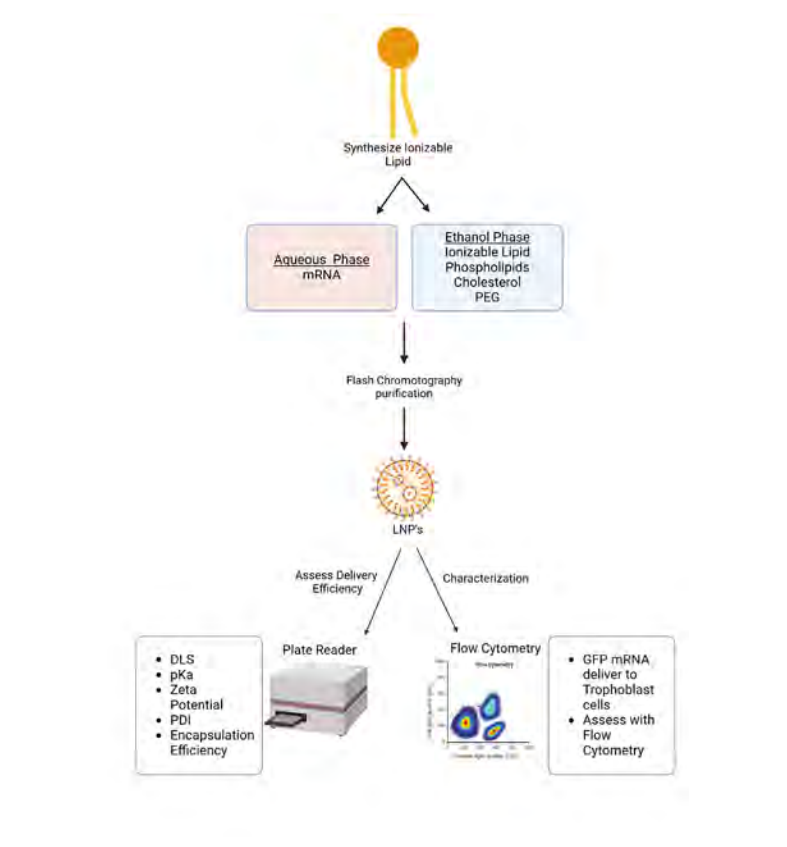
PROJECT MANAGERS
Rachel Riley, Joshua Yang

SPONSORS
National Science Foundation,
New Jersey Department of Health

My work centers on developing improved lipid nanoparticles (LNPs) for nucleic acid delivery, particularly mRNA. LNPs, composed of phospholipids, PEG, cholesterol, and crucial ionizable lipids, facilitate pH-responsive and efficient cellular delivery. I synthesized LNPs with diverse ionizable lipids and characterized their properties using DLS for size and stability, zeta potential for surface charge, Ribogreen assays for encapsulation, and TNS fluorescence for apparent pKa. Flow cytometry assessed cellular uptake. These investigations into structure-function relationships will enable the creation of novel, proprietary LNPs. This advancement holds significant potential for treating various conditions, including pregnancy-related diseases and cancer, by optimizing nucleic acid delivery.

Project Snapshot

1. Novel ionizable lipid design optimizes pH response in LNPs for enhanced nucleic acid delivery.
2. LNP characterization (DLS, zeta, etc.) linked properties to cellular uptake.
3. Proprietary LNPs for pregnancy and cancer show high therapeutic potential in critical unmet needs."



Ultrasound for Post-Hysterectomy Clip Closure Monitoring

TEAM MEMBERS
Christopher Iuliucci

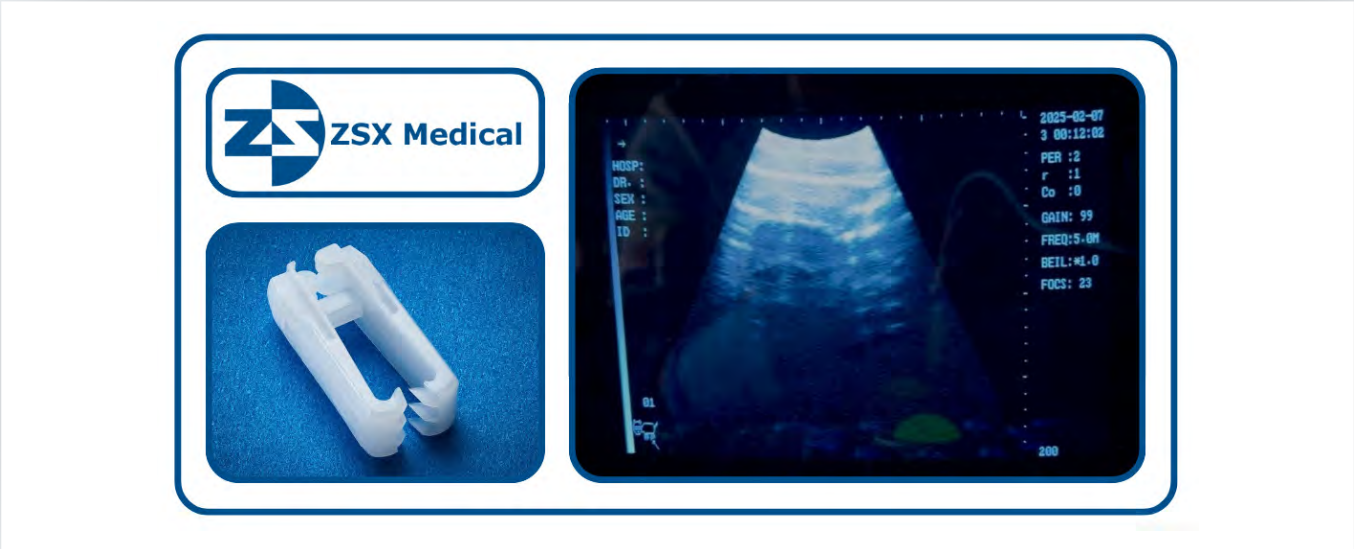
PROJECT MANAGERS
Dan Mazzucco

SPONSORS
ZSX Medical

This project investigates the effectiveness of ultrasound in monitoring the placement and stability of ZSX Medical's innovative clip closure system following a hysterectomy. Aiming to validate this efficient alternative to challenging laparoscopic suturing, the experiment will assess ultrasound's ability to confirm proper clip placement and track its integrity over time. This research will cultivate crucial skills in experimental design, testing, and validation, vital for advancing medical technologies. By exploring ultrasound's role in real-time monitoring, the project seeks to provide valuable insights into improving surgical outcomes and ensuring patient safety post-procedure. Ultimately, the successful demonstration of ultrasound's monitoring capabilities will bolster the case for ZSX Medical's clip closure system as a reliable and minimally invasive option.

Project Snapshot

1. Real-time ultrasound confirms clip placement and detects issues instantly.
2. Exploring non-invasive monitoring for long-term clip closure security without re-surgery.
3. Exploring simpler vessel closure in laparoscopic hysterectomies vs. suturing."



PDO clip degradation analysis for failure prediction

TEAM MEMBERS
Leeza Kumar, Miral Rawy

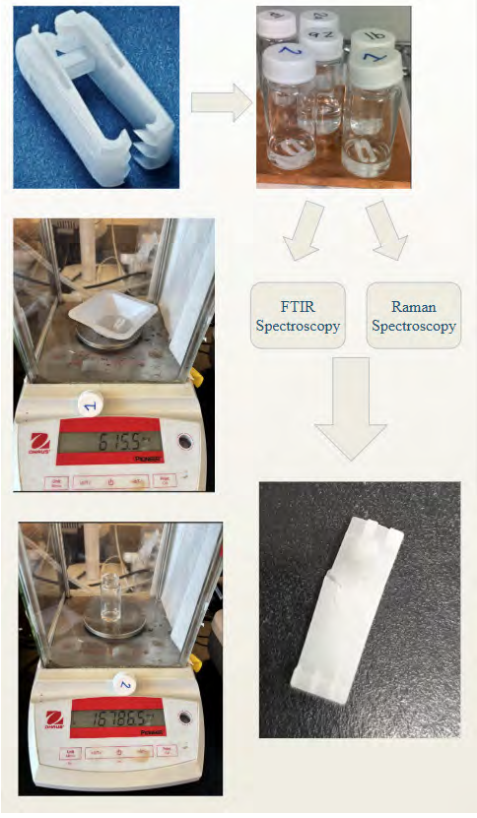
PROJECT MANAGERS
Dan Mazzucco, Matthew Flamini (ZSX Medical)

SPONSORS
ZSX Medical

ZSX Medical's PDO clips degrade during storage, affecting their mechanical strength. We are investigating this through combined mechanical and chemical analyses to predict failure. Initial three-point bend tests provided a baseline. FTIR and Raman spectroscopy were identified as key chemical methods, with a preliminary five-week saline study showing FTIR's utility. A current 15-day study subjects identical clips to simultaneous FTIR and mechanical testing. We hypothesize that gradual chemical degradation precedes abrupt mechanical failure. By correlating these datasets, we aim to establish degradation thresholds and identify early chemical indicators of mechanical failure. This research will inform improved storage conditions and enhance the reliability of these medical devices.

Project Snapshot

1. Real-time FTIR with mechanical data on devices predicts performance effectively.
2. Investigating the link between PDO clip degradation and sudden structural failure.
3. Leading chemical indicators could revolutionize medical device QC and storage.



OpenCap movement measures: validity and reliability.

TEAM MEMBERS
Crystal Johnson, Antonio Sparacio, Kayley Lynch

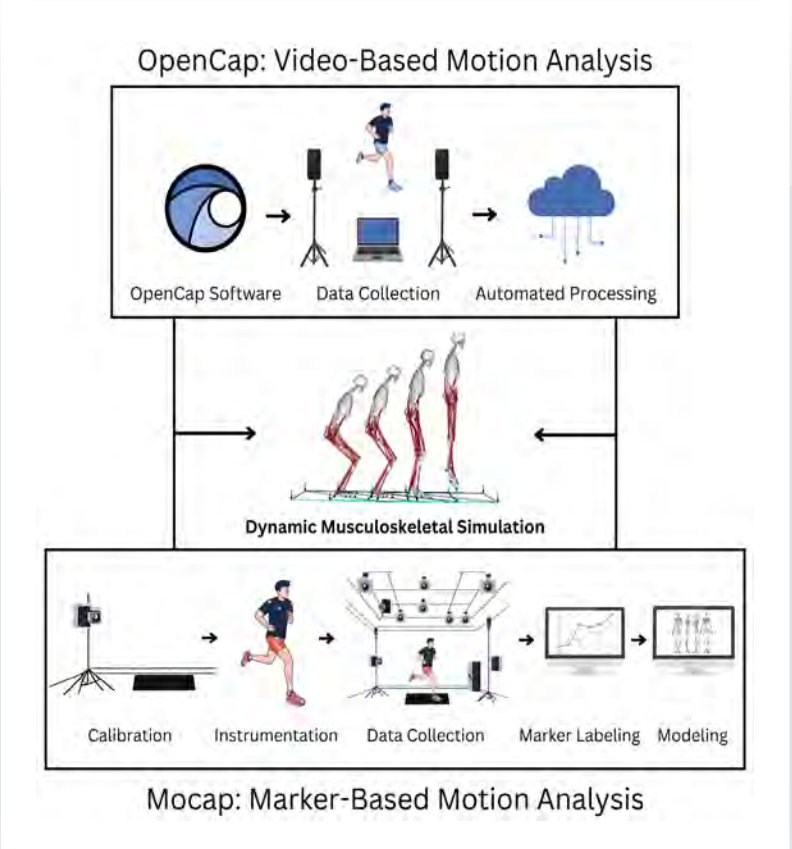
PROJECT MANAGERS
Dan Mazzucco, Reza Koiler (CBE Consultants, Inc.)

SPONSORS
CBE Consultants, Inc.

Traditional marker-based motion capture, the gold standard, suffers from high costs, complexity, and lab-bound limitations, hindering real-world use. OpenCap, a free smartphone app, offers a novel markerless alternative using deep learning to predict 3D kinematics and kinetics from smartphone videos. This study validates OpenCap's accuracy and reliability against a 10-camera optical system and force plates across complex movements like hopping, lifting, throwing, and startle reactions. The research addresses the need for affordable, accessible motion capture, potentially revolutionizing biomechanics and expanding its use in clinics, athletic training, and occupational health.

Project Snapshot

1. OpenCap democratizes motion capture, lowering cost and complexity for real-world biomechanical analysis.
2. Evaluating OpenCap's accuracy across diverse dynamic movements.
3. Deep learning on phone video predicts movement and force data, enabling markerless biomechanics.



Polymer drag reduction in blood: a quantitative analysis

TEAM MEMBERS
Adam Boberick

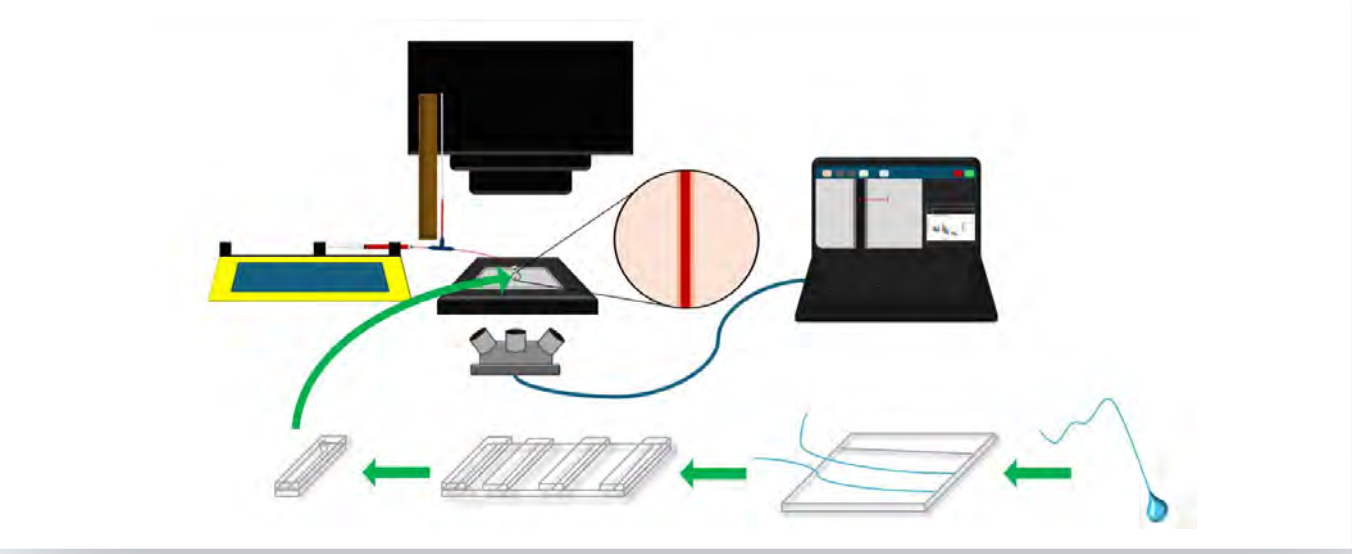
PROJECT MANAGERS
Peter Galie, Louis Paone

SPONSORS
New Jersey Department of Health Commission on Spinal Cord Research

This study investigates how long-chain polymers like PEO and HA affect the flow of whole blood in microcapillaries, mimicking the microvascular environment. Microscale cylindrical channels (30-80 $_3$m) were created in PDMS and perfused with whole blood at varying polymer concentrations (0 ppm, 10 ppm, 100 ppm). Brightfield microscopy was used to observe red blood cell (RBC) behavior. Initial observations suggested that higher polymer concentrations led to a more even distribution of RBCs and a smaller cell-free layer, hinting at drag reduction. To quantify this effect, future work will involve measuring pressure drop and channel resistance across the microchannels at different polymer concentrations. This platform offers a non-invasive method to assess the drag-reducing capabilities of polymers for potential biomedical applications.

Project Snapshot

1. Polymer microadditions significantly alter blood flow in microchannels.
2. Quantitative pressure/ resistance measures will strengthen drag reduction evidence over visual observation
3. Polymer drag reduction offers new blood flow improvement strategies in biomedicine.



3D-printed parts optimize Leica DM IRB microscope repair

TEAM MEMBERS
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PROJECT MANAGERS
Peter Galie

SPONSORS
New Jersey Department of Health Commission on Spinal Cord Research

Microscope maintenance is often hindered by wear or obsolete parts. This project explored 3D printing for repair and optimization using custom inserts and replacements. Additive manufacturing enabled replication and modification of components for improved fit and durability. The study assessed 3D-printed parts' material properties, accuracy, and performance against original standards. 3D printing offers a rapid, cost-effective alternative to expensive or unavailable replacements, extending the life of lab equipment. Beyond repair, this work demonstrates 3D printing's potential in customizing biomedical devices and its role in precision engineering. The findings show additive manufacturing is a practical tool for scientific equipment maintenance, providing insights into printed component tolerances and usability in research. This highlights the growing importance of 3D-printed solutions in labs, paving the way for advanced materials and structural optimization for biomedical tools.

Project Snapshot

1. Cost-effective, rapid alternative to sourcing pricey/unavailable microscope parts.
2. 3D printing: Beyond repairs, customizing and improving biomedical devices.

Optics in BME | Widefield Microscopy

TEAM MEMBERS
Joseph Rosa

PROJECT MANAGERS
Peter Galie, Ashley Sweeney (Edmund Optics), Becca Charboneau (Edmund Optics)

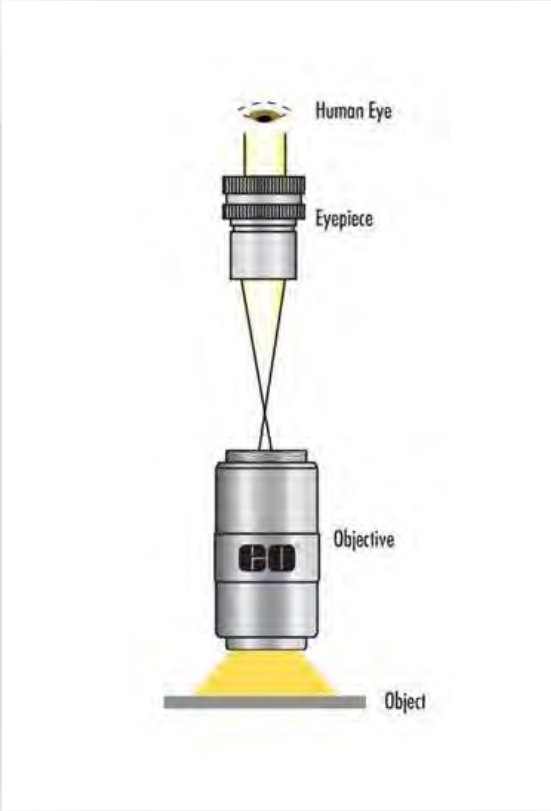
SPONSORS
Edmund Optics

Widefield microscopy (WFM) enables rapid, high-throughput imaging with high resolution, crucial for digital pathology and cell documentation. However, high numerical apertures and short working distances can introduce spherical and chromatic aberrations. These distortions arise from sharp light bending and varying focal lengths for different wavelengths. ISO standards 19012-1 and -2 define correction parameters for these aberrations in objective lenses. Immersion liquids, with refractive indices higher than air, can also mitigate spherical aberration by reducing the degree of light bending required, leading to improved image quality.

Project Snapshot

1. Immersion liquids boost image quality by lessening spherical aberration. They minimize light bending from refractive index differences.

2. Special objective lenses correct spherical and chromatic aberrations (ISO 19012-1/-2).



Breaking Barriers in Bone Repair

TEAM MEMBERS
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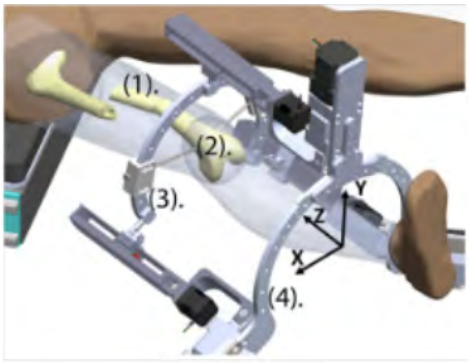
PROJECT MANAGERS
Mohamed Abedin-Nasab

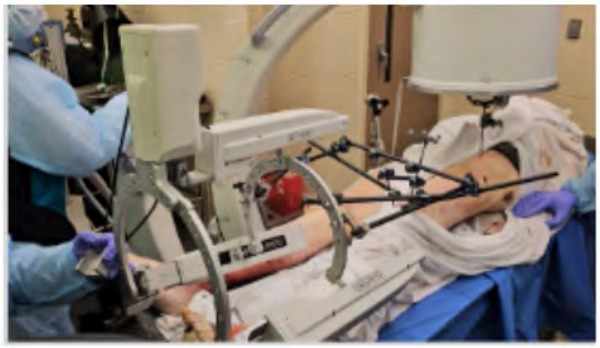
SPONSORS
National Institute of Health, National Science Foundation

The femur bears upper body weight and enables walking. Its surrounding vessels and muscles are crucial for ambulation and circulation. Femur fractures risk severe bleeding, tissue damage, and malunion after surgical reduction, occurring in up to 28% of cases due to surgeon fatigue, bone fragments, and age. Robossis, a surgical robot for orthopedic trauma, aims to assist surgeons by mechanically aligning and maintaining femur fragment alignment during surgery. This reduces surgeon fatigue and improves alignment accuracy, potentially decreasing the need for revision surgeries.

Project Snapshot

1. High femur fracture malunion (up to 28%) poses a major surgical challenge for alignment.
2. Robossis mechanically aligns bones, eliminating surgeon fatigue and addressing malunion's root causes.
3. Robossis: fewer repeat surgeries, better patient outcomes, lower healthcare burden.





CRIPTO in Prostate Cancer: Gene Expression Analysis

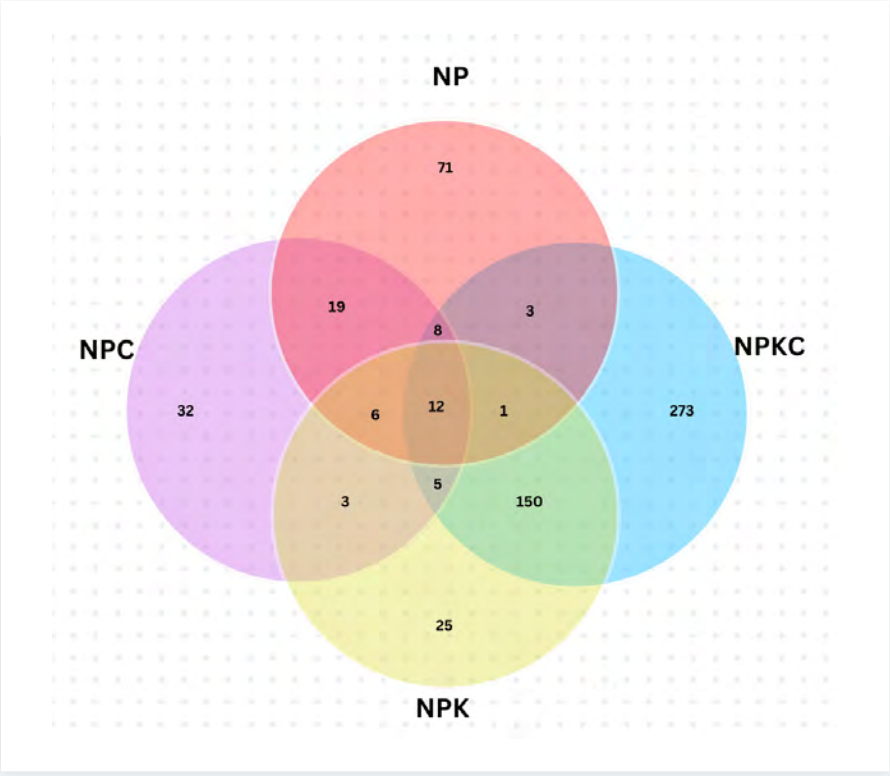
TEAM MEMBERS
Tiago Monteiro

PROJECT MANAGERS
Mary Staehle, Dipon Roy

CRIPTO, a crucial protein in early embryonic development for cell differentiation, self-renewal, and fate decisions, typically diminishes after this stage. However, its overexpression in cancer, including prostate cancer (PCa), promotes cell proliferation, tumor progression, and metastasis by inducing epithelial-mesenchymal transition. In PCa, CRIPTO has been associated with prostate-specific antigen (PSA) progression, potentially influencing cancer development. To understand this relationship, a transcriptomic analysis will compare gene expression in PCa samples with and without CRIPTO upregulation. Identifying differentially expressed genes could reveal the distinct or shared molecular mechanisms triggered by PSA and CRIPTO in PCa, offering valuable insights for targeted therapies and improved treatment strategies.

