Women's Technology Program

https://web.mit.edu/wtp/

Inspiring the Next Generation

Barbara Hughey, Ph.D.
WTP Director

Nov 7, 2024

Mission

To spark interest in the future study of engineering among high school rising seniors who are unsure about their future plans.

Generate Interest in Engineering

“I realize that engineering has so much more depth and so many more applications than I had thought. I'm looking forward to finding a field of engineering that I am really interested in and pursuing that in the future .”

Increase Confidence in Abilities

“I gained confidence in my academic abilities and now feel like I might thrive in a STEM-focused environment, whereas before I wasn't as sure about my path after high school.”

WTP History

STUDENTS 2002 - 2024: 1,108

EECS: 750 ME: 358

2002 Founded in the Department of Electrical Engineering and Computer Science (EECS) as part of a Master’s Thesis by Doug Ricket

2006 Mechanical Engineering (ME) curriculum track added with 20 students. EECS track accepted 40 students from 2003 - 2019.

2020 No WTP programs in 2020. In 2021 and 2022, programs were virtual, with boxes of supplies sent to students’ addresses.

2023 WTP-ME returned to an in person program at MIT.. *WTP-EECS went on hiatus after the 2022 program*

Key Program Features

01

Experiential, Active Learning
Students are ***actively responsible*** for their own learning in a ***collaborative*** setting, developing ***critical thinking skills*** while working on college-level, open-ended problems.

02

Gain Confidence and Independence
Students work and build friendships with ***people from different backgrounds***, developing intuition and ***embracing the unknown*** and failures as a means toward success

03

Positive Impact on WTP Staff
MIT undergraduate and graduate students teach the WTP students, ***facilitating group problem solving*** and hands-on exploration, giving back by ***passing on their passion for engineering***.

WTP Approach

Give students an in-depth, 4-week exposure to Engineering

- Give a “deep dive” into Mechanical Engineering, rather than a survey of multiple engineering fields
- Students learn what it might be like to be a practicing engineer.

Admit students who excel at Math and Science but are not already on the path to engineering

- Most students have not been exposed to engineering in high school
- Students attend the 4-week program the summer before senior year, so they may be influenced to apply to engineering programs in college

WTP Approach

Hands on Classes with Problem Solving and Engineering Labs

- Classes cover basics concepts of physics and mechanical engineering, providing the background needed for the capstone projects

Two Capstone Projects provide opportunity to “be an engineer”

- Third week poster project allows students to do an in-depth analytical, computational, or design study of a problem of interest to them
- Final week Rube Goldberg challenge - hands-on design and fabrication

MIT Students/Recent Graduates are Instructors and Residential Tutors and act as role models for students

Faculty and Industry Guest Speakers and Tours

Program Logic Model

Inputs
- Participants
- Instructors + Tutors
- MIT Staff
- Computers + Internet
- Lab + Shop Equipment
- MITx
- Industry Connections
- Residential Living Spaces

Activities
- Video lectures covering MechE Theory + the women behind it
- Group Problem Solving exploring real-world situations
- Conducting experiments, processing data, and communicating results
- Interacting with and presenting research
- Designing and Building RGM
- Lunch talks
- Field Trips to companies
- Round-table discussions
- Exploration of Boston
- Collecting data in CLP
- College fair
- Monthbook

Outputs
- Students understand what it means to be a mechanical engineer
- Students understand technical essentials and how to apply them to real life problems
- Students can communicate scientific information clearly and accurately
- Students can communicate their ideas and discoveries to a wide audience
- Students are confident
- Students are aware of the accomplishments and support of other women

Outcomes
- Students are empowered to pursue careers in engineering
- Students have strong skills and are confident in their abilities
- Students build resilience and determination
- Students can advocate for themselves and others in a male dominated field
- Students share their experiences and learnings with their peers and mentees

Impact
- More women will pursue engineering careers
- There will be greater diversity of thought and experience in the field of mechanical engineering
- Engineering companies and institutions create an environment that is more welcoming to women entering the field
- **There is an increase in engineering breakthroughs and quality of life increases for everyone**

Assumptions
- **Women bring an invaluable diversity of thought into the workplace and having that diversity will encourage greater progress in engineering fields.**
- There are intelligent, motivated young women who lack experience and role models in engineering and are therefore deterred from entering the field.
- Exposing young women to engineering content + role models will inspire them to enter engineering.
- The flipped classroom approach is a well researched approach that engages students and helps them learn and be comfortable using class material in everyday application.

