

Advancing Environmental Justice Through Movement-Engaged Participatory Research

Students will conduct research in collaboration with environmental justice activist groups. This will include identifying and summarizing relevant academic literature, drafting policy briefs and white papers, and working on scholarly manuscripts. Topics of interest include 1) policies to achieve a just transition away from fossil fuels and plastic production, 2) carbon offsets and credits, 3) solidarity and inclusion within the environmental movement ecosystem, and 4) disasters, mutual aid, and social vulnerability, among other topics.

Advisor: Fernando Tormos-Aponte, *Sociology*

Student: Abigail Wolf, *Law, Criminal Justice and Society, Anthropology (John C. Mascaro Scholar)*

Development of a Reusable Pulse Oximeter Prototype

A comparative life cycle analysis of disposable versus reusable pulse oximeters (manuscript in preparation) showed that the reusable probes have a more favorable environmental profile and 35 times less global warming potential than the disposable probes. We propose using human-centered design principles to address the challenge of implementing reusable pulse oximetry probes in clinical settings. The selected summer intern would work within the SSOE IDEA Lab to address this problem and would also contribute to other ongoing projects within the lab to provide a holistic exposure to the innovation, design, and entrepreneurship process.

Advisor: Kevin Bell, *Bioengineering*

Student: Riya Kothari, *Bioengineering (John C. Mascaro Scholar)*

Nutrition Security & Sustainability

A poor diet is a significant risk factor for chronic diseases. The concept of Food is Medicine (FIM) highlights the crucial link between diet and health. A healthy diet benefits both individuals and the planet. When food is wasted, it generates harmful methane gas in landfills. We will analyze the nutrient content and carbon footprint of the food that is donated through the University of Pittsburgh Food Recovery Heroes to measure the increase in nutrient security and decrease in carbon footprint through sustainable food decisions between UPMC and the University of Pittsburgh.

Advisor: Corey Flynn and Dr. Michael Boninger, *Office of Sustainability in the Health Sciences (OSHS)*

Student: Jennifer Snyder, *Nutrition and Dietetics (John C. Mascaro Scholar)*

Determination of Sustainable and Selective Polystyrene Degradation Mechanisms

Polystyrene is one of the most chemically inert and resilient plastics, but the polymer structure presents significant challenges for recycling. This project aims to develop a more sustainable and selective method of polystyrene degradation using mild reaction conditions, visible light, and green oxidants. Students will apply spectroscopic and computational techniques to fully characterize the oxidation mechanisms responsible for selective polystyrene degradation.

Advisor: Kimberly Carter-Fenk, *Chemistry*

Student: Melody Reynolds, *Chemistry (John C. Mascaro Scholar)*

Filtration properties of binder jet 3D printed porous metals for reusable filter applications

Over the past years, we have worked on printing filters for air and liquid filtration applications that can be reused instead of disposed of after one use. Furthermore, for specific applications, e.g. healthcare, these filters can be made from antibacterial/antiviral copper and are therefore ideal for environments with heavy bacteria and virus exposures. In this project, we want to further enhance filtration capabilities and improve the pressure drop of our 3D printed filters to add even more benefit to these reusable filters.

Advisor: Markus Chmielus, *Mechanical Engineering and Materials Science*

Student: Ethan Kinyon, *Mechanical Engineering and Materials Science (John C. Mascaro Scholar)*

Developing and Conducting a Scope 3 Greenhouse Gas Inventory

The Center for Sustainability is a newer department at UPMC, so we are in the beginning stages of developing methods for conducting a UPMC systemwide greenhouse gas inventory. 2023 is the first year of a scope 1 and 2 inventory, so 2024 will be the first year with a scope 3 inventory. The student will help with data collection, data analysis, methods creation, and research on other scope 3 calculators to help create a tailored calculator for UPMC.

Advisor: Sydney Crum, *UPMC Center for Sustainability*

Student: Trent Stross, *Computational Biology (John C. Mascaro Scholar)*

On the limits of disaster insurance

As our climate changes, so does the frequency and intensity of natural disasters. People insulate themselves (at least financially) from these risks by purchasing insurance. However, as these events become more common, the calculus of insurance policies start to break down and become economically infeasible. For instance, we see such events already occurring in the Florida market for housing insurance. In this project we will explore the limits of these policies and propose modifications. This project will be primarily theoretical/mathematical in nature.