Project Snapshot

1. CRIPTO: key developmental protein; oncogenic driver when overexpressed in cancer
2. CRIPTO overexpression linked to PSA progression in prostate cancer. Synergistic effect suggested.
3. Unraveling CRIPTO in PCa via transcriptomics for new therapies.



Multi-omics prediction of cervical cancer immunotherapy response

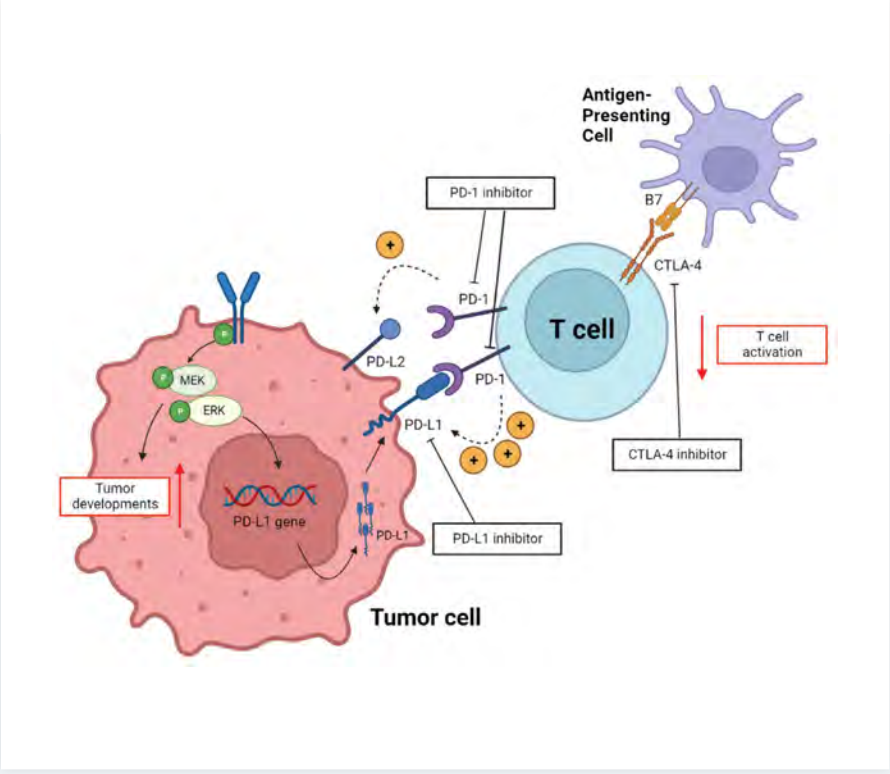
TEAM MEMBERS
Elizabeth Vu

PROJECT MANAGERS
Mary Staehle, Dipon Roy

Cervical cancer, a leading cause of female cancer mortality, shows promise with immune checkpoint inhibitors (ICIs) that empower the immune system to target tumors. However, predicting patient response to ICIs remains a challenge. This study leverages multi-omics data from TCGA-CESC and immunotherapy-treated cohorts to identify immune activation patterns and gene expression changes. Our goal is to discover immune-related biomarkers that can predict ICI response and inform personalized treatment strategies for cervical cancer by understanding how immune pathways impact the disease at a transcriptomic level.

Project Snapshot

1. Immune checkpoint inhibitors: A targeted immunotherapy for cervical cancer.
2. Predicting ICI response in cervical cancer using multi-omics for personalized treatment.
3. Unlocking immunotherapy resistance: Gene expression and immune biomarkers for new strategies.



Goniotape: Patient monitoring for enhanced post-op recovery

TEAM MEMBERS
Caeley Shorr, Madeline Dunsmore

PROJECT MANAGERS
Erik Brewer

SPONSORS
Goniotape

US hip and knee replacement demand will surge by 2030, with revisions increasing dramatically (hips 137%, knees 601%). Low rehabilitation adherence (64%) may contribute to these high revision rates. To improve compliance, we developed Goniotape, a wearable device monitoring post-operative movement restrictions.

Goniotape uses two IMUs and Arduino software to precisely track joint angles via accelerometer data. Dynamic testing showed an average error of 10° compared to motion-tracking software. With calibration, Goniotape can provide real-time patient feedback, potentially increasing rehabilitation adherence and reducing revision surgeries for better patient outcomes.

Project Snapshot

1. The projected 601% rise in knee revisions by 2030 signals a major healthcare challenge.
2. Goniotape improves rehab compliance with tangible, real-time feedback.
3. Device's 10° average error in joint angle tracking shows reliable monitoring potential.

QL+ Ankle Brace to Support Wounded Veteran

TEAM MEMBERS
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PROJECT MANAGERS
Erik Brewer

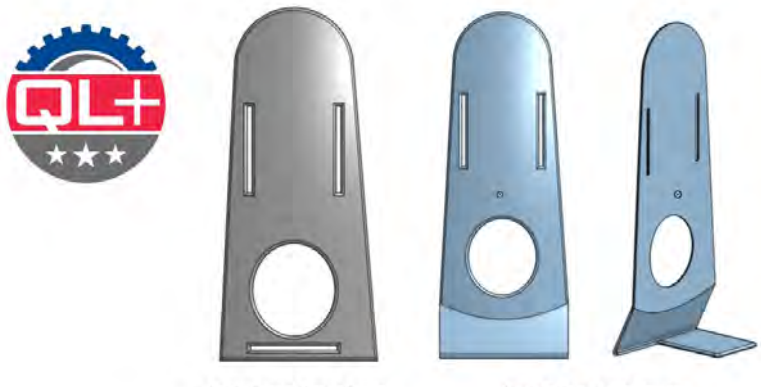
SPONSORS
Quality of Life Plus

The severity of which the ligaments in the ankle can tear raises questions about the structural integration of ankle braces on the market. Which can cause injuries of the ankle that can lead to problems of mobility, independence, and overall quality of life. This project aims to deliver a novel ankle brace with a slim design that provides support, comfort, and stability. The brace utilizes an ergonomic design composed of stainless steel/carbon fiber, soft foam padding, and Velcro straps to maximize protection against ankle inversion and compatibility with any show model. Our verification test aims to analyze the structural integrity and comfort of the brace to ensure it meets performance standards. The ultimate main goal is to restore a sense of freedom, stability, and support to wounded veterans, improving their mobility and quality of life.

Project Snapshot

1. Novel stainless steel/ carbon fiber with soft foam uniquely balances robust ankle support and user comfort.

2. Restoring mobility for wounded veterans highlights this project's societal impact and addresses a critical need through innovative design.



Artificial Intelligence for Improved EMS Decisions

TEAM MEMBERS
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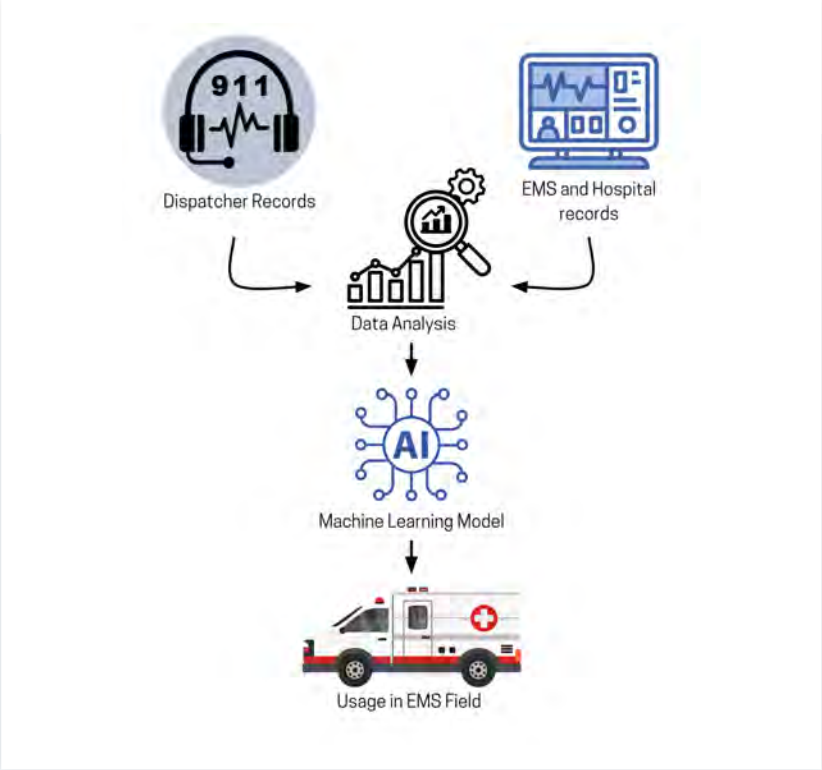
PROJECT MANAGERS
Erik Brewer, Alfred Sacchetti (Virtua Health),
Bruce Graham (Virtua Health), James Newman (Virtua Health),
Mark Chapman (Inspira Health),
Eric Hicksen (NJ Department of Health Grant Organization)

SPONSORS
New Jersey Health Foundation

EMS transport decisions significantly impact outcomes in emergencies like OHCA and EGS. Misidentification and suboptimal hospital choices increase mortality. Limited by time and resources, EMS triage can be enhanced. This project analyzed retrospective EMS and hospital data to find correlations between prehospital decisions and patient outcomes. Factors like dispatch info and on-scene assessments were examined to identify protocol inefficiencies. A machine learning model will be developed to predict patient criticality and suggest optimal transport. This AI aims to reduce misidentifications, improve resource allocation, and enhance patient survival and healthcare efficiency.

Project Snapshot

1. AI guides real-time critical transport via past EMS/ hospital data
2. Uncover EMS protocol blind spots: ML finds outcome correlations
3. AI: better triage, fewer errors, saves lives and resources



Injectable hydrogel expulsion studies for disc disease

TEAM MEMBERS
Sarah Little, Srithan Gayam

PROJECT MANAGERS
Erik Brewer, Zachary Brown (ReGelTec)

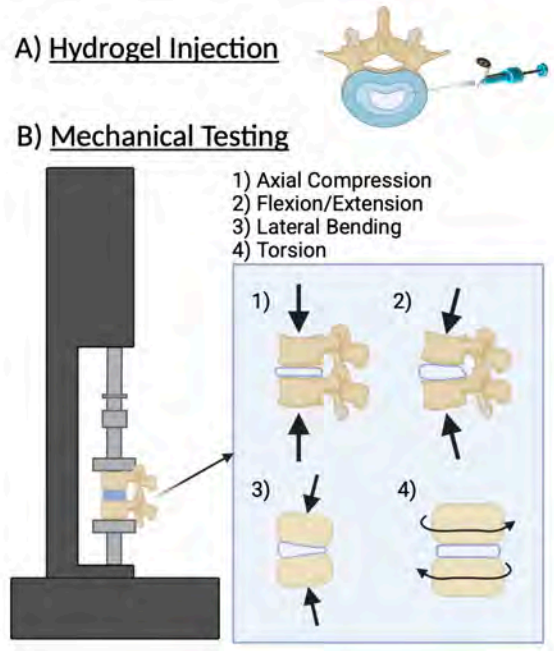
SPONSORS
ReGelTec Inc.

Degenerative Disc Disease (DDD), a major cause of chronic back pain, lacks minimally invasive solutions. ReGelTec's HYDRAFIL, an injectable hydrogel, aims to provide structural support and pain relief. This study assesses HYDRAFIL's retention within bovine intervertebral discs under physiological loads (axial compression, torsion, bending) using specialized fixtures mimicking in vivo conditions. Evaluating hydrogel stability under mechanical stress is crucial to determine expulsion risk before human trials. This research validates HYDRAFIL's potential as a durable, non-surgical DDD treatment, informing future studies and regulatory pathways for a transformative therapy.

Project Snapshot

1. Specialized fixtures mimic complex spinal movements on bovine tails, assessing HYDRAFIL's stability

2. Bridging the gap from in vitro to in vivo, this preclinical research paves the way for human DDD trials



Compressor cooled prosthetic socket for limb overheating

TEAM MEMBERS
Sierra Finn, Nicholas Raylman, Ty walker

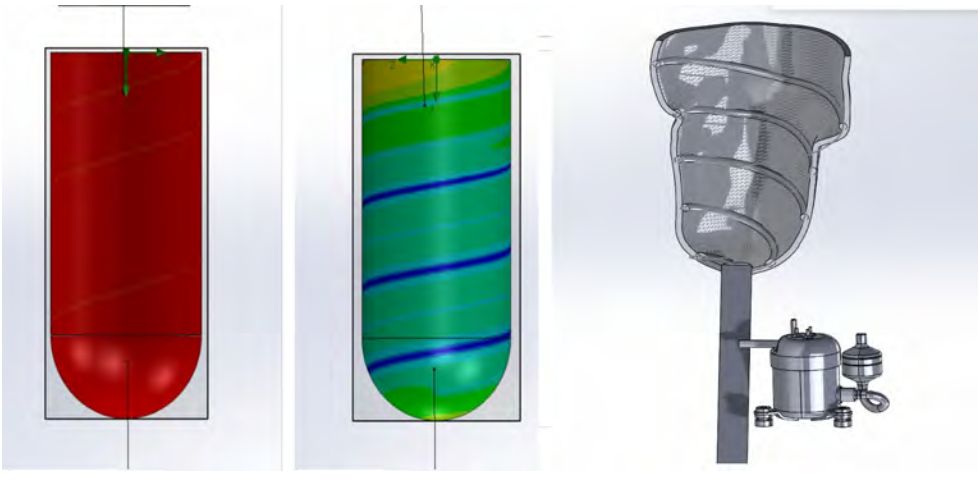
PROJECT MANAGERS
Erik Brewer

SPONSORS
QL+

Amputations, affecting millions, severely impair mobility and self-image. Lower limb prosthetics aid mobility but often cause overheating due to poor ventilation, leading to discomfort and potential slippage. The Rowan team developed a refrigerated prosthetic socket to address this. Their design uses a compressor to circulate cooling R134a fluid through copper tubing embedded in the socket. This absorbs heat from the amputated limb, and the system recirculates the cooled fluid. Simulations suggest a 20°F cooling capacity, effectively managing the average heat output of the thigh. The 350-watt compressor ensures efficient temperature regulation, aiming to improve comfort and the overall prosthetic experience.

Project Snapshot

1. Developed novel refrigerated prosthetic socket using compressor and R134a for active limb cooling
2. Simulations show a significant 20°F cooling capacity, counteracting 10-15W thigh heat
3. 350W cooling suggests efficient temp regulation, mitigating discomfort, irritation, and prosthetic slippage



3D Modeling for Organ Transplant Size Mismatch

TEAM MEMBERS
Todd Mahler, Tanish Jain

PROJECT MANAGERS
Erik Brewer, Nasser Youssef (Virtua Health Transplant Surgery)

SPONSORS
Virtua Organ Transplant Center, New Jersey Health Foundation

Kidney transplant success is hindered by imprecise donor-recipient size matching using current methods. This study proposes 3D modeling from CT scans for accurate anatomical assessment to improve surgical planning and outcomes. A retrospective analysis of past kidney transplants will correlate 3D-modeled size discrepancies with complications like delayed graft function and rehospitalization. Surgeons will evaluate the clinical utility of 3D-printed models. The goal is to establish evidence-based size compatibility thresholds, enhancing surgical precision and organ allocation. This research, a collaboration between Rowan BME and Virtua Health, supported by NJHF funding, may also benefit other organ transplants.

Project Snapshot

1. 3D kidney modeling from CT scans quantifies anatomical mismatches, improving traditional matching methods
2. Investigates kidney size discrepancies' link to post-transplant outcomes (DGF, rehospitalization) for compatibility thresholds

Civil & Environmental Engineering

Bridge Dynamics

TEAM MEMBERS
Taylar Daher, Michael Waldron, Scott Nuss

PROJECT MANAGERS
Adriana Trias, John Vrabel

The vibration of a structure provides substantial information on its condition. Traditional methods for acquiring this information typically require interrupting traffic for sensor installation. This clinic project focuses on evaluating the effectiveness of terrestrial and mobile LiDAR sensors for capturing and characterizing structural vibrations. These proposed sensors collect data remotely. Therefore, the bridge can maintain regular operation during the data collection. The project considers the sensors' accuracy to determine the appropriate framework in which the sensor can be implemented. The outcome of this clinic project provides the initial steps for framework development.

Project Snapshot

1. Structural vibration detection and characterization through remote sensors
2. Effectiveness comparison between terrestrial and mobile laser-based sensors
3. Highlighting benefits, shortcomings, and application scenarios for each technology

Project E3: Energy, Environment and Education

TEAM MEMBERS
Aleksandra Dukleski, Jillian Jankowski, Payton Keblish, Philip Sedalis

PROJECT MANAGERS
Drs. Zhiming Zhang, Kauser Jahan, and Jie Li

SPONSORS
U.S. Environmental Protection Agency (USEPA)

This project aims to educate future generations about environmental. The team has developed a series of educational modules covering air quality monitoring, renewable energy sources, and low-carbon communities. These modules were created using a structured approach that integrates current research, hands-on activities, and age-appropriate discussions to make complex concepts accessible and engaging across different educational levels. The project equipped students with the knowledge and skills needed to understand critical environmental challenges and actively contribute to a sustainable future. Through engagement with K-12 and college students, as well as conference presentations and outreach to local communities, the team continuously evaluates and refines the modules to maximize their impact. Ultimately, this initiative seeks to empower a new generation of environmentally conscious individuals committed to protecting the planet for years to come.

Project Snapshot

1 Educational modules focused on environmental issues were developed Students and local community were empowered with environmental awareness

Green Infrastructure Optimization for Freshwater Protection

TEAM MEMBERS
Andriy Chornopysky, Aidan Mcilhenney, Liam Phillips, Cassandra Glapion

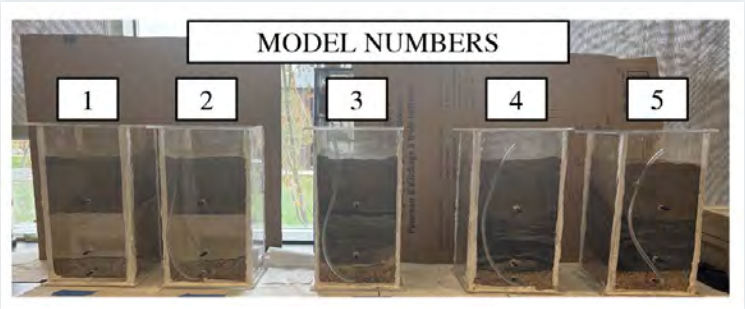
PROJECT MANAGERS
Zhiming Zhang and Kauser Jahan

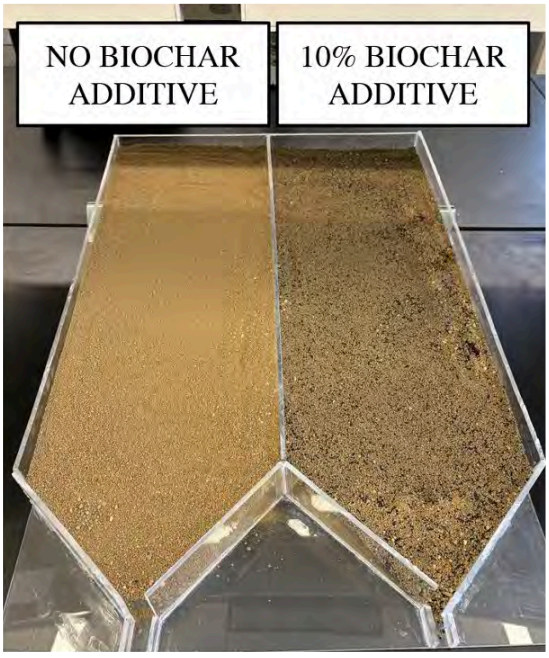
SPONSORS
NJSGC and NJWRRI

Freshwater systems are critically important, providing essential functions for ecosystems, environmental health, and human development. However, despite their significance, more than half of the coastal rivers in the United States are moderately to severely polluted. Stormwater runoff is the primary pathway through which nonpoint source pollution enters these systems. Green infrastructure (GI) and low impact development (LID) offer sustainable approaches to stormwater management by mimicking natural hydrological processes. Features such as rain gardens, bioswales, and riparian buffer strips help reduce stormwater runoff, promote infiltration, and remove pollutants. This project has focused on optimizing GI/LID through targeted amendments to enhance their effectiveness in removing contaminants, such as nutrients, heavy metals, and emerging pollutants like per- and polyfluoroalkyl substances (PFAS), thus ultimately improving water quality and safeguarding downstream ecosystems.

Project Snapshot

1. GI/LID can sustainably reduce runoff and remove pollutants from stormwater GI/LID were optimized to enhance nutrients, metals, and PFAS removal





Identification and Sustainable Removal of PFAS

TEAM MEMBERS
Isabel Guiro, Lauren Walls, Justin Gradski, Thuy Nguyen

PROJECT MANAGERS
Zhiming Zhang and Kauser Jahan

SPONSORS
NJHF and ERDC

Urban stormwater runoff is a major source of non-point pollution, carrying a wide range of contaminants into receiving water. Among these pollutants, per- and polyfluoroalkyl substances (PFAS) are of particular concern due to their persistence, widespread occurrence, and links to adverse health effects. This project provided a deeper understanding of PFAS transport and behavior in stormwater runoff in Trenton and Glassboro, NJ. In parallel, the team evaluated practical treatment strategies for PFAS removal, focusing on the use of drinking water treatment residuals and ion exchange resins. These efforts not only demonstrated the potential of low-cost and sustainable sorbents for PFAS remediation but also contributed to a broader understanding of PFAS fate and mobility in urban hydrological systems. The findings from this project have important implications for stormwater management, environmental risk assessment, and the development of green remediation technologies.