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If our students are exposed to material, labs, activities, and interpersonal connections in mechanical engineering, **then** more women will join the field, **leading** to an increase in important engineering breakthroughs.

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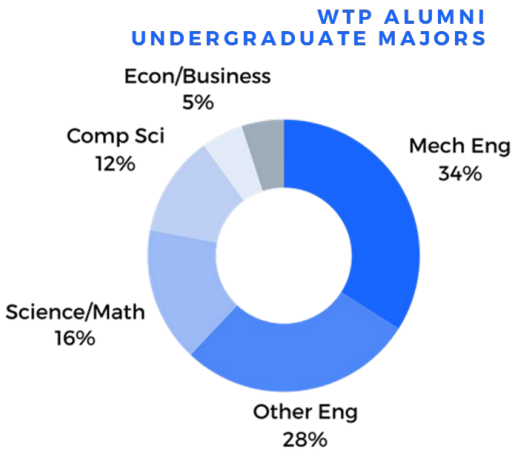
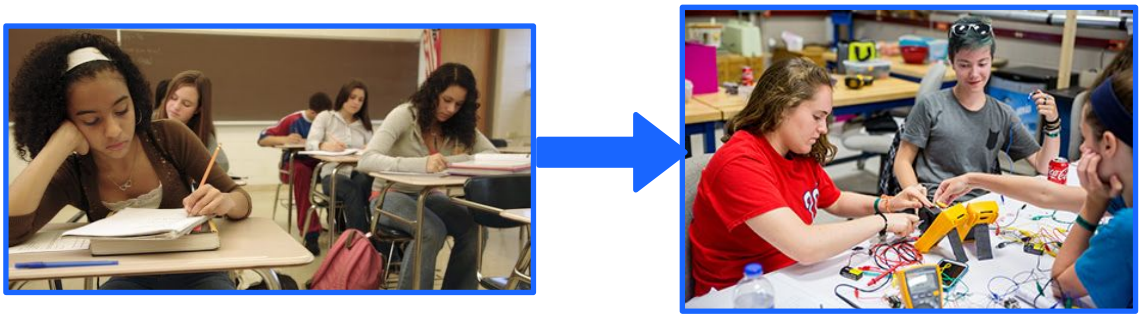
WTP Works!

WTP's high demand is evident each year, with hundreds of applicants vying for just 20 coveted spots. Since its establishment in 2006, the ME program has **positively influenced the lives of nearly 360 students**. Among those who have declared their college majors, **more than 74% have opted for engineering or computer science**. So far, 76 students have matriculated at MIT, with an impressive 83% selecting majors within the School of Engineering.

