

Integrating Sustainability into Engineering Courses:

MEAM 1010 Introduction to Mechanical Design (Fall 2023)

MEAM 2300 Bicycles: The Mechanical Advantage (Spring 2024)



Lead: Dustyn Roberts, PE, PhD (University of Pennsylvania – Engineering)
 Partners: Jessi West (Neighborhood Bike Works)
 Sarah Stuart (Bicycle Coalition of Greater Philadelphia)
 Jarrett Stein (University of Pennsylvania – Netter Center, Rebel Ventures)
 Monique Dowd (University of Pennsylvania – Nursing)

Introduction

Procedure and Progress

Impact and Scaling

MEAM 1010

- Course taught every semester to ~85 students (1/3 mechanical engineers)
- Limited engineering course options for 1st year students outside of math/physics core courses
- Limited course offerings overall that involve sustainability
- Integrate sustainability into MEAM 1010 to reach 95% of mechanical engineers and many other students & majors
- Implement SolidWorks sustainability add-in and leverage EOP learning outcomes in **Design**, **Materials Selection**, and **Environmental Impact Measurement**

MEAM 2300

- New class designed for 1st-2nd year students that will incorporate sustainability
- Uses bicycles as a platform for teaching topics that range from statics and dynamics to transportation engineering
- List class as Academically Based Community Service (ABCS) course
 - Neighborhood Bike Works
 - Bicycle Coalition of Greater Philadelphia
- Leverage EOP learning outcomes from **Critical Thinking**, **Social Responsibility**, **Systems Thinking**, and **Communication and Teamwork**

MEAM 1010

- Created “Attitudes towards sustainability” survey based on existing literature to establish a baseline
- Implemented SolidWorks sustainability add-in to an existing project. Students had to design wooden puzzle cubes and start with a default set of material and assumptions in the add-in (wood, manufactured in Asia, used in North America, etc.). Then, they had to change at least two things, note the impact, and reflect on the differences.

MEAM 2300

- Course successfully rostered and designated as an Academically Based Community Service (ABCS) course. It is currently full with a growing waitlist.
- Continued work with original partners
 - Neighborhood Bike Works
 - Will train 8 students as volunteer bike mechanics and participate in guest lecture
 - Bicycle Coalition of Greater Philadelphia
 - Will provide event-based volunteer opportunities and participate in guest lecture
- Integrated major new partner(s) through Penn4C
 - Jarrett Stein of Netter Center, Rebel Ventures
 - Monique Dowd, Nursing
 - Students will design and utilize bike-powered blenders with local high school students

MEAM 1010

- Integrate sustainability into more exercises & projects
- Create better methods to evaluate impact
- Apply for IRB and publish pre/post attitudes towards sustainability

MEAM 2300

- Build out course content and assignments to specifically leverage EOP learning outcomes from Critical Thinking, Social Responsibility, Systems Thinking, and Communication and Teamwork
- Continue work with new partners to scale up smoothie bike project from one to three high schools and create smoothie bike labs

Both

- Continue to document progress in ASEE Conference paper “Sustainability in Engineering Graphics and Bicycle-Powered Blenders” (accepted to ASEE 2024)

References

1. The Lemelson Foundation (2022). The Engineering for One Planet Framework: Essential Sustainability-focused Learning Outcomes for Engineering Education (2022). Retrieved [December 19, 2023] from EOP_Framework_2023.pdf (engineeringforoneplanet.org)

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