Project Snapshot

1 PFAS in runoff poses health risks due to persistence and widespread presence
This project identified PFAS in stormwater from Trenton and Glassboro, NJ
Low-cost sorbents were tested effective for sustainable PFAS removal

Flood Impact Assessment on Coastal Wastewater Treatment Plants

TEAM MEMBERS
Julia Thornton, Matthew Brown, Wyatt Cervenak

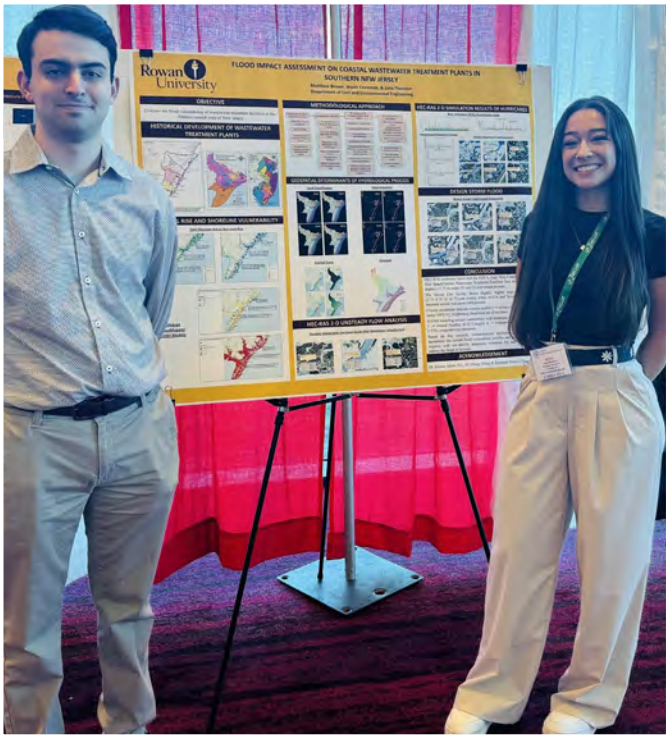
PROJECT MANAGERS
Kauser Jahan and Cheng Zhang

SPONSORS
USDA

The Lower Raritan Watershed in Middlesex County, New Jersey faces heightened flood risks due to its coastal-riverine transition, with a history of severe flooding from Hurricane Irene (2011), Superstorm Sandy (2012), and Tropical Storm Ida (2021). This study quantifies the relative importance of key flood-driving factors using a hybrid approach combining hydrodynamic modeling with neural networks to study impact on wastewater plants. This study combines HEC-RAS hydrodynamic simulations with neural network analysis to rank factors influencing regional flood patterns, and processing inputs including imperviousness, topography, soil characteristics, precipitation, temperature, and drainage indices. Results identify impervious surfaces as the dominant flood driver (32.45%), followed by slope (18.9%), precipitation intensity (14.62%), and soil infiltration capacity (12.36%), with temperature, terrain wetness, and drainage characteristics as secondary factors.

Project Snapshot

1. Student team studied the impact of extreme storm events on coastal wastewater treatment plants in Southern New Jersey
2. Students used conventional models such HEC-RAS to model data
3. Students also investigated impact of sea level rise and shoreline vulnerability



Engineers on Wheels

TEAM MEMBERS
Christian Bogus, Rachel Cohen, Domenick Cats, Anna Sasse

PROJECT MANAGERS
Kauser Jahan

SPONSORS
CATALENT

The foundations of engineering can be introduced early into childhood education with much success. In fact, many school curriculums include engineering education requirements such as the New Jersey Student Learning Standards (NJSLS). With sponsorship from Catalent - a pharmaceutical company based out of Somerset, New Jersey, the Engineers on Wheels program at Rowan University was able to develop new experiments for children of all ages to utilize and implement into the daily classroom and assist in introducing engineering to young minds. For the Fall 2024 and Spring 2025 semester, the Engineers on Wheels team worked with local fourth graders from two Elementary schools. In doing this and receiving feedback from both the instructors and students, the Engineers on Wheels team successfully developed seven experiments, outlines, and relevant worksheets for outreach sessions.

Project Snapshot

1 Students developed hands on activities for K-12 Outreach. Students connected the activities to the New Jersey Student Learning Standards Students went to local elementary schools to promote engineering careers via the developed activities

Intensely Cold Exposure of Young Concrete

TEAM MEMBERS
Ethan Bergmann, Jordan Jeffers, Kenneth Lowry, Joshua Marshall, Ryan Riddle, Jesus Rivera

PROJECT MANAGERS
Gilson Lomboy, William Riddell, Kenneth Fajardo

SPONSORS
ERDC/CRREL

Research demonstrated that concrete with additive-based frost protection (ABFP) can be mixed, cast, and cured at -5 °C while still developing strength comparable to control concrete mixed, cast, and cured at +20 °C. A significant benefit of ABFP concrete is that it eliminates the need for cold-weather protections such as active heating during curing, thus saving construction costs. These investigations will simulate a situation where concrete with ABFP is cast at -5 °C, but an unexpected deep freeze (-10 to -20 °C) occurs shortly thereafter. The research will provide guidance on construction methods and scheduling when adversely cold weather is a concern.

Project Snapshot

1. Studied the effect of the timing of short, low-temperature incursions during curing
2. Compressive strength and static and dynamic modulus were measured
3. The students quantified the damage of low temperatures on young concrete

Microwave Effects on Concrete

TEAM MEMBERS
Patrick Abd, Michael Liberti, Thomas Lambiase, Victor Fernandez, Mason Romeo

PROJECT MANAGERS
Gilson Lomboy, Shahriar Abubakri, Mehdi Roshanbin

SPONSORS
ERDC/CRREL

This project is a novel rapid microwave thermal process to accelerate the demolition, recycling, and repair of concrete structures. The success of the project would revolutionize the repair and maintenance of pavements and highways by introducing new technology with higher efficiency (time and cost) compared to conventional methods and assisting highway agencies in repairing and reopening roads much sooner than current methods. The project aims to apply microwave energy to rapidly increase the internal temperature of concrete and, subsequently, damage the local concrete matrix, thereby accelerating the demolition process.

Project Snapshot

1. Determine the relationships between microwave and concrete properties
2. Study the penetration of microwave energy for concrete
3. Determine the reduction of compressive strength due to microwave heating

Concrete Beam Testing

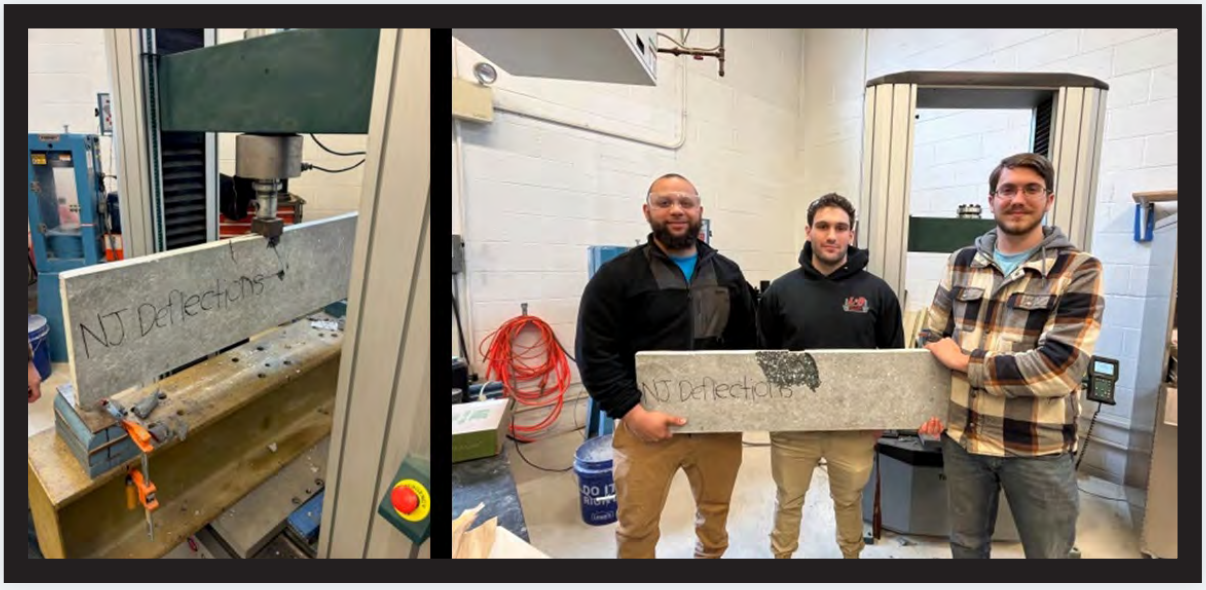
TEAM MEMBERS
John Smith, Lucas Knoop, Nate Karakashian, Dennis Murnane, Devin Moore, Michael Sparks

PROJECT MANAGERS
Gilson Lomboy, Aljhon Morana

Two concrete beams were designed with different geometries and concrete materials. The beams had a uniform depth. They were reinforced concrete beams spanning three feet. The reinforcements were 3/8 inch bars. The weight of the beams was not more than 50 pounds and was designed to achieve the highest possible ultimate load-to-weight ratio. The team won a beam competition organized by the Eastern Pennsylvania and Delaware American Concrete Institute. There were eight participants from four schools. The winning load was 15,905 pounds.

Project Snapshot

1. The students designed and made reinforced concrete beams
2. The students used the finite element method to verify their design
3. A team won the highest strength in a beam competition



Permeability and Porosity of Concrete

TEAM MEMBERS
Liam Heil, Ty Rosas, Hunter Streitz, Kristina Zee

PROJECT MANAGERS
Gilson Lomboy, Arlene Looc

High permeability combined with the concrete's exposure to the unfavorable environment will adversely affect the durability of concrete through physical effects that include surface wear, cracking, and exposure to extreme temperatures, as well as through chemical effects involving leaching of cement paste, sulfate attack, alkali-aggregate reaction, and corrosion of embedded steel. This study will measure the permeability and pore volume distribution of different types of concrete mixtures and relate these properties to electrical resistivity and durability. The specific concrete samples are carbon-cured concrete and concrete that is likely damaged by freezing. These are types of concrete that are potentially more durable due to carbon curing, and concrete that is susceptible to deterioration due to internal frost damage.

Project Snapshot

1. Preparing concrete by carbon curing
2. Collecting samples exposed to freezing temperatures
3. Test the permeability properties of concrete using different methods

School Bus Safety

TEAM MEMBERS
Christian Varrato, Alyssa Lafferty, Antonio Ciasullo

PROJECT MANAGERS
Mohammad Jalayer

This project examines the critical role of school bus safety in protecting children during transportation and the measures required to reduce risks. It explores current safety technologies, including systems enabling communication between buses and vehicles, real-time driver alerts, and mechanisms. The study analyzes crash data from 2016 to 2024, highlighting trends in injuries, seasonal impacts, and the relationship between road classifications, speed limits, and crash frequency. Additionally, the project evaluates state policies such as New Jersey's rigorous inspection requirements and driver background checks to emphasize their effectiveness in mitigating risks. The findings advocate for adopting advanced technologies, refining policies, and fostering awareness to enhance the safety and efficiency of school transportation systems.

Project Snapshot

1. To create awareness of school bus crash trends and to recommend countermeasures and strategies to minimize these crashes; In-depth crash analysis to highlight patterns and areas of concern and evaluate the effectiveness of existing safety measures

Additive Construction (3D Printing of Concrete)

TEAM MEMBERS
Adria Cotler, Joseph Mackin, Aadan Plank, David Sibor, Colton Thomas

PROJECT MANAGERS
Islam Mantawy

SPONSORS
US Department of Education

The purpose of this clinic project was to develop structural elements through additive construction techniques, further optimizing our in house concrete mix as well as introducing a steel fiber mix to improve the strength and durability of the final product.

Project Snapshot

1. Envision new structures enabled by additive construction
   Design and Analyze the envisioned structures
   Additively construct the envisioned structure

Travel Needs for South Jersey

TEAM MEMBERS
Jessica Carroll, Sky Greene, Brian Inclan, Adam Weeks

PROJECT MANAGERS
Mohammad Jalayer

Public transportation offers critical societal benefits such as economic growth, improved safety, reduced congestion, and environmental protection. However, these benefits depend on consistent public usage. This project aims to support ridership growth in South Jersey and the Shore area by identifying user needs and improving transit services. The study began with a literature review to identify best practices from other cities and assess their relevance to NJ Transit. Then, in this study, a survey was designed and distributed to collect the data across 14 bus routes' users to evaluate user satisfaction, travel behavior, and unmet needs. The study concluded with actionable recommendations to improve service quality and attract more riders, aligned with regional infrastructure and resource constraints.

Project Snapshot

1 Understanding travel patterns, identifying gaps in transit service, and uncovering unmet travel needs for South Jersey and Shore Customers.

Enhancing Heavy Vehicle Safety

TEAM MEMBERS
Christopher Canterino, Antonio Ciasullo, Lesley Perez

PROJECT MANAGERS
Mohammad Jalayer

The safety of heavy vehicles is a critical concern due to their significant impact on road safety and infrastructure. This research aims to enhance the safety of heavy vehicle operations by analyzing existing literature and data sources. The study investigates various databases and data collection methods, and data types such as crash/incidents, camera-based, and sensor-based data collection. It explores the specific causes of crashes involving heavy vehicles and identifies the parameters used in safety evaluations. Methodologies employed in data analysis are reviewed to understand their effectiveness in assessing safety measures. The research also compiles specific recommendations to mitigate crash risks and improve safety outcomes for heavy vehicles. Findings from the literature are summarized and organized into an Excel sheet, providing a comprehensive overview of key articles, methodologies, and outcomes.

Project Snapshot

1. Enhancing the safety of heavy vehicles in terms of the reduction of crashes and their corresponding severity; In-depth crash analysis, logit model, and video analysis were used to recommend enhancing heavy vehicle safety.

Electric Curing of Conductive Concrete

TEAM MEMBERS
Dylan Williamson, Kasey Minsky, Dominic Ficarra, Ryan Bates, Nicholas Orsini, Ryan Vickery, Adam Williams

PROJECT MANAGERS
Shahriar Abubakri, Islam Mantawy, Mohamed Masbouba

SPONSORS
USDOD

Our team conducted a detailed investigation into the effects of electric curing on concrete, specifically focusing on key parameters of the electric curing process, the hardened properties of the concrete, and the heat of hydration. As part of our study, we explored the potential application of electric curing in cold weather conditions by casting concrete inside a walk-in freezer. This setup allowed us to simulate the challenges of low temperatures. The primary objective was to test the electric curing regime on a laboratory scale and evaluate its effectiveness. Ultimately, our goal was to assess the feasibility of scaling this method for large-scale concrete applications, potentially improving curing efficiency and concrete quality in colder environments.

Project Snapshot

1. Clinic students worked on the concrete electric curing inside a walk-in freezer
2. Tested cube and beam specimens to evaluate the strength of concrete
3. Studied the porosity of the hardened concrete samples

ASCE Concrete Canoe

TEAM MEMBERS
Jillian Peslak, Zachary Martinho, Nicholas Hui, Marissa Feldman, Anna Willis, Abigail Pino, Maylen Pablo Ortiz, Eric Cunningham, Daniel Friend, Nicholas Gentile, Taylor Manning, Adria Colter

PROJECT MANAGERS
Islam Mantawy and Aly Said

Our team design, formed, constructed, and finished a racing canoe for ASCE competition. From mix design, to formwork fabrication, to casting day, the research team presented Rowan University and obtained second place in the regional competition and qualified to the national competition in Cal Poly

Project Snapshot

1. Model development of racing canoe
   Construction of racing canoe
   Participate in ASCE competition

Flood Impact Assessment on Coastal Wastewater Treatment Plants

TEAM MEMBERS
Student Members: Matthew Brown, Wyatt Cervenak, Julia Thornton; Graduate Student: Rumman Mowla Chowdhury

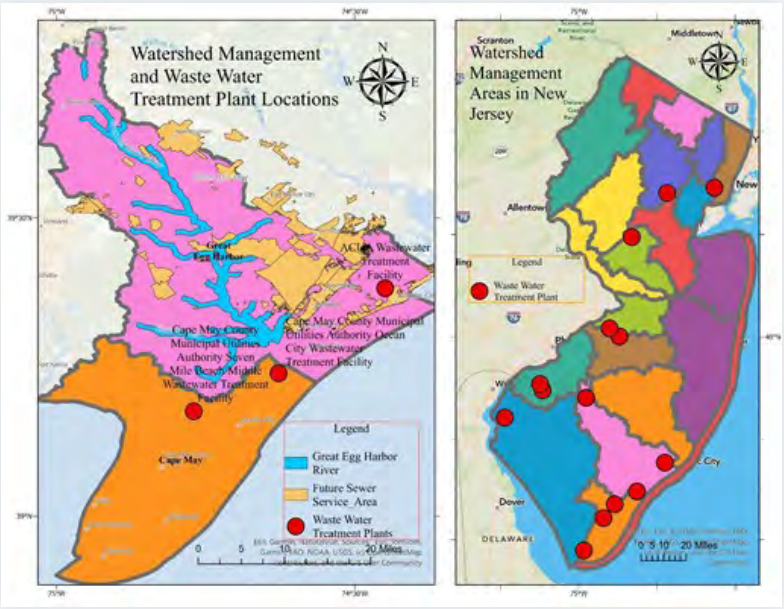
PROJECT MANAGERS
Kauser Jahan, P.E., Cheng Zhang

SPONSORS
Rowan University Civil & Environmental Engineering Clinic Program

This project investigates the flood vulnerability of three key wastewater treatment facilities—ACUA, Ocean City, and Seven Mile Beach—in Cape May County, NJ. By integrating HEC-RAS hydrodynamic modeling with SLOSH storm surge simulations, the team assessed flood risks under both current conditions and future climate scenarios. FEMA flood maps confirm all plants are near high-risk storm surge zones. Simulations show even 10-year and 25-year return period storms can cause moderate flooding, with Category 4 hurricanes bringing over 9 feet of inundation—especially at the Ocean City facility, identified as most vulnerable under future climate projections. The findings underscore the urgent need for infrastructure resilience planning, highlighting the importance of flood defense enhancements, operational contingencies, and climate-adaptive management to ensure uninterrupted wastewater services amid intensifying flood threats.

Project Snapshot

1. Evaluates flood vulnerability of three coastal wastewater treatment plants in Cape May County, NJ.
2. Uses HEC-RAS 2D and SLOSH models to simulate present-day and future flooding scenarios.
3. Recommends adaptive strategies to protect critical infrastructure from rising flood risks.



Meteorological Tsunamis: Historical Events Affect the New Jersey Coast

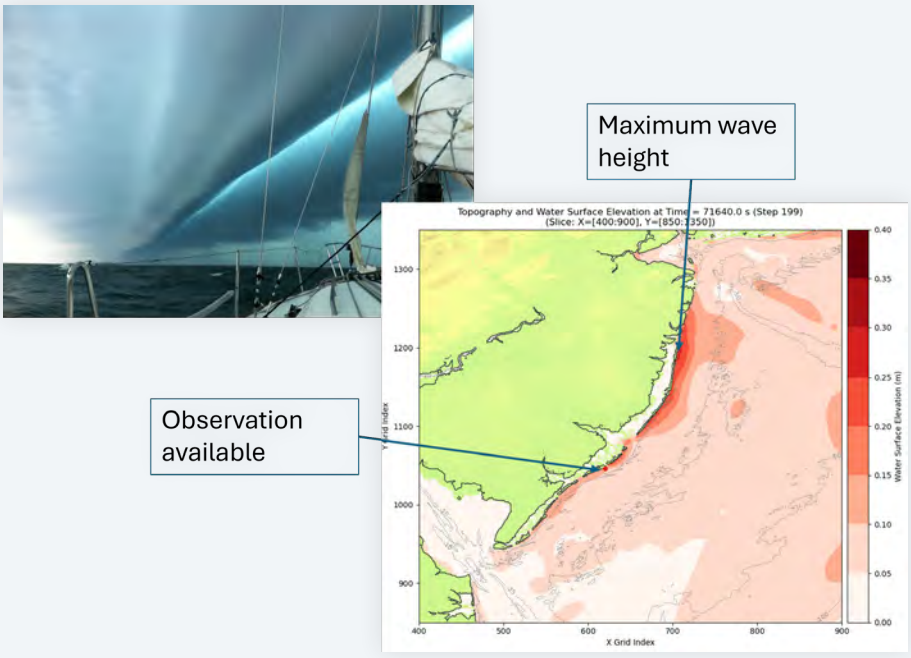
TEAM MEMBERS
David Sibor, Charles Jones, Alex Generosi

PROJECT MANAGERS
Cheng Zhang

A meteo-tsunami is a tsunami-like wave caused by changes in atmospheric pressure, often associated with fast-moving weather events like thunderstorms or squalls. Although the wave heights near the coast are not large, meteo-tsunamis can be very dangerous due to their sudden onset and potential to coincide with high tide. This project numerically investigated the wave runup risks from the historical meteo-tsunami events impacting the U.S. East Coast, with a particular focus on the New Jersey coastline. The numerical results indicate that along the New Jersey coast, the regions facing the highest risks are likely not where observational data are available. This suggests that the risks might be underestimated due to the lack of observational instruments along the shoreline. We also found that resonance mechanisms, which amplify wave heights, vary across different coastal regions and lead to distinct wave patterns.

Project Snapshot

1. Estimated wave runup risks from meteo-tsunamis along the New Jersey coast.
2. Found that the risks may have been underestimated.
3. Identified that different coastal regions exhibit distinct wave patterns.



Control Joint Design for Arctic Pavements

TEAM MEMBERS
James Lefeber, Isaiah Yeldell

PROJECT MANAGERS
Yusuf Mehta, Ahmed Saidi, Caitlin Purdy

SPONSORS
Department of Defense

Pavement material elasticity alone is not always sufficient to prevent thermal cracking in extreme temperature conditions, such as the arctic. An additional method to relieve the stress accumulation from thermal contractions is to cut control joints into the pavement and seal them with a highly elastic sealant. There is a lack of design protocols and lab driven optimization for the selection of joint geometry and sealant. The goal of this study is to develop a design protocol, based on material properties and climate conditions, for control joints in flexible pavements.

Project Snapshot

1. Control Joints allow pavements to contract during large temperature swings without cracking

2. This project aims to develop a process for design of control joints including predicting asphalt slab movement and lab testing tailored to the failure mechanism of control joints

Highly Elastic Asphalt for Arctic and Subarctic Regions

TEAM MEMBERS
Mikayla Jones, Adien Weiss, Moayad Al Issa, Arunkumar Goli

PROJECT MANAGERS
Yusuf Mehta

SPONSORS
USDoD

Rowan University, in collaboration with the U.S. Department of Defense, is researching better asphalt for extremely cold regions like Alaska. Traditional pavement tends to crack and wear out quickly in these environments due to freezing temperatures. To address this, the team tested Highly Elastic Asphalt Binders (HEBs), made by blending asphalt with elastic materials like SBS polymer and softening agents such as corn oil or hydrolene oil. These HEBs are designed to stretch and recover better, making roads last longer under traffic and cold weather. Researchers evaluated how these materials behave chemically and physically using advanced lab techniques like FTIR and fatigue tests. Results showed that HEBs improved durability and flexibility. Interestingly, corn oil provided better flexibility, while hydrolene improved chemical stability. These findings may help build longer-lasting, cost-effective roads in Arctic and Subarctic climates, ultimately saving money and improving safety.

Project Snapshot

1. HEBs significantly reduce thermal cracking due to their superior elastic recovery and flexibility
2. Potential implementation in extreme cold climates with temperature dropping below -30°C
3. Use of bio-based softening agents improve binder workability while reducing reliance on petroleum products

Building Information Modeling

TEAM MEMBERS
Alex Bechtle, Manuel Cruz Quintanilla, Taylar Daher, Kieren Murphy, Meet Patel, Antonia DiSalvatore

PROJECT MANAGERS
Adriana Trias, Jess Everett, William Riddell, Jason Muermann

SPONSORS
NJDMAVA

The New Jersey Department of Military and Veterans Affairs (NJDMAVA) and New Jersey Army National Guard (NJARNG) manage hundreds of buildings throughout the state. Many of these buildings do not have up-to-date floor plans. In this project, students are helping to develop state-of-the-art building information models for NJ DMAVA facilities based upon recent laser scans. These scans are collected through the deployment of light detection and ranging (LiDAR) sensors, which have the capability to capture the geometry of objects, in this case buildings, with an accuracy of 1mm. The resulting 3D models allow 2D floorplans to be produced, and can also include models for fire suppression; heating, ventilation, air conditioning; plumbing; and electrical systems. These models can also be used to manage data from condition assessment and mission readiness inspections. While providing these services to NJDMAVA, students are learning to use state-of-the-art 3D modeling software.