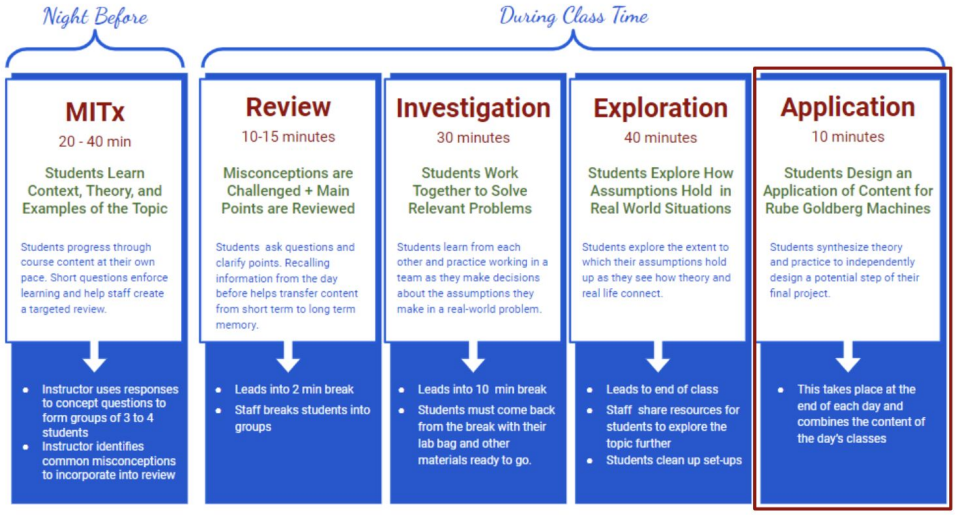


Collaboration

Changing class structure encourages collaboration and exploration

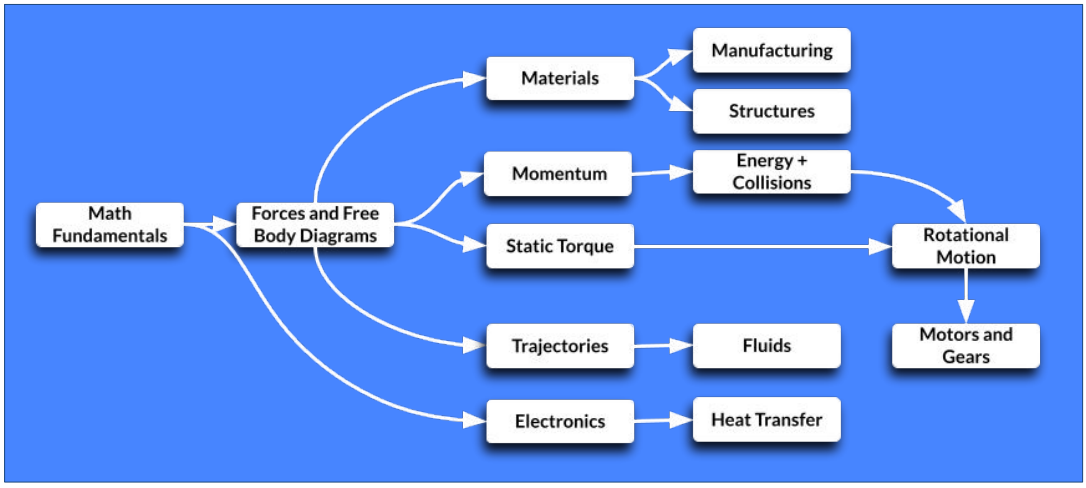


WTP Class Structure



Curriculum Threads

Technical Threads with Shared Themes



Energy Class: MITx

Course / Energy / Agenda + Learning Objectives

Previous

Learning Summary

Bookmark this page

Learning Objectives:

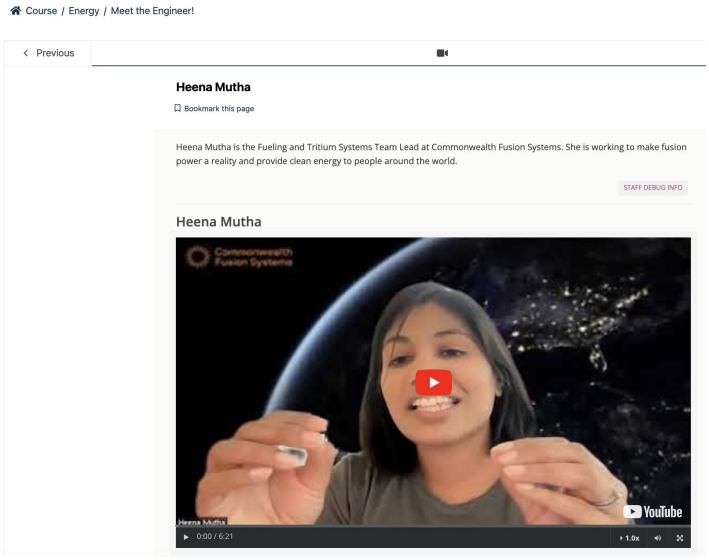
The goal of this module is to cover the ways we describe different types of energy and changes of energy in a system. By the end of this lesson, you should be able to:

- Describe what types of energy an object has in different situations
- Apply equations to calculate kinetic and potential energy
- Understand conservation of energy law
- Understand the relationship between energy, work, and power

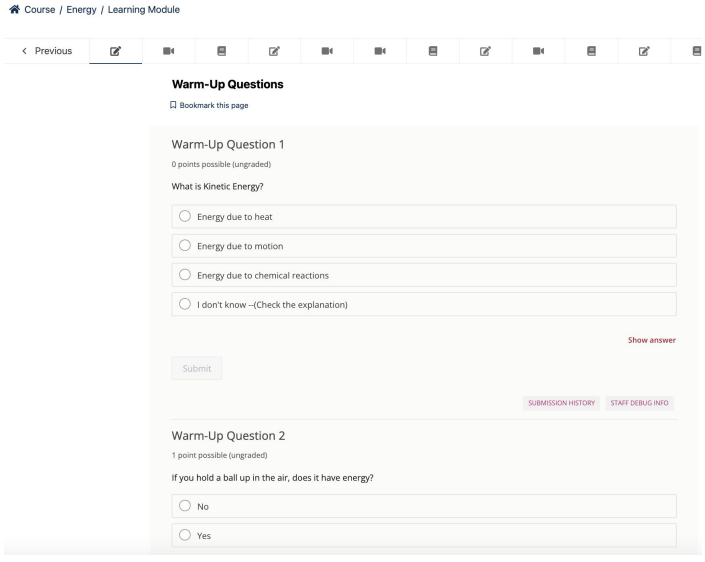
Agenda:

1. Types of Energy: (Kinetic, Gravitational Potential, Elastic Potential)
2. Conservation of Energy and Energy Losses
3. Work and Power

Meet the Engineer



Energy Warmup



Energy Conservation

Conservation of Energy

Bookmark this page

When energy is conserved: Total Energy Final = Total Energy Initial

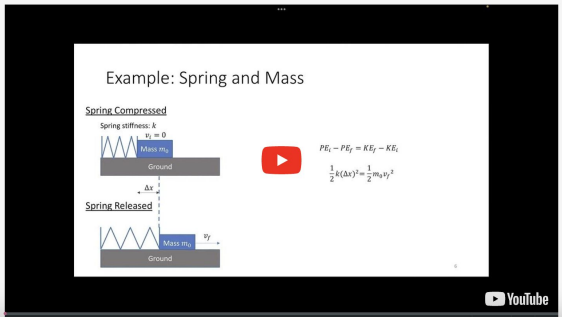
$$PE_f + KE_f = PE_i + KE_i$$

When some energy is lost:

$$Efficiency\,(\eta) = \frac{energy_{out}}{energy_{in}}$$

STAFF DEBUG INFO

Video



End of MITx

Course / Energy / Learning Module

Previous

Module Survey

Bookmark this page

Congratulations! You have completed the required work for Energy.

Please fill out this short, anonymous survey to give us feedback on the content of this learning module.

After the surveys you can move on to the next module, Materials.

Thank you!

Survey Responses

Class name	How long did it take you to complete the required MITx work?	What Speed did you watch most of the videos on?	Did you do any of the optional material?	Please rate how prepared you felt to answer the MITx questions based off of the information in the video.	To what extent do you feel like you can problem solve using the material in the MITx?	The MITx is currently set that it shows the correct answer after two incorrect attempts. What are your thoughts?	Kudos & Complaints: Please provide feedback on the MITx experience for this class so that we can improve it for future WTP-ME students
05 Energy	20 - 30 min	1.5	This class had no optiona	2	1	I do not like this: I would like more times to try the question	was slightly talked about (dissed about) during the natural gas video.
05 Energy	40 - 50 min	1.5	No	1	1	I have no strong opinion on this	
05 Energy	40 - 50 min	1.5	Yes, some of it	1	2	I like this	
05 Energy	20 - 30 min	1.75	This class had no optiona	1	1	I like this	NA
05 Energy	20 - 30 min	Normal	Yes, all of it	4	1	I do not like this: I would like more times to try the question	The energy videos seem to be lacking some information and are very in depth, but in a confusing way... maybe different videos would be better?
05 Energy	20 - 30 min	1.5	This class had no optiona	1	1	I have no strong opinion on this	Everything was great!
05 Energy	40 - 50 min	1.25	This class had no optiona	1	1	I like this	This system is good!
05 Energy	40 - 50 min	1.5	This class had no optiona	1	1	I like this	
05 Energy	30 - 40 min	2	This class had no optiona	1	1	I do not like this: I would like more times to try the question	I felt like the MITx gave me an understanding of the material.
05 Energy	20 - 30 min	2	This class had no optiona	1	1	I like this	
05 Energy	30 - 40 min	2	This class had no optiona	1	1	I do not like this: I would like more times to try the question	
05 Energy	30 - 40 min	1.25	No	2	1	I like this	
05 Energy	30 - 40 min	2	This class had no optiona	1	2	I like this	
05 Energy	greater than 50 min	2	This class had no optiona	1	1	I have no strong opinion on this	I may be biased from physics class, but I liked this section! The questions made sense and I was able to understand where I went wrong and the videos were clear.
05 Energy	40 - 50 min	1.5	This class had no optiona	1	2	I like this	
05 Energy	30 - 40 min	2	Yes, all of it	1	1	I have no strong opinion on this	
05 Energy	20 - 30 min	1.25	This class had no optiona	1	1	I do not like this: I would like the correct answer after one atter	Everything was perfect content wise and it was super interesting! I love the research part of the class!
05 Energy	30 - 40 min	1.5	This class had no optiona	1	1	I like this	NA