Advisor: Michael L Hamilton, *Business Analytics and Operations*

Student: Jiayi Wang, *Marketing Science and Business Analytics (John C. Mascaro Scholar)*

Modeling Climate Change Impacts on Insect-Pollination Dependent Crops

This project seeks to evaluate the impact of climate change on insect-pollination dependent crops. We will identify regions and crops most resilient/vulnerable to effects of climate change and identify management strategies for sustainable crop production.

Advisor: Vikas Khanna, *Civil and Environmental Engineering*

Student: Jarod Hart, *Sustainable Engineering and Environmental Engineering (John C. Mascaro Scholar)*

Understanding management and services of urban and backyard ponds in Pennsylvania

Our current understanding of aquatic ecology is largely focused on pristine ecosystems. However, many amphibians and aquatic invertebrates live in human-altered habitats under different and unknown management regimes. The student associated with this project will work to contact land managers to understand the management practices (dyes, algicides, etc.), and the services and values that ponds provide to different landowners (golf courses, cemeteries, private residences).

Advisor: Kevin Kohl, *Biological Sciences*

Student: Randy Richardson, *Biological Sciences (John C. Mascaro Scholar)*

Detecting low-cost retrofit solutions in homes

This project focuses on identifying air leakage in homes using thermal imaging technology to improve energy efficiency. Thermal cameras detect temperature differentials, highlighting areas where heat escapes or drafts infiltrate through poorly sealed windows, or doors. We will develop a hybrid approach that uses machine learning and building models to automatically detect such anomalies, compensating for potential inaccuracies from low-cost thermal cameras. This cost-effective solution aims to reduce energy consumption and lower utility bills for a wide range of homes.

Advisor: Stephen Lee, *Computer Science*

Student: Raymond Zong, *Computer Science (John C. Mascaro Scholar)*

Solar Panel Recycling

This project aims to develop new methods to enhance the recycling of solar panels at the end of their life cycle (EOL). While solar energy is a rapidly growing renewable and sustainable power source, around 90% of EOL solar panels currently end up in landfills. This project focuses on improving material separation processes to reduce waste and support more efficient recycling efforts.

Advisor: Paul Leu, *Industrial Engineering*

Students: Ruoyi Xu, *Chemical Engineering (John C. Mascaro Scholar)*

Yuankai Zhang, *Industrial Engineering (John C. Mascaro Scholar)*

Sustainable Glass

This project focuses on creating environmentally friendly glass with high transparency to help combat global climate change. The goal is to produce glass with a lower carbon footprint and reduced melting temperature, while maintaining excellent transparency. These advanced glass materials would be ideal for applications in buildings, infrastructure, solar energy, and consumer electronics, enhancing energy efficiency and promoting sustainability.

Advisor: Paul Leu, *Industrial Engineering*

Student: Madeleine Stone, *Mechanical Engineering (John C. Mascaro Scholar)*

Investigation and mitigation of climate change impacts on Pennsylvania regions

In this project, an open data and open model cyberinfrastructure software system (CyberWater) will be used to analyze future climate predictions from complex Earth system models (e.g., CMIP6) under different CO2 emissions scenarios. The project will also explore strategies for better managing the impacts on water resources and energy in Pennsylvania and other regions of the U.S.

Advisor: Xu Liang, *Civil and Environmental Engineering*

Student: Alex Taylor, *Civil Engineering (John C. Mascaro Scholar)*

Using Generative AI to Identify Sustainability Gaps in Healthcare

This project will focus on using generative AI, large language models such as GPT and LLaMa, for retrieving application specific knowledge in the health domain to evaluate the sustainability practices, identify gaps, and propose improvements for these practices. We will use the existing set of tools in MeLoDy lab to access LLMs through APIs and collect large amounts of information and data from articles, organize them in a structured form, and analyze the collected information to generate recommendations.

Advisor: Natasa Miskov-Zivanov, *Electrical and Computer Engineering*

Student: Ethan Estatico, *Information Science (Doug Condon Scholar)*

Fiber Optic Sensing, Modeling, Application and Data Processing for Energy Infrastructure Monitoring

Fiber optic sensing will be applied for monitoring of energy infrastructure such as pipelines and pressurized vessels. Students will have a chance to experimentally work with measurements using fiber optic sensors and/or utilize physics-based modeling of responses to understand how data can be optimally processed and applied.