Project Snapshot

1. Students are developing Building Information Models from laser scans for New Jersey Department of Veterans Affairs facilities

2. These models will be used to create plans for fire suppression, HVAC, and electrical systems, as well as to manage condition assessment and mission readiness data.

Sustainable Facilities Management

TEAM MEMBERS
Noemi Urguia-Ortiz, Gabrielle Bernard, Sarah Remick, Alex Soderman, Nickolas Francks, Vincent Cafiero

PROJECT MANAGERS
Jess Everett, Adriana Trias, William Riddell, William Johnson

SPONSORS
NJDMAVA

The New Jersey Department of Military and Veterans Affairs (NJDMAVA) and New Jersey Army National Guard (NJARNG) manage ~ 250 buildings on 1,200 acres. It is essential that NJARNG and NJDMAVA maintain mission readiness for both facilities and equipment, so a computerized maintenance management system (CMMS) has recently been implemented. Rowan University engineering students assist these efforts by creating planned maintenance recommendations to use with the CMMS, involving building structural, HVAC, plumbing, fire protection, and/or electrical systems, as well as equipment. Students perform site visits during the academic year to NJDMAVA facilities to survey equipment. Students research manufacturers' recommended maintenance procedures for each piece of equipment that was found, while also meeting with the armorers to ensure that the proposed plans are feasible. This information is compiled on a comprehensive list of maintenance activities that could be performed throughout the year.

Project Snapshot

1. Students are assisting the New Jersey Department of Military and Veterans Affairs (NJ DMAVA) to develop planned maintenance strategies for their equipment and facilities throughout New Jersey.

2. Students perform field data collection of operating facilities to improve asset management.

Sustainable Drinking Water

TEAM MEMBERS
Liza Clarke, Brian Inclan, Charles Jones, Robert Ruhl, Christina Sosa, Amna Bashir

PROJECT MANAGERS
William Riddell, Jess Everett, Jagadish Torlapati, Kirti Yenkie

SPONSORS
New Jersey American Water

Students are helping New Jersey American Water to decrease the energy needed to extract, treat, and distribute clean drinking water. For this project, students have evaluated drinking water system schematics, well reports, and utility bills to analyze how energy is used throughout the process of supplying clean drinking water to consumers throughout New Jersey. Site visits to both groundwater and surface water facilities have been performed. These efforts allowed energy use to be compared on both region and facility level. These comparisons have identified specific areas for further investigation. The spring semester included a poster presented by students at the New Jersey Water and Environment Association conference in Atlantic City, NJ.

Project Snapshot

1. Students are helping New Jersey American Water save energy
2. System schematics, well reports and utility bills were analyzed
3. Site visits to both ground and surface water facilities were performed.

NJDMAVA Energy and Water Use Audits

TEAM MEMBERS
Edward Coyle, Alex Generosi, Vlad Groshev, Josh Guillermo, Bryce Holloway, Dominic Iannelli, Ian Janaszik, Joseph Mihalik, Maritza Ruiz-Alcantar, Brian Scala, Marcus Sosa, Elisa Tovar, David Miller, Anna WIllis, Gus Van Walsen

PROJECT MANAGERS
William Riddell, Jie Li, Mac Haas, Adriana Trias, Jason Muermann

SPONSORS
New Jersey Department of Military and Veterans Affairs

Student teams have performed site visits to six different New Jersey Department of Military and Veterans Affairs (NJ DMAVA) buildings throughout the state. Students measured air temperature and quality, lighting levels, took thermal images of the building envelope, identified devices that use electricity and water. In addition to the site visit, the teams studied building plans and utility bills. Students created building simulations to analyze and model both energy use. Students used these simulations to identify candidate measures to reduce energy and water use, as well as opportunities to generate clean energy on site through solar power. Each candidate measure was evaluated for potential energy savings, as well as economic return on investment. These recommendations help NJ DMAVA to operate their facilities in an efficient manner, and design improvements to their infrastructure.

Project Snapshot

1. Students are helping NJ DMAVA reduce electric, gas and water use in facilities throughout New Jersey

2. Students performed site visits, and used model-based design to analyze building performance, and recommend cost effective measures to save energy and water.

Chemical Engineering

NJ Alternative Diesel Fuels

TEAM MEMBERS
Braden Waller, Nicholas Andrianto

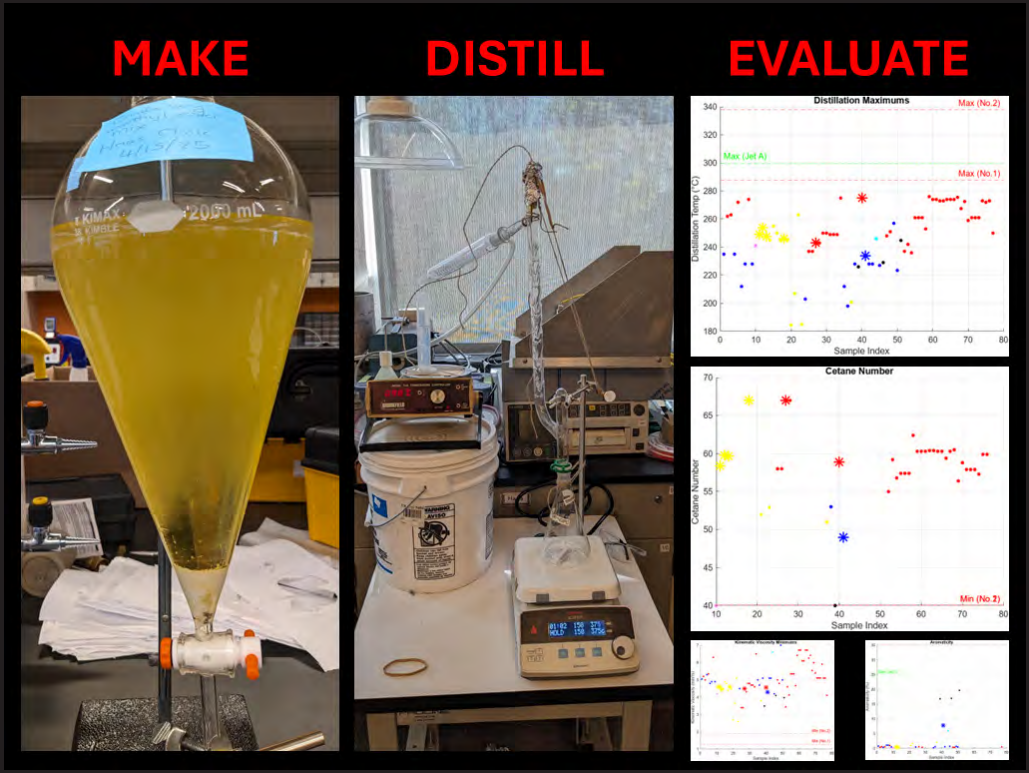
PROJECT MANAGERS
Mac Haas

SPONSORS
NJ Department of Transportation

Several NJ entities have shown interest in using green diesel fuels to reduce CO2 emissions. Certain emerging sustainable aviation fuels (SAFs) have the potential to serve as alternative diesel fuels (ADFs). This Clinic investigated SAF/ADF use cases and found that, indeed, certain SAFs can be further processed to meet diverse ASTM criteria for use as ADF.

Project Snapshot

1. Conventional fuels are not, in general, interchangeable (e.g., gasoline vs. diesel)
2. However, there may be cases in which fuel properties overlap different use cases
3. Certain sustainable aviation fuels can be separated into alternative diesel fuels



Mixing in baffled and unbaffled vessels

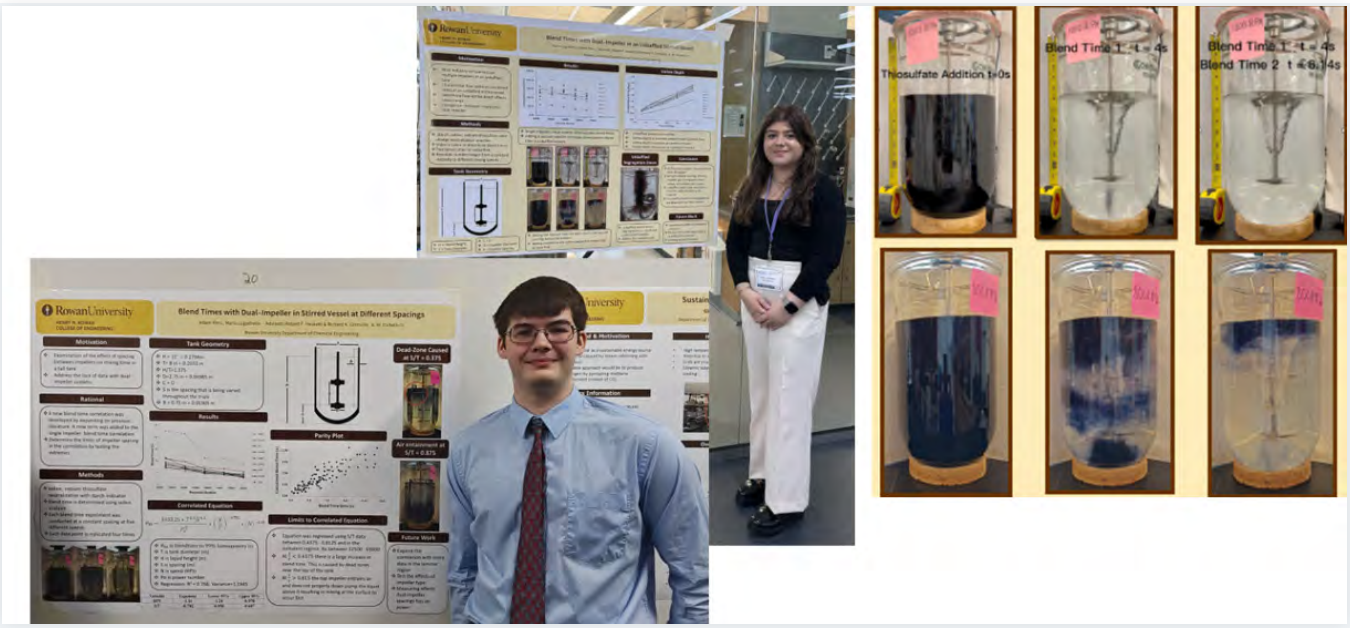
TEAM MEMBERS
Maria Logothetis, Adam Peru

PROJECT MANAGERS
Hesketh, Grenville, Etchells

The standard vessel for mixing in the process industry is a baffled tank. This design is very common especially for low viscosity fluids. Nonetheless, unbaffled vessels are found in industry and the laboratory. The reasons given for using unbaffled vessels are primarily concerns around cleaning the vessel between batches and the possibility of stagnation zones in high viscosity fluids particularly when properties change over the processing time. In this project we investigate the effect of baffles on the blend time using one vessel: with and without baffles. In addition, we examine the effect of placing 2 impellers on one shaft. The blend time is measured using the iodine color change method using a range of viscosities and Reynolds Numbers.

Project Snapshot

1. At High Reynolds Numbers (NRE>20k) baffled vessels show a lower blend time than unbaffled Transition Reynolds Numbers
2. 10,000 where baffled and unbaffled vessels are roughly equivalent blend times
3. At low Reynolds Numbers (NRE<10k) baffled vessels show a higher blend time than unbaffled



Machine Learning for Sustainable Processes

TEAM MEMBERS
Matthew Conway, Marcella McMahon, Brendan Weil, Jahnvi Patel

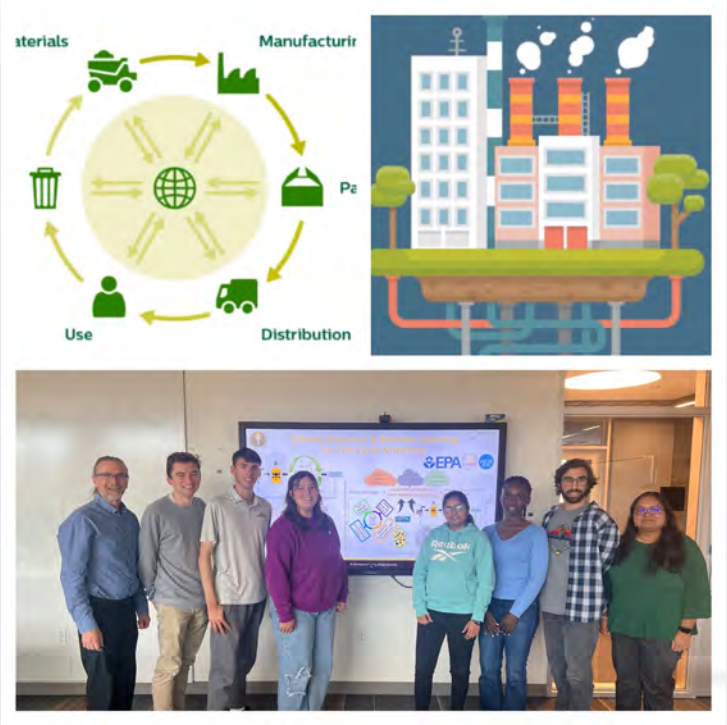
PROJECT MANAGERS
Kirti Yenkie, Robert Hesketh, Graduate Mentors: Harriet Appiah, Andres Castellar

SPONSORS
US Environmental Protection Agency, AstraZeneca, and AIChE

Life cycle assessment (LCA) is systematic analysis of potential environmental impacts of materials, products, and services during their entire life cycle (i.e. manufacturing, distribution, use, end-of-life). Initial design for a given product/process is inherently complex and lacks information, posing challenges for effective LCA. Artificial Intelligence, the combination of Data Analytics and Machine Learning (ML), emerge as valuable solutions to address these challenges. Data Analytics allows the user to identify data gaps and generate reasonable estimates. ML algorithms (ANN and XGBoost) prove effective in predicting environmental impacts of new chemicals. This work is extended to technology scale-up analysis, focusing on transition from lab-scale to industrial-scale production of greener chemicals. We anticipate that the combination of LCIs for chemicals and the scalability indices will enable early-stage LCA and lead to more sustainable processes.

Project Snapshot

1. Students learned how to extract valuable data from research papers and databases
2. Developed Machine learning algorithms for early-stage sustainability assessment
3. Integrated knowledge of chemical engineering design with environmental goals



Coffee to Jet Fuel

TEAM MEMBERS
Ishmaiah Small, John Pazik, Jack Kleissler

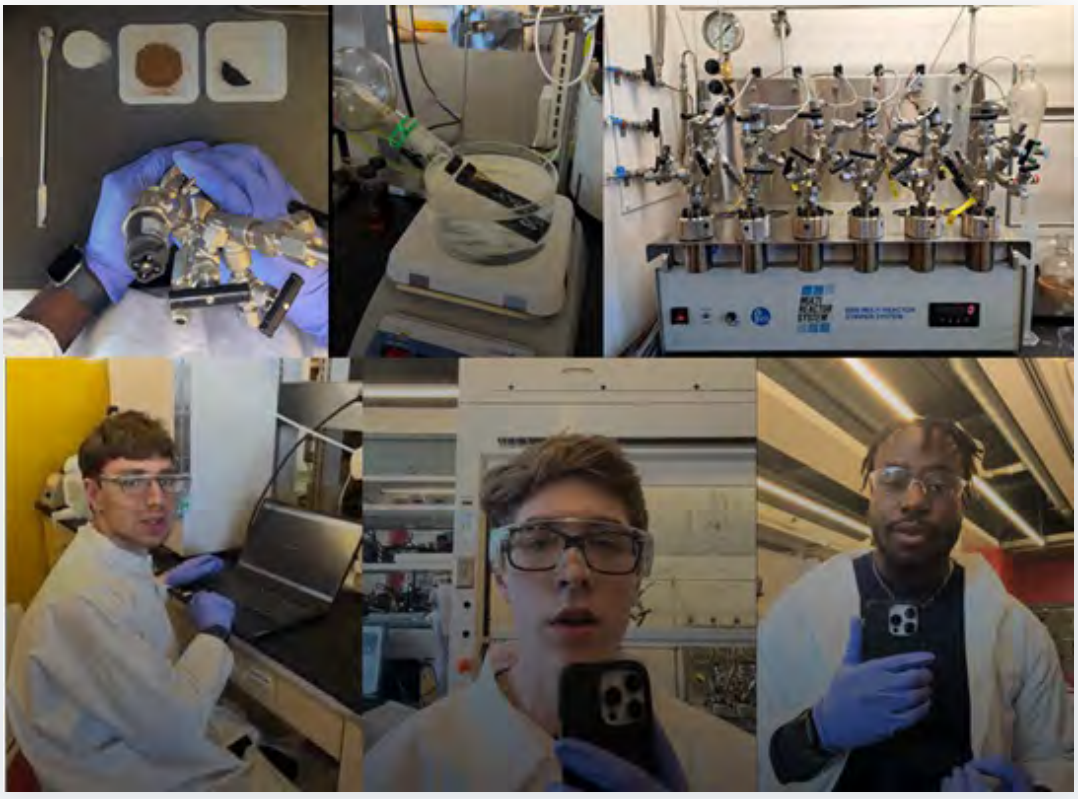
PROJECT MANAGERS
Jun Hee Jang

SPONSORS
American Chemical Society

In this project, our team developed efficient solvent-based fractionation methods to separate spent coffee grounds into their major components: lipids, lignin, and carbohydrates. Beyond upstream fractionation, we also designed metal/zeolite catalysts for the hydrodeoxygenation of the lignin stream into jet-range hydrocarbons.

Project Snapshot

1. Team developed solvent-based separation methodologies
2. Extracted lipid oil from spent coffee grounds
3. Designed new catalysts for the deoxygenation



Lignin-based membranes

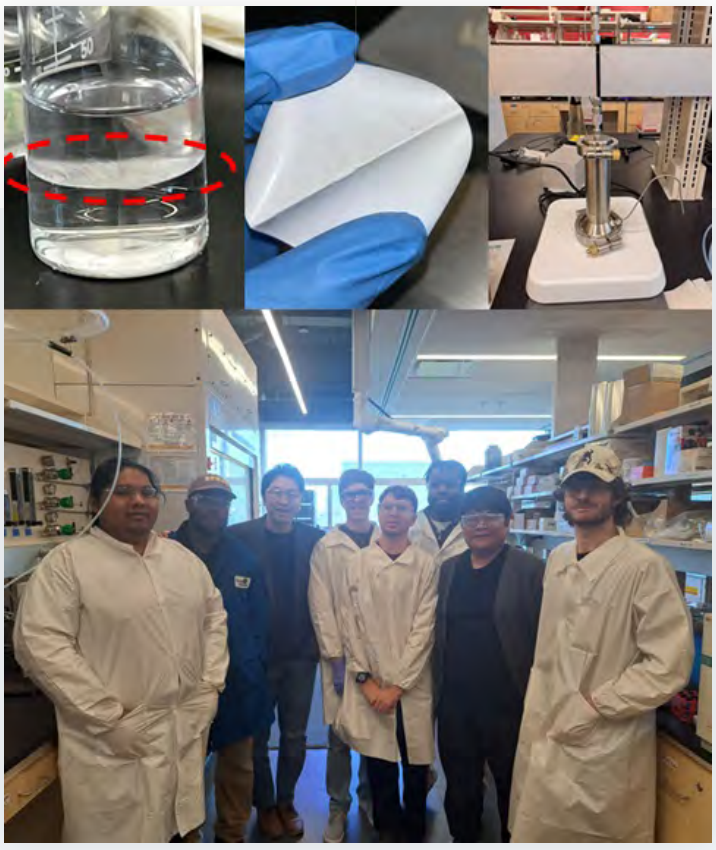
TEAM MEMBERS
Nathaniel Holl, Brian Ramirez

PROJECT MANAGERS
Jun Hee Jang

In this project, we proposed a novel approach to utilize biomass-derived lignin as a starting material for synthesizing polymeric membranes. We developed interfacial polymerization techniques to create nanofiltration-level active layers on ultrafiltration supports, and systematically investigated the effects of various parameters on membrane formation.

Project Snapshot

1. Team developed interfacial polymerization methods for lignin-based membranes
2. Investigated synthesis parameters and their impact on the membrane formation
3. Tested different types of substrate chemical



ExxonMobil Pipeline Operations

TEAM MEMBERS
Thien An Pham, Emma Padros, Andrew Malec, Amarelys Rios, Joel Patterson

PROJECT MANAGERS
Kirti Yenkie, Robert Hesketh, C. Stewart Slater, Graduate Mentor: Barnabas Gao

SPONSORS
ExxonMobil, US Environmental Protection Agency

ExxonMobil Lubricants Plant in NJ is 2nd largest facility in the world performing oil blending and filling operations. Goal is to reduce amount of flush oil produced during changeovers in blending/filling lines. In real-time industrial operations, the typical flushing process involves use of large volumes of finished product to displace previous oil in packaging line. Thus, resulting in commingling and downgrade, increased operational costs, and inefficient resource utilization. This study presents a comprehensive experimental and computational investigation into the flushing process of compositionally distinct oils, utilizing industrial and laboratory data collected from a pilot plant, designed and constructed by students to mimic the industrial plant. The objective is to develop guidelines for optimized flushing that enhances efficiency, minimizes product loss, and ensures product integrity by incorporating real-time measurement devices, such as inline viscometer.

Project Snapshot

1. Students interacted with industry operators to learn oil packaging operations
2. Developed lab-scale pilot plant to study pipeline flushing and packaging
3. Tested different samples and developed models for optimal flush guidelines

Water Treatment — Machine Learning and Graph Theory

TEAM MEMBERS
Alec Guerra

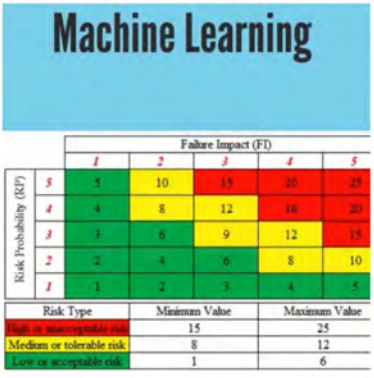
PROJECT MANAGERS
Kirti Yenkie, and Graduate Mentor — Andres Castellar

SPONSORS
National Science Foundation

Wastewater Treatment Networks synthesis and design is a complex problem that demands innovative approaches in design, retrofits, and maintenance strategies. Considering this, an enhanced framework for improving reliability in wastewater transportation networks based on graph theory and machine learning is presented. Machine learning models were used to predict failure probability, where the XGBoost model provided the best predictions. To select the appropriate solution, a trade-off between cost and reliability metrics is presented which is implemented by analyzing the results obtained for the real wastewater treatment plant case study. Project is in collaboration with Széchenyi István University-Hungary and Atlantic County Utilities Authority, NJ.

Project Snapshot

1. Students interpreted data from water treatment and transportation systems
2. Developed machine learning (ML) models to detect failure probability of components
3. Integrated ML with process design to create reliable water treatment networks



Pollution Prevention in Industries

TEAM MEMBERS
Benjamin Chivers, Milo Barkow

PROJECT MANAGERS
Robert Hesketh and Kirti Yenkie

SPONSORS
US Environmental Protection Agency

The project focuses on the reduction of specialty chemicals containing fluoride being released into the environment. Many of these chemicals are used in the electric power industry and in microelectronics processing. The broad goals of Pollution Prevention (P2) are achieved via reduction in greenhouse gas (GHG) emissions, energy utilization, material use, hazardous wastes, as well as cost savings, and integration of all the above to create modernized greener facilities that could serve as a role model for allied industries to follow. We are currently working with one of the largest domestic providers of SF6 to equipment used by electric utilities. The goals include minimization of the use of gases such as SF6 in the power sector which have a very high global warming potential as well as explore alternatives to it. Furthermore, separation and purification technologies are explored for efficient recycling of existing SF6 in the value chain.

Project Snapshot

1. Students learned the applications of fluorinated gases in chemical and power sectors
2. Explored recovery and purification methods for SF6 (very high global warming potential)
3. Integrated chemical engineering separations with environmental goals

Purifying Pharmaceuticals

TEAM MEMBERS
Jacob Mason, Elvis Mwesigwa, Jason Neagle, Jennifer Skwarlo

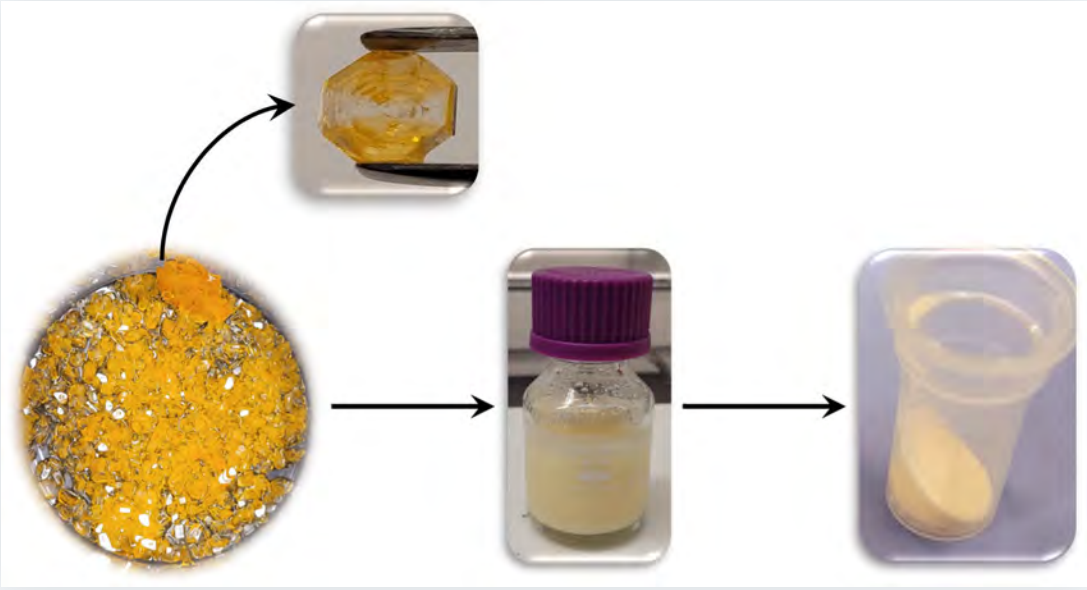
PROJECT MANAGERS
Gerard Capellades

SPONSORS
US National Science Foundation

Pharmaceutical products keep getting more complex and difficult to manufacture, owing to the formation of larger molecules with more complex syntheses. The manufacturing process always results in the presence of undesired impurities as process by-products that can pose health risks to the patient, especially if those drugs are taken regularly. Despite that, methods for purification are still highly centered on trial and error due to the poor understanding of how those impurities incorporate in the product. This clinic sought to gain understanding of those mechanisms by utilizing dyes as model impurities, and tracking where they end in the final product as well as the caused changes in pharmaceutical behavior.

Project Snapshot

1. Students investigated how impurities incorporate in pharmaceuticals using dyes
2. The performance of purified and impure pharmaceuticals was compared
3. Novel techniques were developed for their analysis



Crystallizing Chocolate

TEAM MEMBERS
Abigail Barnhardt, Ciara Cummiskey

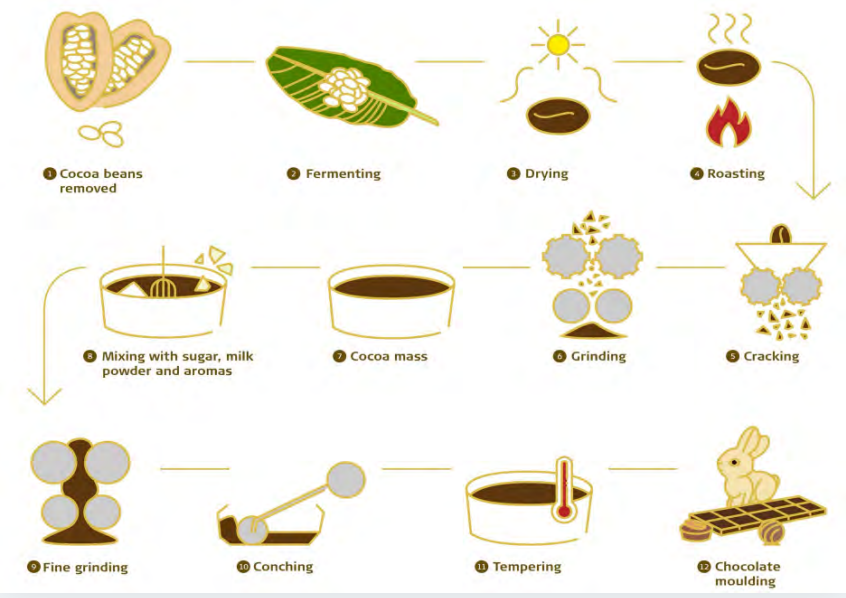
PROJECT MANAGERS
Gerard Capellades

SPONSORS
US National Science Foundation

Pharmaceutical products keep getting more complex and difficult to manufacture, owing to the formation of larger molecules with more complex syntheses. The manufacturing process always results in the presence of undesired impurities as process by-products that can pose health risks to the patient, especially if those drugs are taken regularly. Despite that, methods for purification are still highly centered on trial and error due to the poor understanding of how those impurities incorporate in the product. This clinic sought to gain understanding of those mechanisms by utilizing dyes as model impurities, and tracking where they end in the final product as well as the caused changes in pharmaceutical behavior.

Project Snapshot

1. This clinic developed an outreach activity for K-12 students
2. Chocolate crystallization methods resemble those in pharmaceutical crystallization
3. The work raises awareness to what chemical engineers do



Glass Plant Design & More

TEAM MEMBERS
David Bauer, William Kubic, Dylan Mack, Brenden Rostucher, Thomas Stard, Aiden Tahmazian, Kaitlyn Vogel

PROJECT MANAGERS
Joe Stanzione, Justin Elko, Elias Timmons

SPONSORS
NJ Department of Environmental Protection

This project focused on utilizing engineering design principles and industrial-scale plant units/equipment in designing a state-of-the-art glass recycling and processing plant. A pilot-scale demonstration plant was established and utilized at Rowan's Advanced Materials & Manufacturing Institute (AMMI). Students closely worked will Bottle Underground in Philadelphia on solving real-world engineering problems. In addition to the processing plant, main engineering projects included sieving glass sands and powders and characterizations thereof, improving upon the safety and workability of a lift system at Bottle Underground, redesigning Bottle Underground's intake-to-output material workflow, and re-engineering a custom-built cataloging and data analytics software tool.

Project Snapshot

1. Pilot-scale demonstration plan design, creation, and utilization
2. Advanced sieving of glass sands and powders and characterizations thereof
3. Collaborative engineering design and implementation work with Bottle Underground

Developing Bio-based Polymers

TEAM MEMBERS
Alex Andershonis, Alessandra D'Alessio, Ambr Higgins

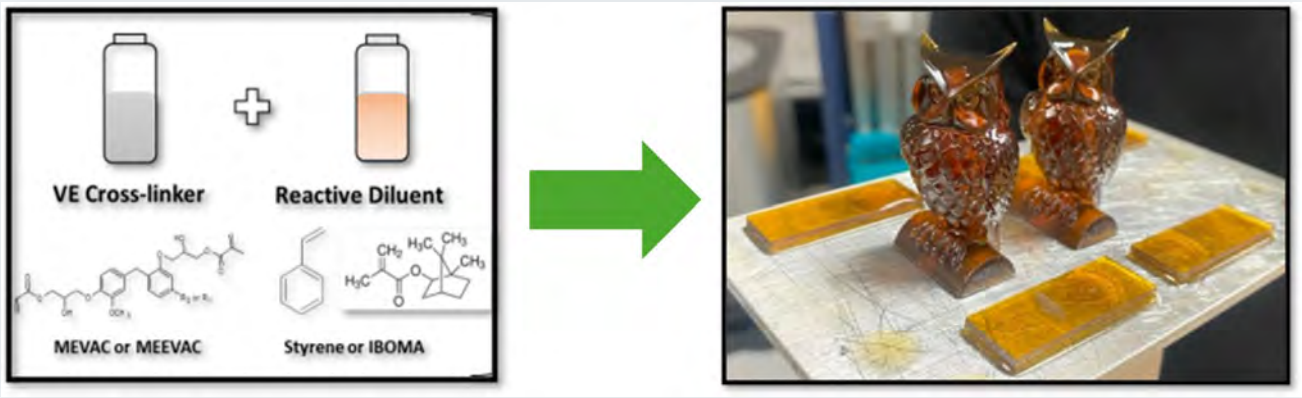
PROJECT MANAGERS
Joe Stanzione, James Newell, Emre Kinaci, Heather LaFrance

SPONSORS
DoD — Army Research Laboratory

The potential harmful health and environmental effects of monomers used during a polymer's manufacturing stage are important yet often disregarded considerations when evaluating the sustainability of synthetic materials. In this project, novel epoxy and vinyl ester bio-based resins derived from cashew nutshell liquid and lignin-sourced small aromatics were synthesized and characterized. The vinyl ester bio-based resins were cured with typical reactive diluents as well as a bio-based alternative that is derived from tree saps. Such resins were cured via thermal and 3D printing techniques. The cured resins were experimentally tested to determine their processing-structure-property relationships. Furthermore, the environmental health and safety in producing these bio-based resins were evaluated. Students worked closely with folks in the Chemical Engineering Department at Rowan University as well as with Rowan's Advanced Materials and Manufacturing Institute (AMMI).

Project Snapshot

1. Synthesis of new bio-based resins and characterization thereof
2. Curing of bio-based resins via thermal and 3D printing techniques
3. Determination of processing-structure-property relationships of cured bio-based resins



Sustainable Li Ion Batteries

TEAM MEMBERS
Ethan Blanda, Braedan Booth, Christian Frank, Evan Gromen

PROJECT MANAGERS
Ken Lau, Joe Stanzione

SPONSORS
HiT Nano & US Department of Energy

Graphite is traditionally mined outside of the United States, so finding a domestic and sustainable source to replace graphite as the anode in lithium ion batteries is an attractive alternative. Our team pyrolyzed biomass waste, such as birch bark and avocado pits, to make hard carbon anodes. These materials were assembled into cells that showed suitable electrical conductivity and battery performance.

Project Snapshot

1. Student team studied sustainable materials to replace graphite anodes in LIBs
2. Birch bark and avocado pits were pyrolyzed to form hard carbon anodes
3. Anodes showed reasonable electrical conductivity and battery performance

Clean Hydrogen Processing

TEAM MEMBERS
Glenn Johnson, Max Palmer, Steven Roth, Eric Tanzosh

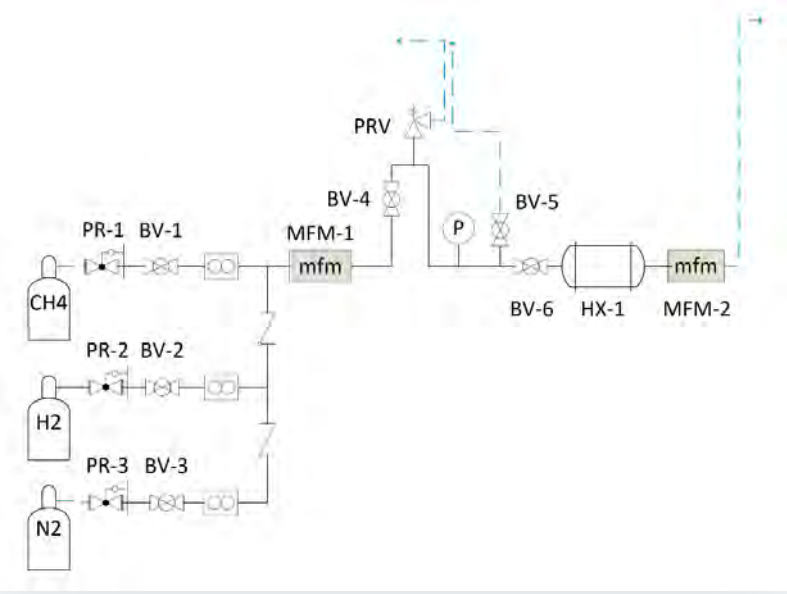
PROJECT MANAGERS
Ken Lau, Jun Hee Jang

SPONSORS
US Department of Energy

Hydrogen is potentially a clean source of energy if it can be produced without generating environmental pollutants at the same time. A potential reaction pathway to produce clean hydrogen is through pyrolysis in an inert atmosphere. Our team designed and assembled a lab-scale continuous flow reactor system to pyrolyze methane into carbon and hydrogen, and by measuring the flow and mass before and after the reaction, the amount of hydrogen can be determined to understand the reaction behavior.

Project Snapshot

1. Student team designed and assembled a reactor system to make clean hydrogen
2. Hydrogen was produced by pyrolyzing methane in a nitrogen atmosphere
3. Mass and flow measurements were made to quantify the amount of hydrogen



Advanced Composites for Aerospace

TEAM MEMBERS
johnso195, matago55, parrys88, hobanr18, ramosl39

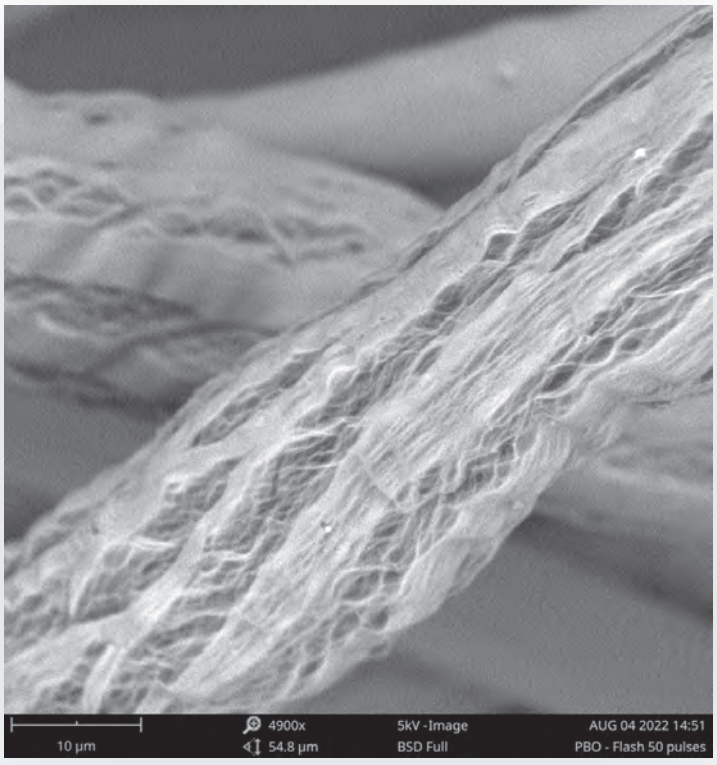
PROJECT MANAGERS
James Newell, Joseph Stanzione, Casey Barrett

SPONSORS
Department of Defense

This project investigated the production of carbon/carbon composites for military and aerospace applications. The clinic team developed a process to manufacture fiber-reinforced composites from a novel blend of materials, then pyrolyzing them to form an improved carbon-carbon composite capable of remaining thermally stable throughout travel through the atmosphere, into space, and back through re-entry. The team studied the structure and properties of the composites that they developed.

Project Snapshot

1. Developed process to manufacture composites from new materials
2. Characterized the mechanical properties
3. Worked closely with Army Research Lab sponsors



Electrical & Computer Engineering

AI: Continual Learning

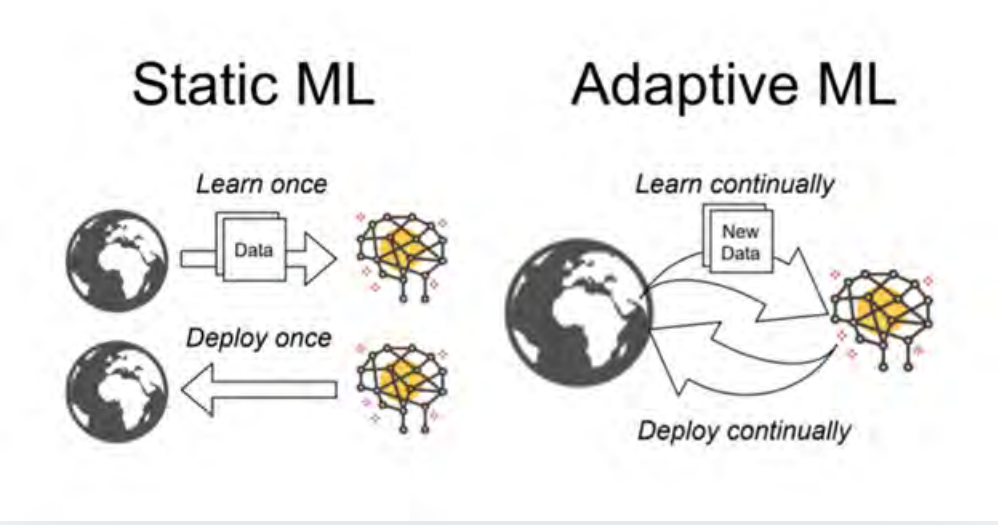
TEAM MEMBERS
Akua Abanyie

PROJECT MANAGERS
Ravi P. Ramachandran, Muhammad Umer

Continual learning involves sequential learning from potentially infinite task streams. It enables machine learning models to adapt continuously to changing environments, such as self-driving cars adjusting to varying weather conditions and medical systems diagnosing patients. However, a significant challenge in continual learning is catastrophic forgetting, where the model's performance degrades on previous tasks as it learns new ones. Much of the prior work in continual learning has focused on mitigating this issue. Unfortunately, these approaches are vulnerable to adversarial attacks. To enhance model robustness against such attacks, we propose training continual learning models with additional cleanly labeled defensive samples during each task training. This project aims to integrate explainable AI models into continual learning models to demonstrate the model's focus on defense patterns while ignoring adversarial imperceptible patterns during predictions.

Project Snapshot

1. Continual Learning: Machine learning models adapt continuously
2. Practical applications in transportation and biomedical
3. Integrate explainable AI models into continual learning



AI: Explain Your Attention

TEAM MEMBERS
Jaric Abadinas, Lauren Eckert, Jordan Reyes, Dean Siedlecki, Jillian To, Chelsea Small, John Radulic.

PROJECT MANAGERS
Ravi P. Ramachandran, Ian Nielsen

SPONSORS
Department of Education

A pressing question in the field of Artificial Intelligence (AI) is "how and why did you make that decision?" As AI is expanded into more and more critical areas of our lives (i.e. self-driving cars, medicine, defense, information technology etc.), it has become more critical than ever to answer this question for us to be able to trust these models for such life and death applications. This clinic will focus on training machine learning models for the task of both computer vision (Object Detection) and natural language processing (NLP) tasks. Students will also peek into the internal processes of these models by generating visualizations that explain why a model made a particular decision using Attribution Mapping. These maps show us where the model's "eyes" were focused on, similar to an eye tracking software that shows where a person is looking on a screen.

Project Snapshot

1. How and why did the AI model make that decision?
2. Critical to answer above question
3. Done through attribution mapping

AI: Federated Learning

TEAM MEMBERS
Ayo Overton, Michael Insana, Luke Wilkins, Andrew O'Donnell, Henry Conde, Jacob Cicchetti

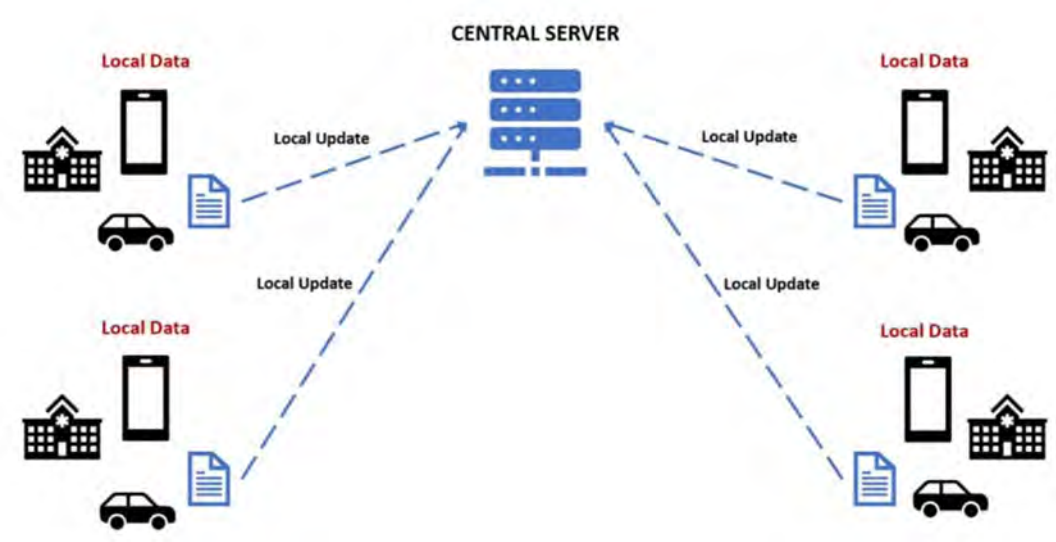
PROJECT MANAGERS
Ravi P. Ramachandran, Sepide Mojalal

SPONSORS
Department of Education

In this clinic, we will focus on Federated Learning (FL), a decentralized approach to machine learning that enables model training across multiple devices or locations without the need to share sensitive data. This approach is particularly crucial in the transportation sector, where privacy and data security are of utmost importance. Students will engage with real-world applications of Federated Learning in transportation, focusing on predicting future vehicle acceleration while maintaining strict data privacy and security standards. We will emphasize practical applications in transportation, utilizing techniques such as Federated Averaging and Secure Aggregation, which are essential for understanding the distributed machine learning systems. By the end of this course, students will have the skills necessary to implement and assess federated learning models specifically tailored to the challenges in transportation.

Project Snapshot

1. Federated Learning (FL) enables model training across multiple devices or locations
2. No need to share sensitive data
3. FL in transportation, focusing on predicting future vehicle acceleration
4. Maintaining strict data privacy



AI: Offshore Wind Turbines

TEAM MEMBERS
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PROJECT MANAGERS
Ravi P. Ramachandran, Keith Soulesl

SPONSORS
NJ Department of Environmental Protection

The maintenance of wind turbines is a critical concern for stakeholders in the energy industry. Traditional methods of inspecting turbines for defects such as blade cracks, leading edge erosion, and lightning strike damage are time-consuming and costly. Machine learning have shown promise in alleviating these challenges by automating defect detection and improving maintenance efficiency. Students will investigate the development of a transformer-based object detection model tailored for predictive maintenance of offshore wind turbines. Transformers have demonstrated state-of-the-art performance in various machine learning vision tasks. Our model will be trained on comprehensive datasets, including the DTU NordTank blade inspection dataset and the Ørsted turbine blade inspection dataset, to ensure robust and accurate defect detection. To foster trust and transparency among stakeholders, we will incorporate explainability techniques such as feature visualization and attribution mapping.