Advisor: Paul Ohodnicki, *Mechanical Engineering and Materials Science*

Student: Fangchun Li, *Engineering Science (Frank and Daphna Lederman Scholar)*

EvolvingSTEM: a three-dimensional laboratory evolution curriculum to increase STEM occupational identity through authentic experiences

Our aims are to assess program impacts on subject learning and STEM attraction in high school biology classes. We will assess high school student attitudes and motivation toward STEM-related careers with established surveys based on the STEM occupational identity survey and focus group interviews. Students will be grouped by starting attitude and evaluated after standard and extended inquiry programs. We will assess student understanding with pre- and posttests based on AAAS Project 2061 and aligned to NGSS performance expectations, which include a focus on environmental education and sustainability. We will track durability of STEM attraction by longitudinal self-reporting and opinion surveys. We will evaluate the effects of near-peer mentors and curriculum duration on student's identity as researchers.

Advisor: Cassie Quigley, *Teaching, Learning, and Leading*

Student: Nathan Cho, *Chemistry and Teacher Education (John C. Mascaro Scholar)*

Data-Driven Analysis of Landfill Greenhouse Gas Emissions through Statistical Modeling and Geospatial Insights

This project aims to analyze greenhouse gas (GHG) emissions from landfills across the United States using statistical modeling and geospatial mapping. The goal is to identify key factors influencing emissions and map geographic trends to support real-time decision-making and targeted sustainability practices. Objectives:

1. Statistical Correlation Analysis: The goal is to assess the relationship between landfill characteristics, such as waste volume, ownership type, equipment suppliers, and GHG emissions. This analysis aims to uncover significant drivers of emissions and provide insights into the effectiveness of reduction strategies.
2. Geospatial Mapping of Emissions: This geospatial analysis seeks to identify high-emission hotspots and regional trends, supporting a clear understanding of emission distributions across the country.

Advisor: Amin Rahimian, *Industrial Engineering*

Student: Ethan Furr, *Data Science (John C. Mascaro Scholar)*

Sustainability research project on a selected topic

This project aims to advance sustainability learnings and commitments based on research on a selected topic of student's interest. Student is encouraged to bring a proposal. The project will cover fundamental knowledge on sustainability, guiding principles, and basic approaches for sustainable development. It will explore scientific literature on the selected topic and provide an analysis to highlight the most promising opportunities for further development. The project will elaborate on the most active research centers in the field, sources of publication, current initiatives and tools for analysis. It is aimed to approach a life cycle analysis of the material or process. Student will get training in project management and advancing research on sustainability.

Advisor: Joaquin Rodriguez, *Chemical and Petroleum Engineering*

Student: Phoebe Esser Katz, *Mechanical Engineering (John C. Mascaro Scholar)*

Electric Vehicle Charging Infrastructure in Pennsylvania: Addressing Barriers to Adoption

This research will examine how the availability and distribution of electric vehicle (EV) charging stations impact the growth of EV market in Pennsylvania. It will explore how strategically placed charging stations can alleviate concerns such as range anxiety, boost consumer confidence, and drive EV adoption. Additionally, the study will address other challenges, including the availability of fast-charging stations, infrastructure affordability, and the sustainability of the energy used. This research aims to evaluate how an optimized, sustainable EV charging network can support Pennsylvania's transition to electric mobility and reduce carbon emissions.

Advisor: Ramin Shabanpour, *Civil and Environmental Engineering*

Student: Tianshun Li, *Marketing Science and Business Analytics (John C. Mascaro Scholar)*

Using Diatoms to Reconstruct Environmental Change

The major objective of the proposed research is to use previously obtained sediment cores from lakes in Chile and Pakistan to reconstruct climate and environmental change over the Common Era. The student will sample diatoms from sediment cores and identify diatoms to species to indicate past environmental conditions. Hydroclimate variability as indicated by diatoms will be compared with planktonic (water column) diatoms dominating relative abundance during warmer conditions and periphytic (attached) diatoms dominating relative abundance during cooler conditions in Patagonia and the Himalayas. Diatoms will be used to indicate changes in water quality conditions, system tropic status, and lake level.