Project Snapshot

1. Maintenance of wind turbines is a critical concern
2. Machine learning can automating defect detection
3. Development of a transformer-based object detection model

Elevating Flight Safety with Virtual Reality

TEAM MEMBERS
Carley Iverson, Gwenn Abano, Michelle Morales, Matthew Zmuda, Carmine Petronglo, William Covert

PROJECT MANAGERS
George Lecakes

SPONSORS
Federal Aviation Administration

This groundbreaking project, sponsored by the Federal Aviation Administration (FAA), is transforming the future of flight safety through immersive technology. Leveraging Virtual Reality (VR) the team created advanced cockpit overlays for pilot training, allowing users to interact with realistic flight controls in a safe, simulated environment. They also began development on a crash site investigation trainer, providing future investigators with a fully immersive experience to analyze crash scenes and understand complex accident scenarios. Built using the Dreamscape Learn platform, these training modules are not only scalable but also customizable, making them accessible to a wide audience of aviation professionals. By blending engineering, immersive technology, and safety protocols, this project represents the future of training for next generation aviation experts.

Project Snapshot

1. Leveraged Virtual Reality and Augmented Reality for advanced cockpit training.
2. Developed immersive crash site investigation modules in VR for hands-on learning.
3. Developed for VR classrooms for scalable and interactive training experiences.

Mastering Drone Recognition with Synthetic and Real-World Datasets

TEAM MEMBERS
Sean Becker, Dharma Upadhyay, Kristian DelSignore

PROJECT MANAGERS
George Lecakes, Nidhal Bouaynaya, Kyle Naddeo

SPONSORS
Picatinny Arsenal, U.S. Army

This cutting-edge project, sponsored by Picatinny Arsenal and the U.S. Army, combined synthetic and real-world data to enhance drone recognition in combat scenarios. Using Rowan's DyVir synthetic dataset generator, students created endless VR-generated datasets, simulating various drone types and behaviors. They learned to pilot drones and capture real-world data, recording diverse flight patterns and behaviors. These datasets were used to train AI models capable of identifying drone types, analyzing their behavior, and assessing potential threats. The project merged virtual and physical data, provided a robust training foundation for AI models, ensuring that soldiers of the future can quickly respond to drone threats in the field.

Project Snapshot

1. Rowan engineered DyVir synthetic dataset generator to create unlimited drone scenarios in Virtual Reality (VR).
2. Captured and analyzed real-world drone behavior for enhanced AI training.
3. Developed AI models to identify drone types, behaviors, and threat levels for battlefield awareness.

Expanding Immersive Worlds: Dynamic Effects in Dreamscape Learn

TEAM MEMBERS
Matthew Zmuda, Michelle Morales, Kristian DelSignore

PROJECT MANAGERS
George Lecakes

This innovative project empowered students to explore and extend the capabilities of the Dreamscape Learn Free Roam Pod platform, creating even more immersive virtual reality (VR) experiences. By integrating a DMX control system, the team connected real-world effects to the digital environment, enabling motorized props, fog machines, and dynamic lighting to respond in real time to user interactions. Students experimented with synchronized effects, crafting multi-sensory experiences that blurred the line between the physical and virtual worlds. This hands-on experience not only taught students advanced VR development techniques but also challenged them to think creatively about how digital and physical systems can seamlessly blend.

Project Snapshot

1. Enhanced VR experiences using the Dreamscape Learn Free Roam Pod platform.
2. Integrated DMX control for real-time motorized effects, fog, and dynamic lighting.
3. Created hyper-immersive environments that respond to user interactions.

Cyber-physical Power System Digital Twin

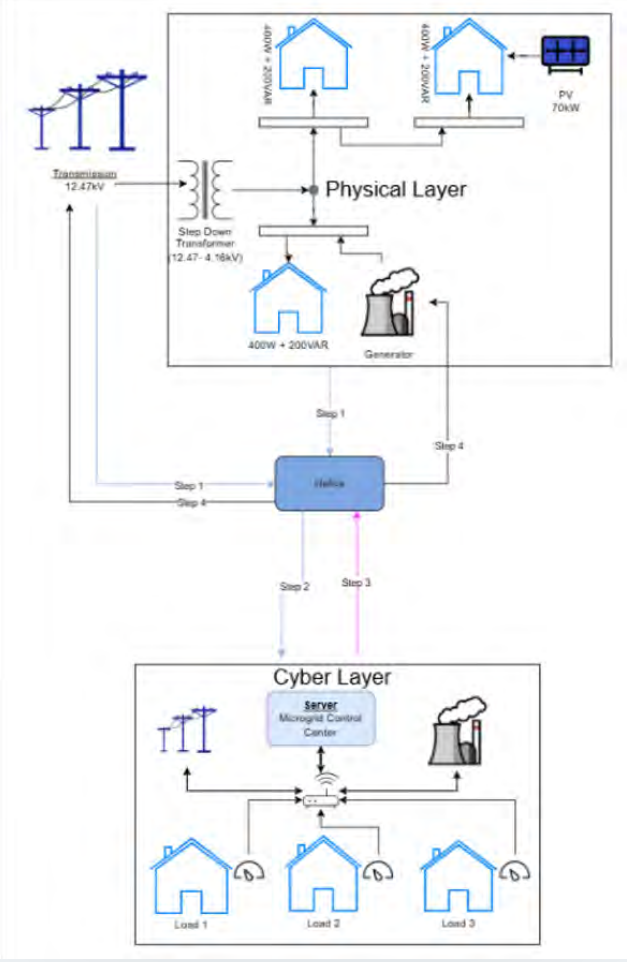
TEAM MEMBERS
Anthony Chicketano, Gianna Brock, Shakiell Acevedo-Vargas

PROJECT MANAGERS
Jie Li

The utilities face challenges in managing a dynamic and cyber-physical coupled grid. Rapid changes associated with energy transition make the grid less predictable, and harder to operate. Digital Twin offers a holistic understanding of how the power grid has responded, and can predict its future responses, to familiar and unprecedented events. This project designed a cyber-physical power system digital twin on the HELICS platform, coordinating the physical system simulation in GridLab-D and communication system simulation in NS3, to investigate grid operation economics, security, and resilience.

Project Snapshot

1. Student team investigated cyber-physical co-simulation platforms
2. Studied the interfaces to enable cross-simulator co-simulation and data exchange
3. Established physical and cyber networks modeling and simulation



iFROST Mapper

TEAM MEMBERS
Benjamin Harrison, Jim Kang, Sammir Md Redwan, Tyler Casas

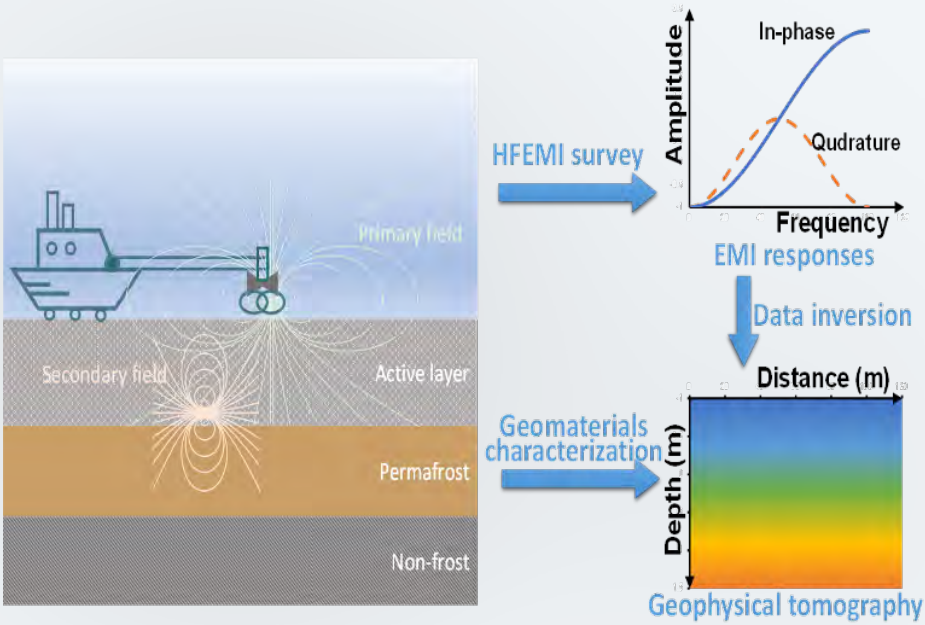
PROJECT MANAGERS
Jie Li, John Schmalzel, Ahmed Saidi

SPONSORS
DoD

This project investigates High Frequency Electromagnetic Induction (HFEMI) technology for geophysical characterization of soils in cold regions. High resolution, multi-scale geophysical characteristics of frozen soils are investigated using electrical and electromagnetic measurements, collected by a portable and cost-effective HFEMI device. This technology is especially useful for cost-effectively surveying massive amounts of land for permafrost deposits in cold regions. To accurately characterize the geophysical properties of soils from EMI data, a robust inversion algorithm is required. In this project, we designed and developed the HFEMI hardware, HFEMI data inversion algorithms, and methods for geomaterials characterization of frozen soils at Rowan University.

Project Snapshot

1. Design the multi-frequency electromagnetic induction sensor
2. Develop data inversion algorithms to accurately reconstruct soil conductivity profiles



Experiential Engineering Education

Design Thinking Innovation

TEAM MEMBERS
Sarah Remick, Isabella Fasciani, Olivia Eddis, Richard Nasuti

PROJECT MANAGERS
Michael T. Dominik

Students provided empathetic engineering designs and alternatives for a low-income woman Client seeking to launch her food truck business.

Project Snapshot

1. Students practiced empathy by meeting with the low-income Client at the current location of her food truck to understand her needs and goals.
2. Students explored alternative solutions to Client requirements within strict low-budget constraints.
3. Students provided technical design alternatives.

Immersive Case Studies

TEAM MEMBERS
Margaret Bowman (Fall and Spring), Nicolas Gerace (Fall), Erick Ayala-Ortiz (Spring), Aadan Plank (Spring)

PROJECT MANAGERS
Cheryl Bodnar, Mrs. Brittany Butler-Morton

This project developed an immersive case study that would allow for stronger student engagement while mitigating hindsight bias. The immersive case study was built applying storytelling principles and gradually revealed the context and situations pertaining to the case study in real-time to students. Leveraging Lego stop-motion and the Edpuzzle software, the immersive case study included five stages with embedded reflection prompts related to situational elements, character perspectives, and potential outcomes. In the second part of the clinic project, clinic students analyzed process safety student submissions from those that engaged with the immersive case study as part of their process safety course to determine what situational elements they were identifying. This analysis helped identify new strategies that can be used in process safety education to better prepare chemical engineering students for the judgments they will encounter when working within industry.

Project Snapshot

1. Research best practices in use of case studies for process safety education
2. Design and build an immersive case study for use in a process safety course
3. Analyze student data for effectiveness of the immersive case study implementation

A website for narratives of food insecurity

TEAM MEMBERS
Nik Leckie, Jason Lee

PROJECT MANAGERS
Justin Majori

SPONSORS
Office of the Secretary of Higher Education (OSHE)

Food insecurity on college campuses is an issue needing immediate attention. Social stigma keeps the public from understanding the issue leading to a lack of buy-in that might help solve the issue. As part of a project collecting and telling the stories of food insecure students, students in this clinic finalized a series of pre-created narratives, generated AI images and voiceovers, and created a website that would display the narratives for the general public to read.

Project Snapshot

1. Increase the readability of 24 pre-collected narratives of food insecurity.
2. Generate images and voiceovers using AI that support the readability of the narratives.
3. Design and build a website that showcases the narratives, including AI components that the public can enjoy.

Faculty definitions of entrepreneurial mindset

TEAM MEMBERS
Vincent Sambucci, Patrick Riley, Alexander Siniscalco, Mathew Longstreth

PROJECT MANAGERS
Justin Major

SPONSORS
KEEN

Entrepreneurial Mindset (EM) is an essential skill for engineering students that leads to greater impact upon society. How EM is taught matters, and likely influences the learning students receive. As part of a project investigating how marginalized students experience EM differently, students in this clinic thematically analyzed 14 faculty interviews to understand: 1) how faculty define EM, and 2) how their definitions impact how they teach EM. Findings from this work will be published in an academic journal in the future.

Project Snapshot

1. Analyze 14 faculty interviews regarding entrepreneurial mindset for themes.
2. *Identify how faculty define and teach entrepreneurial mindset in engineering.

Transition Portfolio Website

TEAM MEMBERS
Abigail Cassino, Jessica Mastriano, Douglas Snyder

PROJECT MANAGERS
Juan Cruz, Cassandra Jamison

SPONSORS
Burlington County Special Services School District

The Burlington County Special Services School District (BCSSSD) is seeking to better support their disabled students who are transitioning out of public education and into the workforce or college. Our team has worked closely with BCSSSD through meetings and site visits to understand their needs and develop a digital portfolio solution to help them track and share their students' skill development and support needs. We utilized UX Design to generate user roles and activity diagrams that articulate how each unique user would interact with the portfolio. Using Google Classroom and Sites, we have established the baseline programming that will be needed to support the student and reviewer roles in the portfolio.

Project Snapshot

1. Leveraged client feedback to articulate product constraints.
2. Utilized Website Design principles to establish user roles.
3. Explored Google Classroom and Sites to meet client needs.

Engineering a Children's Book

TEAM MEMBERS
Zeynep Bartek, Christian Frank, Sophia Moglino, Joy Lynn Torelli

PROJECT MANAGERS
Danielle Farrell, PE

SPONSORS
The Gearing Towards Engineering Foundation,
Warshauer Electric Supply

In Owen the Owl and the Wires in the Wall, Owen's sister Olive follows the transmission lines from different power sources back to their treehouse where she learns along with readers about electricity, wires, and circuit breakers. The message in the story is reinforced with science experiments that can be carried out using items that are typically found around the home. Rowan's engineering students conduct book readings and experiments at libraries and day cares around the region.

Project Snapshot

1. Students author and illustrate a children's book on a STEM subject by breaking down complex topics and using analogies that relate to 4–6 year olds.

2. Students improve on their communication, project management, and teamwork skills.

Mechanical Engineering

Polymer Composites for Navy Applications

TEAM MEMBERS
John Hayes, Matthew Olivo, Madeline Seybold, Thomas Moderski, Tyler Belvin, Joseph Marshina, Logan Allison, Oludayo Ibikunle, Lynn Le, Frank Saladino

PROJECT MANAGERS
Wei Xue

Our team has been investigating novel polymer nanocomposites as potential dielectrics for gas helium (GHe) cooled high-temperature superconducting (HTS) systems. Different types of polymer-nanoparticle composites (e.g., polyimide or polyamide as hosts, with silicon dioxide or POSS as nanofillers) have been designed, fabricated, and characterized, with the intent to improve the thermomechanical performance of dielectrics while maintaining their high breakdown strength. Accordingly, a variety of novel and fully customized experimental test systems have been designed, manufactured, and implemented in order to effectively characterize the material behaviors in the cryogenic environment. These advanced dielectrics can potentially offer critical advantages for applied superconductor systems, including wider temperature windows, greater design flexibility, higher current density, and increased power capacity, making them particularly beneficial for GHe-cooled HTS systems on Navy ships.

Project Snapshot

1. New high-performance polymer-nanoparticle insulators have been developed.
2. Novel, fully customized experimental tools have been designed and implemented.
3. New insulators may improve Navy high-power, high-energy system performance.

Repair of Composites by Cold Spray

TEAM MEMBERS
Stephen McClain, Nicoletta Philippoussis

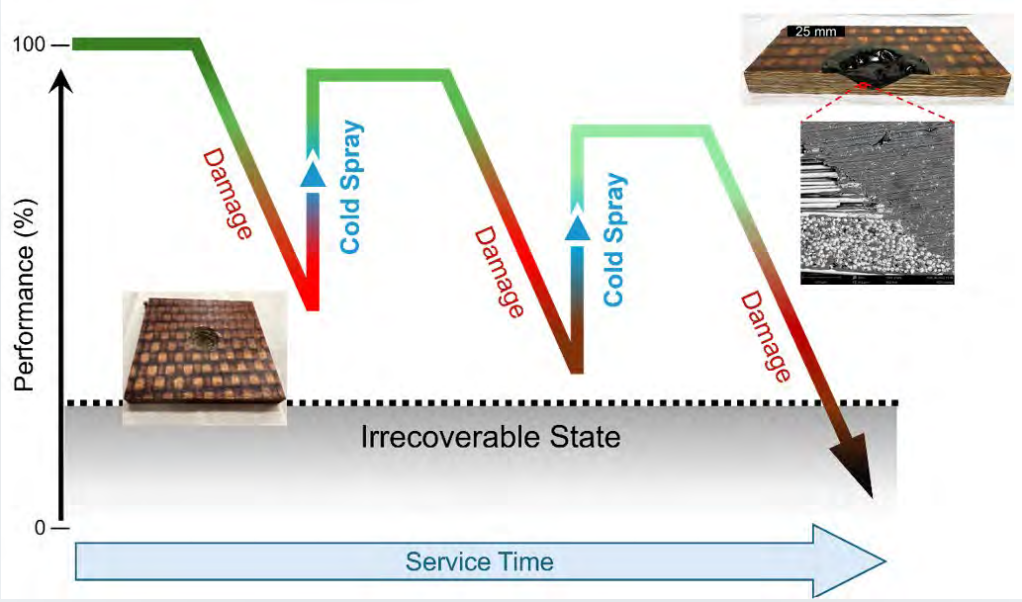
PROJECT MANAGERS
Behrad Koohbor

SPONSORS
Army Research Lab

This Engineering Clinic project investigates the mechanical performance and repair of composite materials subjected to Barely Visible Impact Damage (BVID). The team applies controlled impacts to composite samples and uses Scanning Electron Microscopy (SEM) to analyze internal damage and establish correlations between impact conditions and damage severity. In parallel, students design and fabricate test specimens to evaluate the mechanical properties of cold spray deposits using powders provided by PPG. By testing undamaged, damaged, and cold spray–repaired samples, the project aims to quantify the effectiveness of cold spray as a repair method.

Project Snapshot

1. Restored damaged composite parts without heat or major reshaping
2. Extended part life by designing a cold spray process to fill in the damage zone
3. Cold spray repair offers a fast, low-cost fix for barely visible damage in composites



Syntactic Strcutures

TEAM MEMBERS
Lawrence Agostini, Robert Avanzato, Matthew Longshaw, Shayne Michot

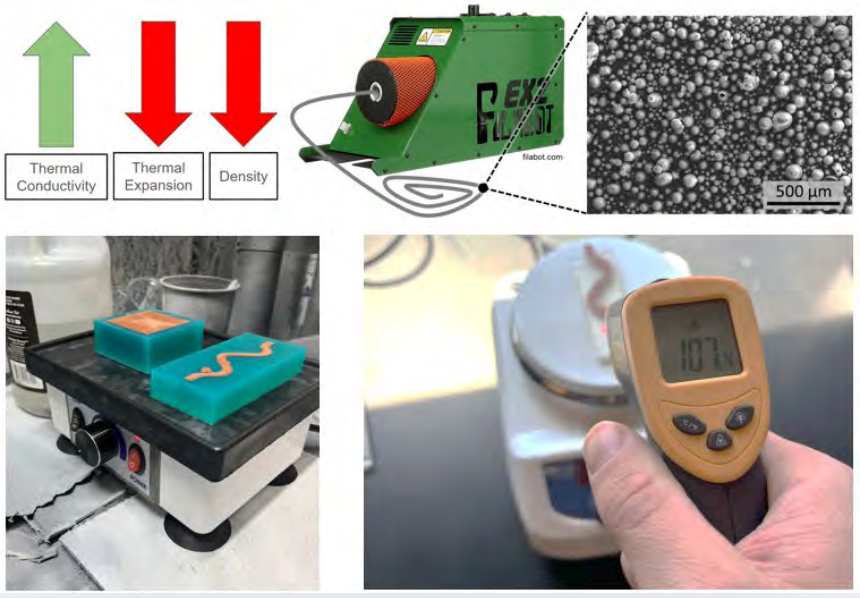
PROJECT MANAGERS
Behrad Koohbor, Nicholas Pagliocca

SPONSORS
National Science Foundation

Effective thermal management is critical in modern mechatronic systems, yet passive solutions remain underexplored. This project investigates the use of thermally conductive, particle-reinforced composites—particularly TPU with hexagonal boron nitride (h-BN)—for passive heat transfer in applications like robotics. Building on previous material screening and simulations, the team focused on manufacturing challenges, casting limitations, and the behavior of these materials in complex geometries. Additionally, the team initiated development of a custom finite element tool for heat flow optimization, employing PyVista and ANSYS for meshing and analysis. Using a 2D tensor field to model spatial temperature distribution, the team explored graph-based optimization methods (e.g., Dijkstra's algorithm) to minimize heat path distance in high-thermal-load regions. This research supports the creation of lightweight, passive thermal solutions for demanding electromechanical systems.

Project Snapshot

1. Improved cooling in robots using new heat-conductive materials
2. Reduced system cost and complexity by avoiding active cooling methods
3. Explored new ways to shape and mold advanced cooling materials



SAMPE Student Bridge Contest

TEAM MEMBERS
Donovan Kenny, Alexander Bohensky, Austin Felixbrod

PROJECT MANAGERS
Behrad Koohbor, William Beck

SPONSORS
Beck

This Engineering Clinic project focuses on the design, simulation, fabrication, and testing of carbon fiber reinforced polymer (CFRP) bridges for the SAMPE student bridge competition. The team began by creating a composite model to simulate 3-point bending scenarios and predict bridge performance. Concurrently, they fabricated an initial composite bridge and multiple design variations to explore structural optimization. These designs were physically tested to assess load-bearing capacity and failure modes. Based on these results, a final, competition-ready CFRP bridge will be fabricated and submitted to the SAMPE bridge competition in 2026.