Advisor: Patrick Shirey, *Geology and Environmental Science*

Student: Rebekah Mischler, *Environmental Science (Charles and Linda Sorber Scholar)*

Towards Circular Use of Polyurethanes

Recycling plastic waste is essential to reducing environmental pollution, conserving resources, and minimizing the carbon footprint of polymeric materials. Polyurethanes, widely used as insulation materials, flexible foams for furniture and bedding, coatings, sneakers, and cell phone cases (to name a few of their many uses!) are particularly important in this context due to the absence of any effective recycling solutions. We are investigating two different approaches towards PU recycling - careful chemical disassembly using targeted catalysts, and robust pyrolysis technology based on using molten metals as novel catalytic reaction media.

Advisor: Goetz Vesper, *Chemical and Petroleum Engineering*

Student: Helayna Baer, *Chemical Engineering (John C. Mascaro Scholar)*

Design spinel ferrite magnetic adsorbents for water purification

In this project, advanced computational methods will be used to predict the capability of a series of spinel ferrites for removing metal ions (such as Pb, As) from industrial wastewater. The outcome of the project is to identify the optimal composition and morphology of spinel ferrite particles to chemically adsorb and remove metal ions from the water.

Advisor: Guofeng Wang, *Mechanical Engineering and Materials Science*

Student: Zhe Lu, *Material Science and Engineering (Charles and Linda Sorber Scholar)*

Can Improved Waterway Quality Enhance Economic Resilience in Coal Communities?

The student will assist with researching the experience of particular communities in coal producing regions of Pennsylvania, some of which have waterways still polluted with mine drainage and some of which have had cleanups. The case studies will focus on understanding the role that cleanups (or lack of them) have played in revitalizing local economies. These case studies will complement more systematic data analysis that the student researcher, if desired, could participate in work on.

Advisor: Jeremy Weber, *School of Public and International Affairs*

Student: Aidan Semanco, *pursuing Master of Public Administration – Energy and Environment (John C. Mascaro Scholar)*

Additive manufacturing of nonclassical alloys with multi-principal elements for improved sustainability

The goal of this project is to design and study a nonclassical alloy known as multi-principal element alloys (MPEAs), also referred to as high-entropy alloys. The purpose of this work is to (1) develop a functionally graded alloy with a high entropy composition gradient between traditional alloys and thus enable their functionality, and (2) develop a new composition through computational thermodynamics for improved sustainability. The student can have the opportunity to design a new alloy, in addition, they could also design a co-free cemented carbide to reduce the toxicity of the transitional cutting tool made by this material. The students involved in this project will get a chance to learn the state-of-the-art metal 3D printing techniques as well as the materials characterization.

Advisor: Wei Xiong, *Mechanical Engineering and Materials Science*

Student: Sasha Roth, *Engineering (John C. Mascaro Scholar)*

Energy and Smart Data Analytics

Innovative energy research and developing smart dashboards and analytics to inform design making for hospitals and healthcare.

Advisor: Kate Zettl, *UPMC Center for Sustainability*

Student: Joshua Raj, *Data Science and Statistics (John C. Mascaro Scholar)*

Surveying the Woody Vegetation across Powdermill Nature Reserve to Track Change Over Time

The woody vegetation across Powdermill's 2,000 acres of forested habitat was exhaustively surveyed in 2008-09. Seventeen years later, we are interested in how the forest community has changed due to factors including climate change and invasive species. A field crew of 6 will revisit the >500 original survey plots during the summer of 2025 and collect data on the species and size of trees and shrubs currently living here, giving us valuable insights into how this Appalachian habitat is adapting to these changes.

Advisor: Andrea Kautz, *Carnegie Museum of Natural History and Esmee de Cortie, MCSI*

Student: Keanna Marcelo, *Environmental Science (Carnegie Museum of Natural History Scholar)*

Using CURE-Based Labs to Investigate Environmental Stress Response Genes in the Grain Crop Sorghum

Develop a CURE (Course-Based Undergraduate Research Experience) Lab at WVU; identify genes involved in environmental stress responses in the grain crop Sorghum bicolor; perform yeast plasmid transformation, genome annotation, and create a yeast expression library; assist with curriculum development, creation of handouts and protocols, and assessment design.

Advisor: Melissa Lehrer, *West Virginia University*

Brackenridge Scholar: Jacob Halka, *Molecular Biology (Brackenridge Scholar)*