Project Snapshot

1. Designed and built bridges to carry maximum weight with minimal weight
2. Gained hands-on experience in composite manufacturing and structural engineering
3. The team is ready to participate in the national contest showcasing innovation and teamwork

Impact Mechanics of Foams

TEAM MEMBERS
Caitlyn Knoerzer, Ahmed Shah

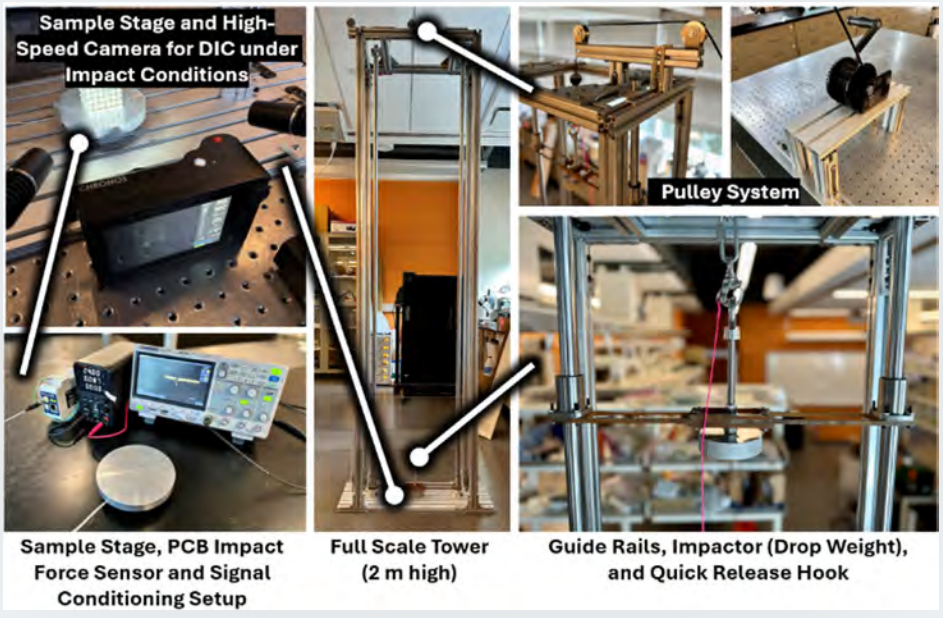
PROJECT MANAGERS
Behrad Koohbor, Matthew Heras

SPONSORS
National Science Foundation

This project advances the development of 3D-printed auxetic (negative Poisson ratio) structures engineered to mimic the mechanical behavior of flexible foams. Building on the results obtained in previous semesters, the team continues to design and fabricate novel geometries while integrating new experimental capabilities. A temperature-controlled chamber is developed to enable testing under cold and elevated temperatures, expanding the understanding of thermal effects on material performance. Multiscale image correlation techniques, paired with high-speed photography, are used to analyze deformation in impacted structures. The team is also designing and testing rotating-cell structures with density gradients, using stress-strain data to inform optimization algorithms.

Project Snapshot

1. Created 3D-printed flexible structures that mimic foam-like behavior
2. Built a chamber to test materials in both hot and cold conditions
3. Used high-speed cameras to study how new materials respond to impacts



Cultivate Soft Robotics

TEAM MEMBERS
Kathy Trieu, Aiden Tahmazian, MarcAnthony Scalera, Marcus Sosa, Jason Lee, Kinsey Ginsberg, Macy Gregory, Markus Lewis, Matthew Emann, Jessica Wesnofske, Brittany Forbes, Vincent Mullary, Joshua Gross, Devin Hughes, Dharma Upadhyay

PROJECT MANAGERS
Wei Xue, Mitja Trkov, Smitesh Bakrania and Cassandra Jamison

SPONSORS
National Science Foundation

Soft robotics is an emerging field that envisions soft-bodied robots performing everyday tasks. Although research in this area has advanced significantly, educational efforts have yet to fully keep pace. This project bridges that gap by providing students with hands-on opportunities to engage directly with soft robotics and by creating student-generated modules to spark learning and interest in the field. Over the past year, our team developed nine unique hands-on lab modules, each accompanied by physical prototypes and comprehensive instructor documentation. These modules include: Robotic Heart, Hex Tech, Musculoskeletal, Chameleon Tongue, Thermal Crawler, Jaws, Mechanical Design Adaptable Claws, Actuation Machine, and Material Science Gripper. Designed for broad adoption, these learning modules aim to equip the next generation of engineers with practical knowledge of soft robotics, fostering innovation and expanding educational opportunities in this rapidly growing field.

Project Snapshot

1. Bridged the gap between soft robotics research and student education.
2. Created nine hands-on lab modules with prototypes and instructor guides.
3. Designed modules for easy adoption into mechanical engineering curricula.

Stirling Engine Project

TEAM MEMBERS
Arthur Anenberg, Arthur Mathew Walker, Emma Benkovic, Jeremy Reilly, Tommy Peters, Prince Washington

PROJECT MANAGERS
Smitesh Bakrania and Krishan Bhatia

Students were tasked with creating an engaging hands-on project for the Introduction to Thermal-Fluid Sciences (iTFS) course. The team developed a soda-can-based Stirling engine project, including a build procedure for the base model and an advanced prototype to maximize output. They analyzed power output and developed a testing procedure to assess engine performance. The team also supported the implementation of this project in Spring 2025, where over 85% of students successfully built functioning engines and completed thermodynamic analyses. Additionally, the team created a secondary project for another course to introduce sophomores to basic engine testing.

Project Snapshot

1. Team developed a project involving household materials to build a working engine
2. Over 85% of students taking the course produced a functioning engine
3. All students completed a thermodynamic analysis of the engine

Beyond Learning Analytics

TEAM MEMBERS
Selena Johnson, Michael Howell

PROJECT MANAGERS
Paromita Nath and Smitesh Bakrania

Our past work used learning analytics from online engineering courses to understand student behaviors, such as how and when students interact with lecture videos. However, this data is limited—it's difficult to uncover "why" these behaviors occur. To address this gap, the clinic team added student interviews to provide context behind the interaction patterns. Students analyzed anonymized data from two Mechanical Engineering courses taught by the same instructors, allowing for more controlled comparisons. Large language models (LLMs) were used to identify themes in both the course interaction data and student reflections. These interviews revealed motivations behind behaviors like rewatching content before assessments or skipping familiar material. The addition of this qualitative context will help us design more effective and supportive learning experiences for students.

Project Snapshot

1. The team interviewed students who have taken online courses to gain behavioral insights
2. LLMs were used to analyze the themes and gain better understanding of prior data
3. Students are preparing this work for journal publication

Self-Sustainable Energy System for New Jersey

TEAM MEMBERS
Diana Martin-Baul, Alejandro Ramirez-Jimenez, Gabriel Castro, Gershon Awa Mokom

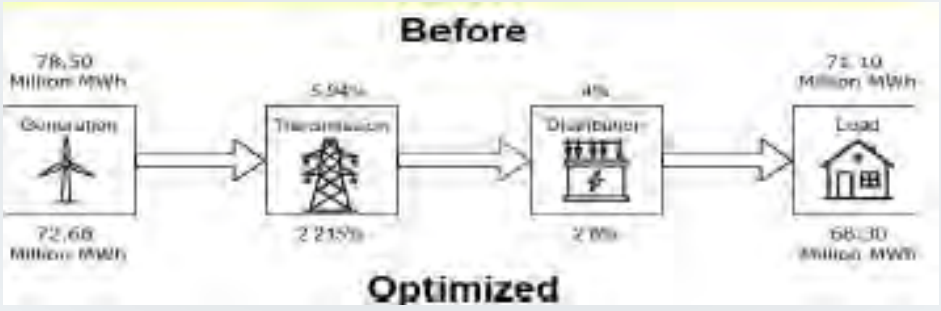
PROJECT MANAGERS
Yashwant Sinha

The project looked at optimizing sustainable power generation using renewable energy resources and optimizing transportation, distribution, and power utilization to make NJ self-sustainable in power generation and utilization. Preliminary results show that by making use of smart energy systems, upgrading electrical infrastructure, and supporting the development of energy consciousness in users can enable NJ can become self-sufficient in its energy needs.

Project Snapshot

1. NJ has been an importer of electricity. To make NJ sustainable in its energy needs, generation, transmission, distribution and utilization (GTDU) of power need optimization.

2. This work optimized power GTDU using algorithms and coding. Results show 10 year ROI for upgrades and smart power.



Using Wasteful Energy from Electronic Devices

TEAM MEMBERS
Jacob K Boyle, Brandon D Tran, Jasleen Kaur Jaswal

PROJECT MANAGERS
Yashwant Sinha

Wasteful energy is widely prevalent, and techniques and devices need to be designed to harness such energy and optimize the way we manufacture devices and source energy. This project looked at harnessing energy from a laptop using thermocouples and provided a broader overview of the potential of such approach in making our energy systems smart.

Project Snapshot

1 Many electronic and electrical devices generate a significant amount of energy in the form of heat and light. This project investigated if such wasteful energy could be harnessed for other productive uses.

Too Much Rim

TEAM MEMBERS
Victor Adeyeri, Tim Estlow, Susannah Llugani, Michael Neuls, and Ryan Zheng

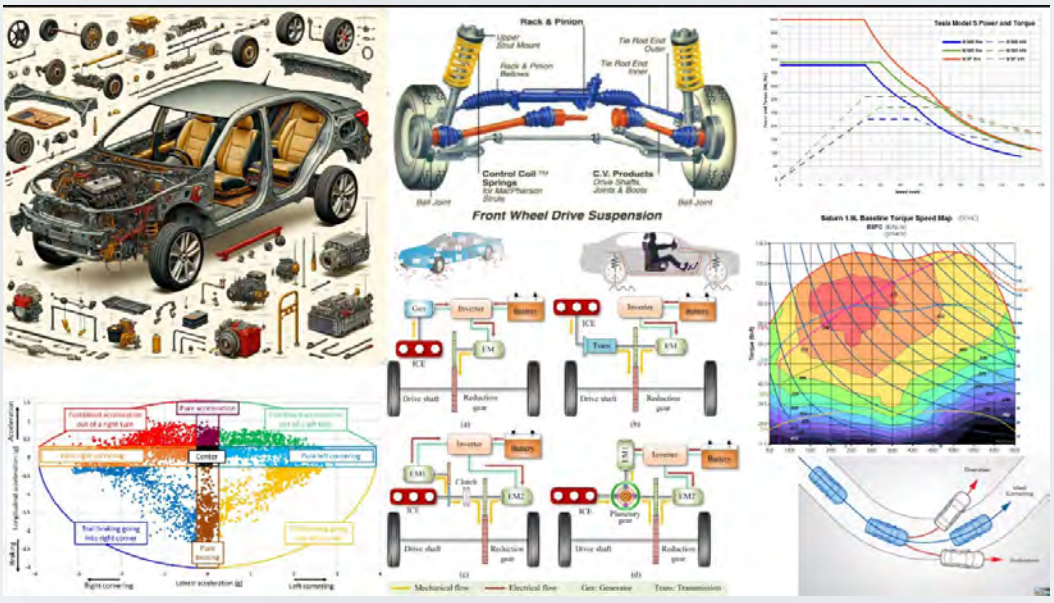
PROJECT MANAGERS
Krishan Bhatia

The goal of this project was to develop hands-on automotive engineering related projects for students in courses such as Vehicle Dynamics, Internal Combustion Engines, and Powertrains. Projects involve vehicle level measurement, data acquisition tools, interfacing with on-board diagnostic equipment, and data processing/analysis (in Matlab). These projects should improve automotive engineering education at Rowan. Students developed nearly a dozen projects measuring things such as ride quality, suspension natural frequency and damping, steering geometry, engine efficiency and vibration, exhaust noise levels, transmission shift strategy, and drive cycle efficiency.

Project Snapshot

1. Student team developed numerous automotive experimental projects related to Vehicle Dynamics, Internal Combustion Engines, and Powertrains

2. Team then created a website for future students to access and run these experimental projects



Exoskeleton for Fall Prevention

TEAM MEMBERS
Zach Roberts, Sarah Smith, Fawaz Mallick, Nathan Mains, Luca Franco, Preston Haddon, Thomas Peters

PROJECT MANAGERS
Mitja Trkov

SPONSORS
National Science Foundation (NSF)

Falls is a leading cause for injury for the elderly. The goal of this project is to create an exoskeleton which prevents falls by detecting gait perturbations in real time. Students worked on improving the hip-knee exoskeleton design to increase comfort and functionality. Instrumented brace and OpenSim model were developed to quantify human-brace interaction force. Improved bench test setup for testing and IMU suit for kinematic data collection were developed.

Project Snapshot

1. Students improved the hip exoskeleton design to increase comfort and functionality Instrumented brace and OpenSim model were developed to quantify interaction forces

2. Improved bench test setup and IMU suit were developed

Soft Assistive Glove

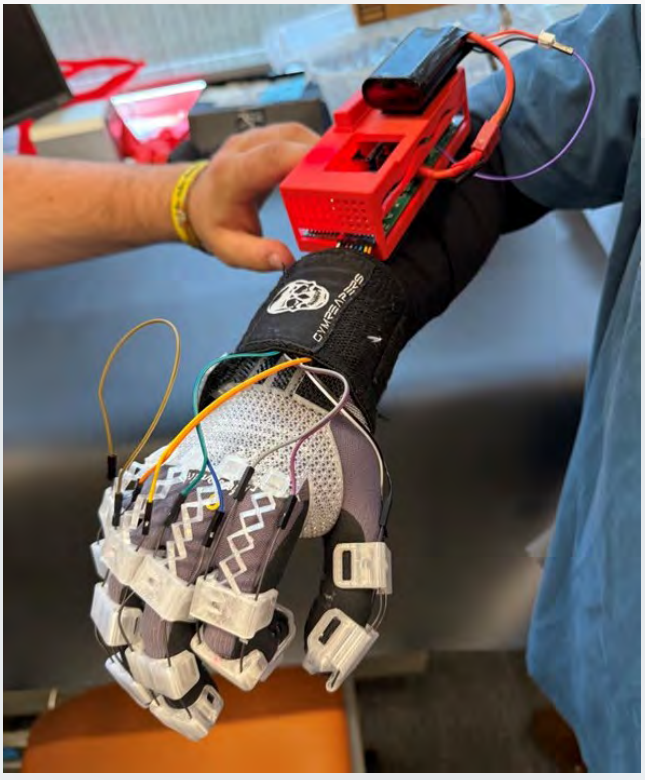
TEAM MEMBERS
Vanesa Hutchinson, Connor Ferraris, Macy Gregory, Nicholas Martino, Matthew McBurney, Julian Porras Arcos, MarcAnthony Scalera, Christopher Zupko, Harrison VanDewater

PROJECT MANAGERS
Mitja Trkov

The goal of this project was to develop a soft assistive glove that can assist users during grasping, pinching, or other daily tasks, while providing a sleek, comfortable, and safe experience. In our design, we used shape memory allow (nitinol wire) as an actuating member that can bend into a desirable position when an electric current is provided and closes the finger into that respective position. The glove was designed to be lightweight and wearable. All the electronics and battery included and mounted on the lower arm. Preliminary test were conducted to evaluate the deformation and force produced of an individual finger as well as a pinch strength. Thermal and electrical/power analysis through simulations and analytical calculations were performed for selected nitinol wire to investigate the safety and actuation duration of the glove.

Project Snapshot

1. Students developed a soft assistive glove to assist users with grasping and pinching
2. Experimentally evaluated the bending, force, and pinching capabilities
3. Thermal and electrical analysis were performed for selected nitinol wire



Improve the Design of a Farming Robot

TEAM MEMBERS
William Maguire, Gavin Yiu, Zaid Mazahreh, Cole Cahill, Jacob Wojcicki, Anthony Alliegro, James McLaughlin, Brian Smith,

PROJECT MANAGERS
Hong Zhang

Farming robot is the core of the precision agriculture, where it can automatically recognize weed and crop, and then accurately spray corresponding herbicide or fertilizer. This will improve productivity and reduce pollution. In this clinic, the student team continuously transforming the proof-of-concept farming robot to a working prototype. They redesigned the transmission mechanism from chain drive to direct drive. They also replaced 3D printed parts to more rugged machined aluminum parts. The motor control panel is also streamlined for easier troubleshooting and future expansion.

Project Snapshot

1. Redesigned the transmission mechanism.
2. Streamlined the motor control panel.
3. Cleaned up documentation.

Develop a Quadruped Robot

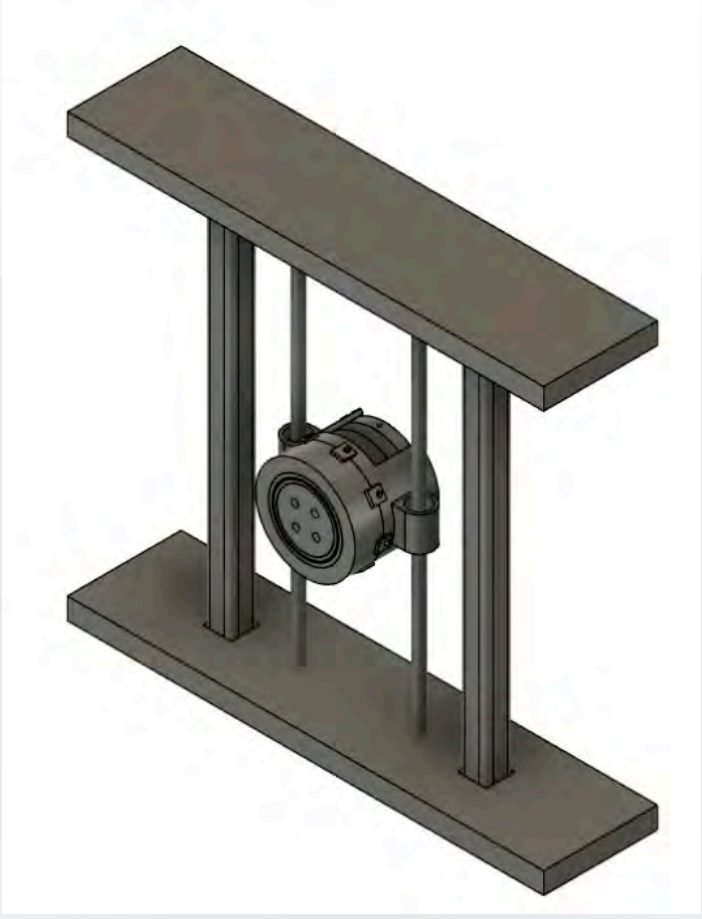
TEAM MEMBERS
Chris Rios, David St John, Oluwaferanmi Sodimu, Peter Romeo, Ethan Blankman, Nicholas Del Rossi, Jake Van Slooten, Zachary Tucker

PROJECT MANAGERS
Hong Zhang

A quadruped robot can be used in surveillance, site reconstruction, and remote construction, etc. The Rowan team is trying to build a fully functional quadruped by starting with a working linkage. Based on open source, the team finished a basic set including a brushless motor, a custom-build motor controller, and a cycloid-drive based reducer. This set built a foundation for a complete let and then a fully functional robot dog.

Project Snapshot

1. Design and built a compact gear-reducer based joint.
2. Design and custom build a PCB board to control a brushless motor.
3. Test the performance of the motor-joint linkage.



ASME Design Competition — Bearing Ball Sorter

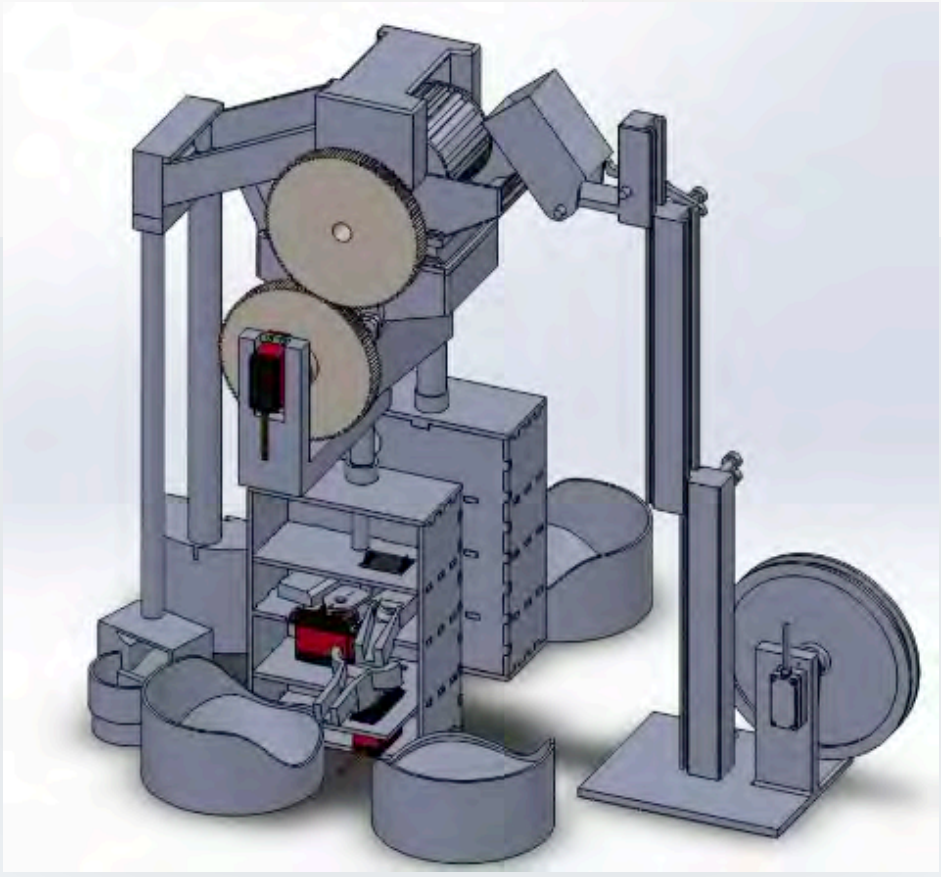
TEAM MEMBERS
Zachary Freese, William Heil-Heintz, Matthew Stavalone, Alexander Vosper

PROJECT MANAGERS
Hong Zhang

The project is to compete the annual ASME student design contest. The goal is to separate 60 bearing balls with two sizes and three materials. An auger system is used to elevate the balls from the floor to top for sorting. Then a size-sorting hopper separate the 1/4" balls from the 1/2" ones. On each size, a combination of magnet, weight, and color based mechanisms are used to differentiate the balls with different materials.

Project Snapshot

1. Developed an auger and dump system to lift up the balls.
2. Use magnet, weight and color to differentiate steel, brass and nylon.
3. Use different sizes of channels to separate different sizes of balls.



Acoustic Propulsion System

TEAM MEMBERS
Sean Vuksanic, Anthony Franchino, Andrew Mastro

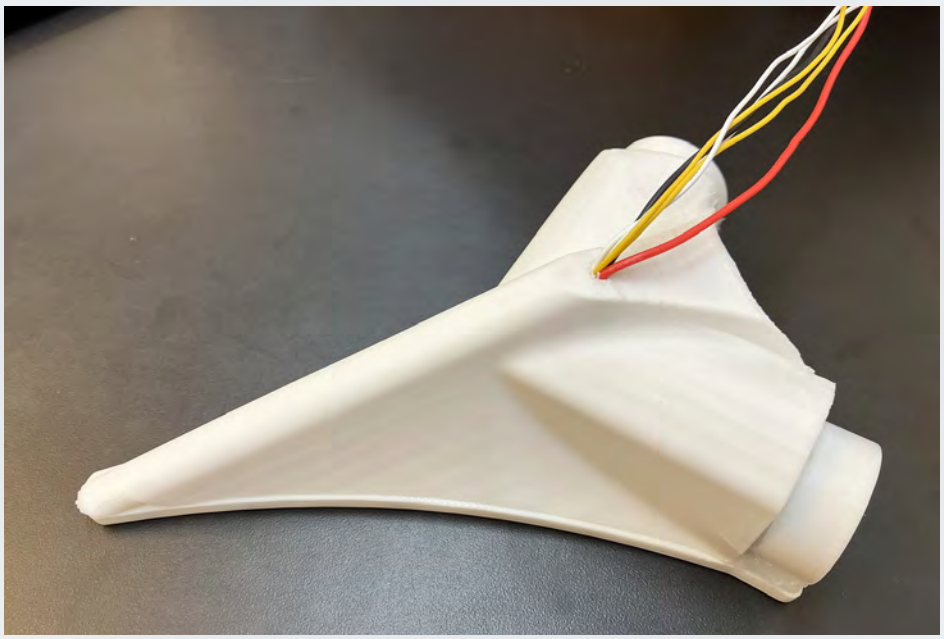
PROJECT MANAGERS
Chen Shen, Chadi Ellouzi

SPONSORS
National Science Foundation

In this project, we designed an acoustic propulsion system and tested its performance for 3-D motion control of a mini-robot in water.

Project Snapshot

1. Designed an acoustic propulsion system to drive mini-robots in water without having any moving parts.
2. Optimized and tested the mini-robot in water using ultrasound transducers.
3. Full 3-D motion control in water.



Sonic Guns for Drones

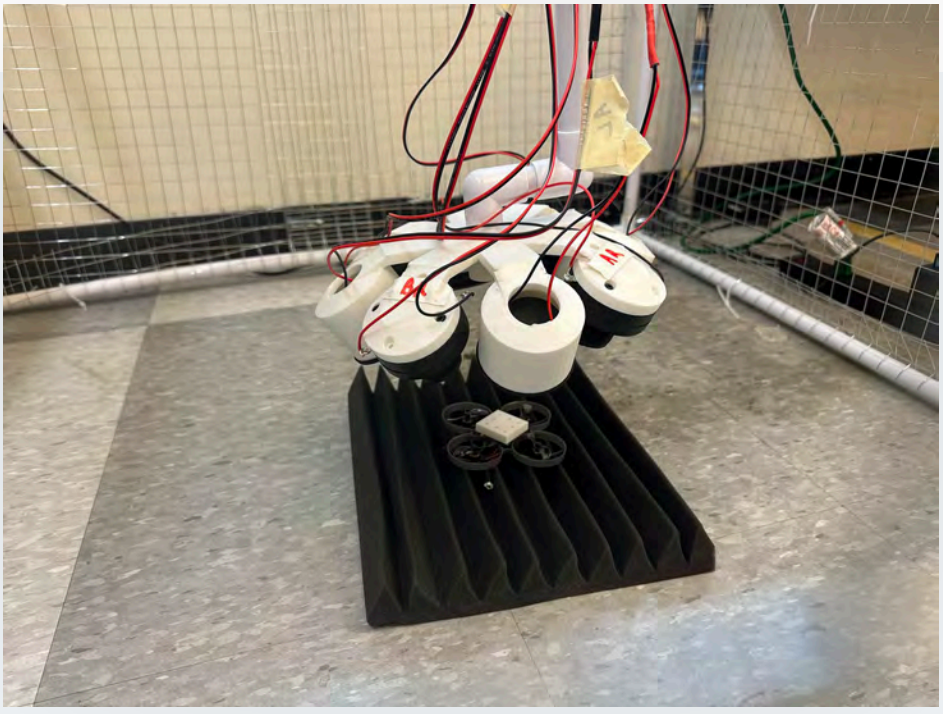
TEAM MEMBERS
Samuel Vandzura, Ivan Anderson, Matthew Emann, Harrison Tashjian

PROJECT MANAGERS
Chen Shen, Corey Churgin

In this project, we implemented an ultrasound wave technique for drone attack by generating resonance of drone sensor modules, and also researched associated defense strategies.

Project Snapshot

1. Developed a “”sonic gun”” to knock out drones remotely using ultrasound waves by inducing strong vibration of the sensors and corrupting their output.
2. Performed preliminary tests on the effectiveness of this approach.
3. Designed acoustic filters to defend this attack.



Low-Grade Waste Heat Recovery

TEAM MEMBERS
Thomas Brown, Leonardo Failla, Glen Vosgerichian

PROJECT MANAGERS
Amin Nozariasbmarz

Waste heat, particularly below 100 °C, represents a largely untapped renewable energy source. This project explores thermomagnetic materials to generate continuous electricity through cyclic heating and cooling. This process converts even small temperature differences as low as 1 °C into electricity. The system utilizes Gadolinium's low Curie temperature (around 21 °C) to create a continuously rotating ring system. This rotation was coupled with a custom-designed axial flux generator to directly convert waste heat into electricity.

In this project, students gained extensive hands-on experience in the design, manufacturing, testing, and simulation of a thermomagnetic generator for energy generation from low-grade waste heat. This involved simulations, 3D printing, machining, manufacturing processes, and circuit design. Furthermore, they enhanced their understanding of materials science, thermal transport, magnetic properties, and renewable energy principles.

Project Snapshot

1. Design and build a thermomagnetic generator for low-grade waste heat recovery
2. Enable to convert small temperature differences as low as 1 °C into electricity
3. Students gained extensive hands-on experience

Mobile Medical Refrigerator

TEAM MEMBERS
Gavin Bates, Kyle Knowles, Matthew Mastej, Andrew McGlynn

PROJECT MANAGERS
Amin Nozariasbmarz

Thermoelectric coolers (TECs) are reliable solid-state devices recognized for their compact size, silent operation, rapid response time, and vibration-free performance. This project investigates the design and fabrication of a mobile medical refrigeration device suitable for transporting organs or vaccines using a TEC. The design comprises internal and external containers. The TEC transfers heat from the internal to the external container. The internal container is sealed and fully insulated to maintain the temperature between 2 to 8°C, while the external container functions as a passive heatsink. The TEC is powered by a battery, and a circuit was designed to manage TEC operation.

Students gained extensive hands-on experience in system design, manufacturing, testing, and simulation of TECs and heatsinks. They were able to resolve heat transfer and sealing issues refrigeration unit. They enhanced their knowledge of TECs, materials science, thermal transport, and cooling principles.

Project Snapshot

1. A mobile medical refrigeration system was fabricated using thermoelectric coolers
2. The device can be used to transport human organs or vaccines over long distances
3. A unique passive heatsink design was made to maximize heat transfer

Hot Water Energy Recycling

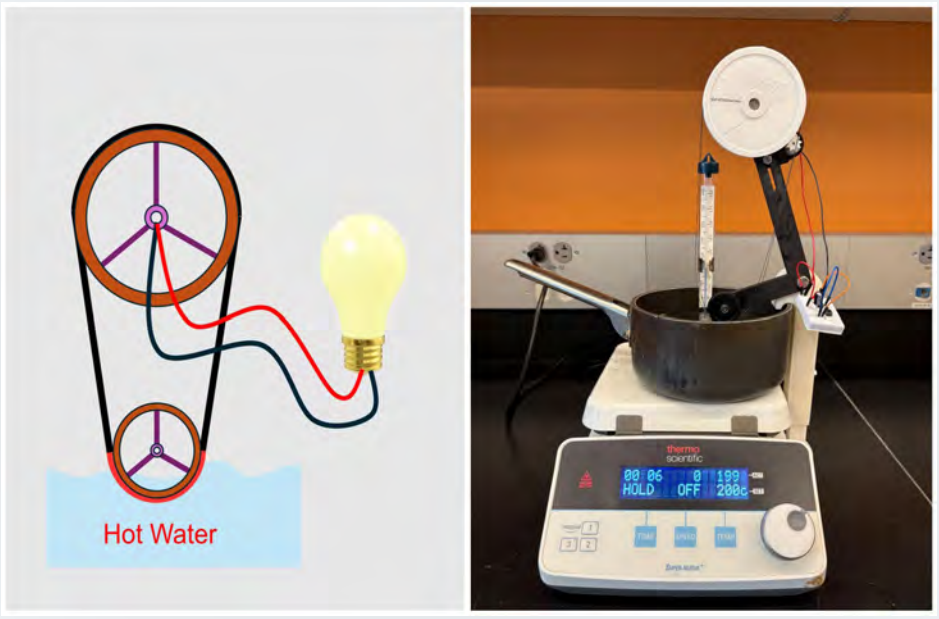
TEAM MEMBERS
Chris Bender, Ian Janaszik, Braden Waller

PROJECT MANAGERS
Amin Nozariasbmarz

Shape memory alloys (SMAs) such as Nitinol are a unique class of materials that can “remember” their original shape upon heating. They have various applications in the medical, aerospace, and automotive industries. This project utilizes this unique characteristic to design a heat engine that can directly convert thermal energy, as a renewable energy source, into mechanical energy and further generate electricity from mechanical energy. Hot water was used as a heat source. Nitinol wire was welded to a loop, and it was used to drive a 3D printed pulley and gear system. Students gained extensive hands-on experience in pulley and gear system design, manufacturing, and testing. They enhanced their knowledge of materials science, heat transport, and gear trains.

Project Snapshot

1. Hot water energy recycling is enabled using shape memory properties
2. A pulley system was fabricated to continuously run Nitinol wire
3. Analyze student data for effectiveness of the immersive case study implementation



BAJA SAE Senior Clinic

TEAM MEMBERS
Brayden Bruseo, Addison Deckert, Hunter Givone, Ryan Hussey, Lorenzo Linarducci, Sebastian Maslach, Erin Miklencic, Briana Roman, Christopher Spicer, Ethan Struble, Anthony Tramontana, John Truitt, Edgar Velazquez, Jason Wheeler

PROJECT MANAGERS
Anu Osta

SPONSORS
Gene Haas, Polaris, Penske, HMS Motorsports, KHK, Metlab, Summit Racing, Rowan SGA

The Society of Automotive Engineers (SAE) hosts the annual Baja Collegiate Design Series, challenging student teams to design, build, and test a single-seat, all-terrain vehicle. As part of Rowan University's clinic experience, a team of sixteen students designed and manufactured a 4WD vehicle in accordance with SAE regulations. The project was divided into several subsystems: transmission, suspension, frame, brakes and throttle, safety, and data acquisition. Throughout the Fall 2024 and Spring 2025 semesters, the team focused on completing the vehicle's manufacturing. The finished vehicle was tested in various performance areas, including acceleration, maneuverability, endurance, hill climb, and towing capacity. The team competed in Épreuve du Nord 2025 in Canada, Oktobaja Fest 2024 in NY, and Rowan Rumble 2025 in NJ, and is scheduled to participate in the Baja SAE competition in Mechanicsville, MD in Summer 2025.

Project Snapshot

1. Students built and tested a working off-road vehicle from the ground up.
2. Team gained hands-on skills in design, manufacturing, and problem solving.
3. Project fostered collaboration, leadership, and real-world engineering experience.

BAJA SAE Junior Clinic

TEAM MEMBERS
Christian Bruno, Jaydon Elcock, Lucas Garabo, Alex Garfield, Carlo Importuna, Nate King, Scott Marcuson, Zander Marks, Paul Porreca, Rocco Raimondi, Nick Stephan, John Sikoski, Andrew Vasiliou, Blake Viggiano, Tien Vu, Emery Whitescarver

PROJECT MANAGERS
Anu Osta

SPONSORS
Gene Haas, Polaris, Penske, HMS Motorsports, KHK, Metlab, Summit Racing, Rowan SGA

The Society of Automotive Engineers hosts annual competitions where student teams design and build a single-seat, all-terrain vehicle following strict design rules. These vehicles are tested in both static and dynamic events that evaluate their engineering, performance, and durability. The junior clinic team began designing in summer 2024 with the goal of creating a lightweight yet reliable vehicle. The team plans to compete in regional competitions throughout 2025 and 2026. The car will undergo extensive testing, with redesigns as needed to address any issues. The team is organized into key subsystems: frame, transmission, front suspension and steering, rear suspension, brakes and throttle, safety, and data acquisition. Reliability is the top design priority, with careful weight reduction strategies aimed at improving long-term performance. This hands-on project helps students apply classroom concepts to real-world engineering challenges in a competitive and collaborative environment.

Project Snapshot

1. Students built and tested a working off-road vehicle from the ground up.
2. Team gained hands-on skills in design, manufacturing, and problem solving.
3. Project fostered collaboration, leadership, and real-world engineering experience.

Developing Teaching Modules

TEAM MEMBERS
Zachary Tucker, Adrian Segovia, Aidan Pham, Adrianna Cirucci

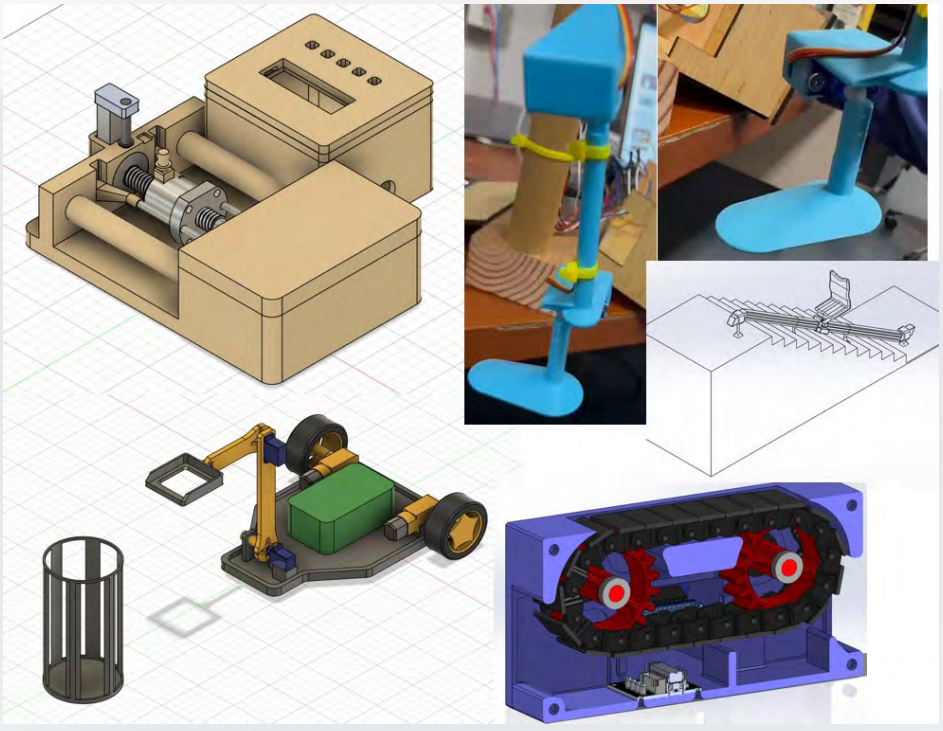
PROJECT MANAGERS
Anu Osta

SPONSORS
Proctor and Gamble, NJ Health Foundation

In this clinic, students developed hands-on demonstration and lab modules using a range of design and manufacturing tools. These included 3D printing, CNC machining, microcontroller programming (PLC and Arduino), laser and waterjet cutting, electronics, and robotics. Students combined custom-made components with off-the-shelf electronics and applied programming and CAD modeling to complete their projects. The modules supported courses in Manufacturing, Mechanical Design, and Materials. Key projects included: (1) a mini tensile tester for weak elastomeric materials, (2) an industrial conveyor model, (3) a remote-controlled bot for simple gaming tasks, (4) a prototype human leg prosthesis, and (5) a modular, portable stair-assist device for individuals with limited mobility. This clinic gave students the opportunity to explore real-world design challenges while building technical skills across mechanical, electrical, and software domains.

Project Snapshot

1. Students built working prototypes to solve real-world design challenges.
2. Projects blended hands-on skills in electronics, coding, and fabrication.
3. Designs focused on everyday needs, like mobility and material testing.



Sustainable 3D Printing

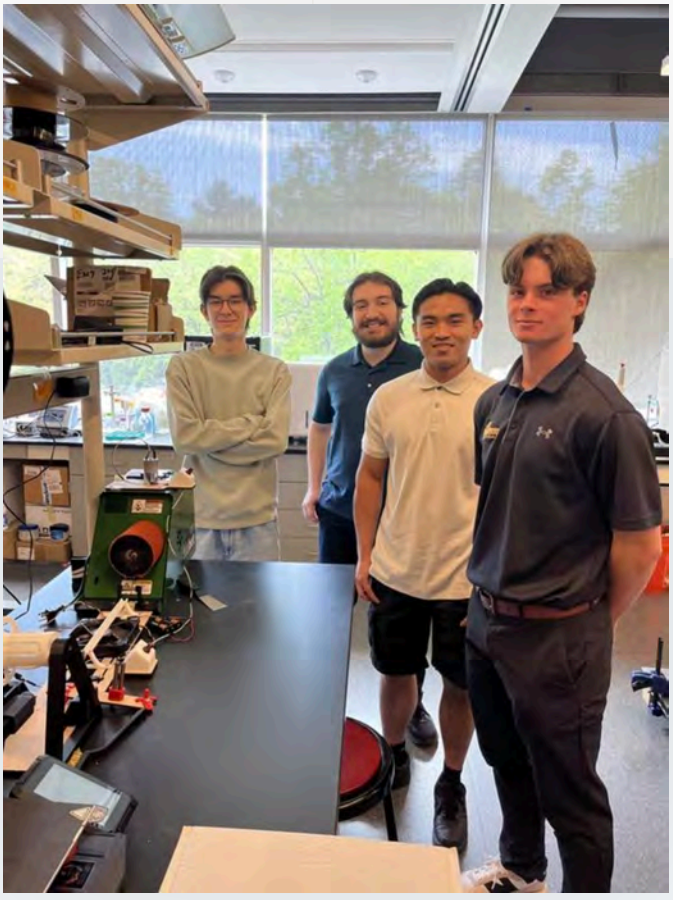
TEAM MEMBERS
Jordan Malgapo, Kevin Cole, Alessio Sainato, Tristan Wyskiewicz

PROJECT MANAGERS
Paromita Nath

This clinic project explored the potential for recycling and reusing 3D printed thermoplastics with a focus on polylactic acid (PLA), a widely used material in campus makerspaces. Students developed a closed-loop workflow that included shredding, drying, extruding, and reprocessing discarded prints into usable filament. Recognizing that mechanical and thermal properties degrade with repeated recycling, the team experimented with mixing recycled material with neat polymer and other additives such as lignin. These efforts aimed to improve material performance while promoting sustainable practices in 3D printing. Initial testing showed encouraging improvements in strength, thermal stability, and flow behavior.

Project Snapshot

1. This project established a repeatable recycling process for 3D printed materials.
2. To address property degradation from repeated recycling, the team mixed reprocessed PLA with neat PLA and lignin.
3. By supporting onsite recycling the project promotes sustainability in makerspaces.



Shredder for 3D Printed Parts

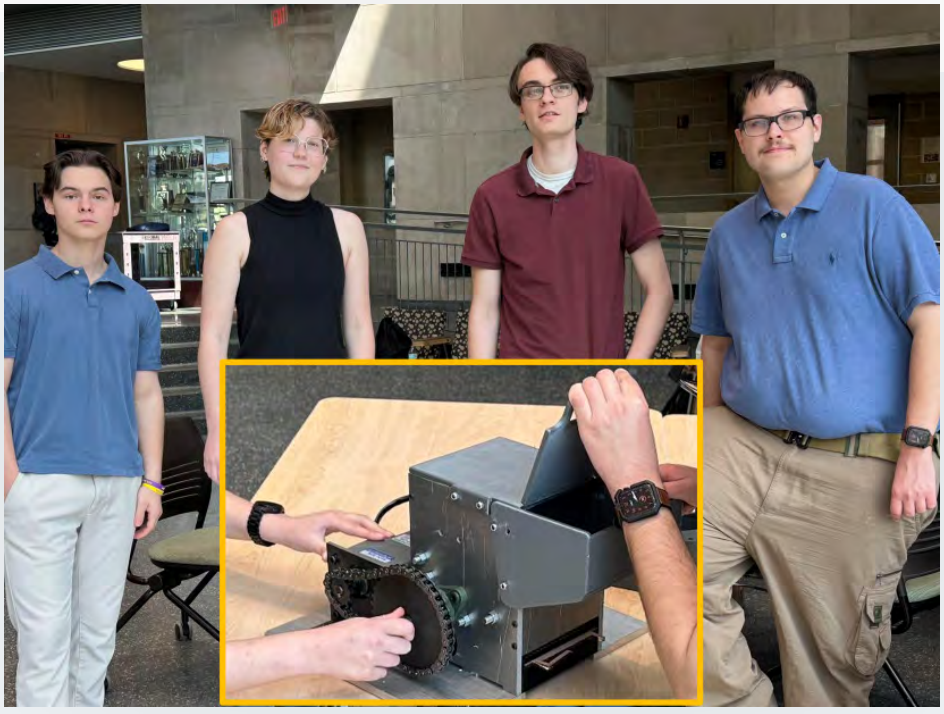
TEAM MEMBERS
LeeAnn Cleckner, Michael Brito, Eric Carty, William Covert

PROJECT MANAGERS
Paromita Nath

Last semester, students built a prototype shredder to process discarded 3D printed parts on campus for recycling into filament. While the concept proved viable, the initial design had several limitations. This semester, the clinic team began by evaluating the earlier version through targeted performance tests, identifying key mechanical and operational shortcomings. The critical components were redesigned to increase output, improve material flow, and integrate safety features such as protective guards and emergency shutoffs. This resulted in a more robust, user-friendly solution tailored to the university's 3D printing labs. By developing this in-house shredder, students are advancing sustainable 3D printing practices in campus makerspaces.

Project Snapshot

1. The team designed a shredder to process discarded 3D prints, enabling recycling of waste into reusable filament.
2. The previous prototype was analyzed and redesigned to improve efficiency, safety, and performance.
3. The shredder was customized to support sustainable 3D printing practices on campus.



Rowan Rocketry

TEAM MEMBERS
Rowen Christianson, Elise Heim, Daniel Rodriguez, Jake Robinson, Ilinca Vilceanu, Caleb Slusarski, Nina Stonitsch, Aidan Sharpe, Marian Yanka, Sarah Ely, Victoria Van, Justin Dougherty, Marcelo Bisicchia, Jeremiah Francois, James Lee, Nolan Heaney, Bamidele Obadina, Ryan Kane, Kevin Osborn, Tyler Jones, Jared Crane

PROJECT MANAGERS
Charlotte de Vries, Aditya Lele

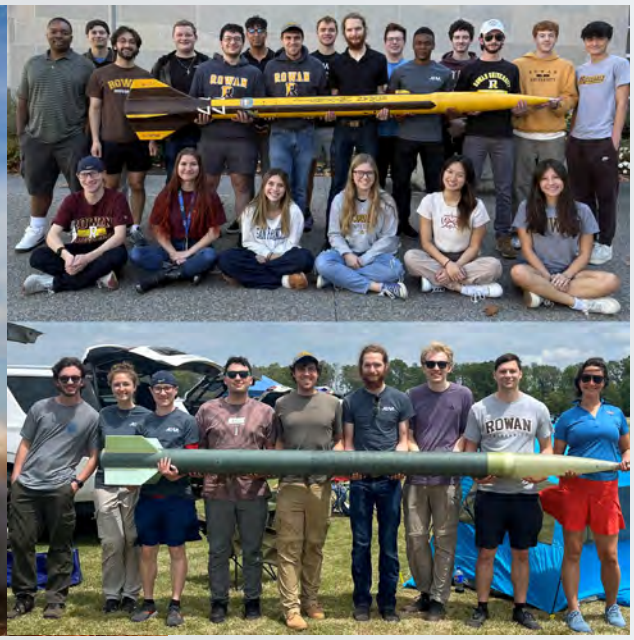
SPONSORS
AIAA Club

The Rowan University Rocketry Team participates in the Spaceport America Cup, the world's largest intercollegiate rocket engineering competition. This event, sponsored in part by American Institute of Aeronautics and Astronautics (AIAA), provides a unique opportunity for students to apply their knowledge by designing, building, and launching rockets.

Their mission for this year's competition was to construct a sounding rocket capable of exceeding an altitude of 10,000 feet. The team is organized into six specialized sub-teams—airframe, avionics, payload, recovery, propulsion, and operations/logistics. Each sub-team plays a critical role in the development process, from structural design to data transmission and safe recovery, ensuring the success of their rocket. This year's rocket, "The Profecy," will carry a payload consisting of a small rover "Lil Planty" that will plant a flag in the ground as proof of a successful mission.

Project Snapshot

1. Design, build, and launch a rocket capable of exceeding an altitude of 10,000 feet.
2. Create a payload capable of showcasing scientific or engineering merit
3. Compete among 150 student rocketry teams



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