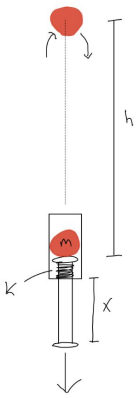
Group Problem to Lab

Group Problem

Energy & Momentum and Collisions

Problem 1

During this problem, you will explore conservation of energy. A spring launcher with spring constant k = 25 N/m is pointed directly upwards. It is loaded with a ball of m = 500 g and the plunger is pulled down 50 cm. Assuming that friction is negligible and the plunger is massless, we want to find the maximum height the ball will reach when launched.



a. What is the equation for the potential energy of the spring when pulled fully downwards?

b. What is the equation for the potential energy of the ball when it's reached its maximum height before starting to fall?

c. Before substituting in values for the variables, can you use conservation of energy with those two equations to isolate and solve for the unknown variable h? You will know you are done when you have an equation in the form of h = something.

d. Now, plug in the known values and solve for h. How does your h change if the spring constant changes? What about the mass of the ball, or distance the spring is compressed?

Lab Instructions

Energy

Summary

In this lab, you will explore the concept of conservation of energy in a simple launcher set up. The first part demonstrates the conservation of energy straightforwardly, while the second part shows the areas where you might get error if you neglect to consider things like friction, air resistance, and how different materials absorb and distribute kinetic energy.

If at any point you have questions or something isn't working right, make sure to ask a staff member!

Materials:

You should have received the following materials for this lab. Please check to make sure you have everything before starting.

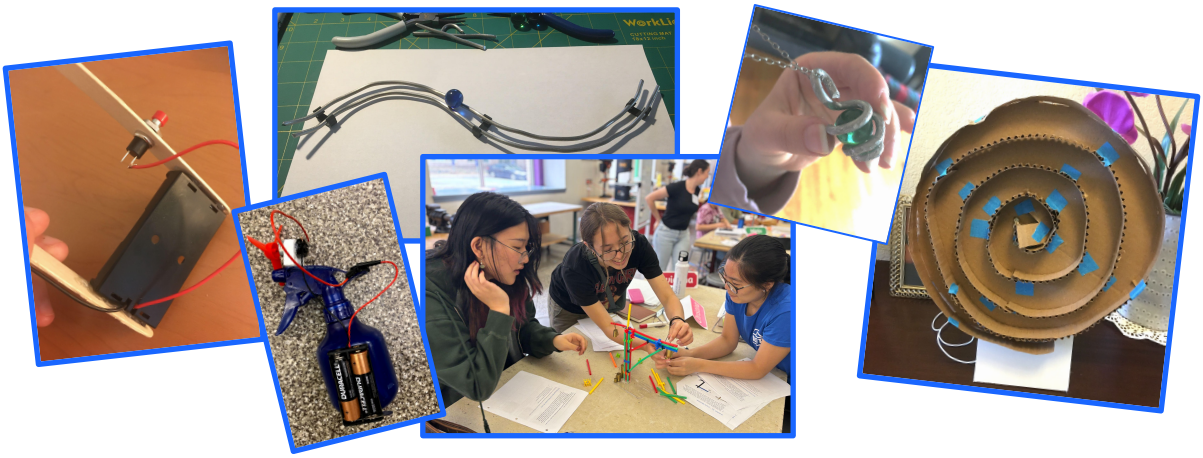
- ➔ 1 launcher
- ➔ 1 small wooden ball
- ➔ 1 small styrofoam ball
- ➔ Measuring tape

Instructions:

1. Pick up your spring launcher and find a good place to test it. You'll be shooting the two balls directly upwards, and will want to make sure that there are no obstructions or things that could be damaged when you do so. Assume that the ball **could** launch as far as 5 or so feet. The styrofoam ball has a mass: m = 0.08g. The wooden ball has a mass: m = 2.65 g. Using that information, fill in the table below.

Building Workshops

Building confidence through hands-on creation



Circuit Construction

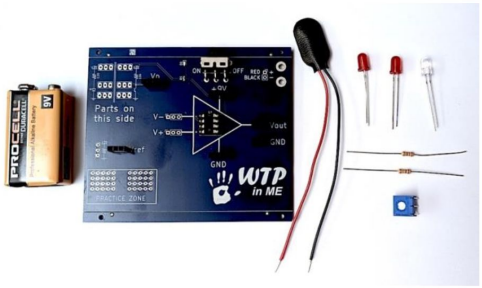
Women's Technology Program in Mechanical Engineering

Tachometer Circuit Construction Instructions

You have just been introduced to the circuit you are going to build today: the "guts" of a tachometer, a device used to measure rotational speed. These instructions will lead you through the activity, which will also be described by your instructor at the front of the room.

Put on your safety glasses if the are not already on!

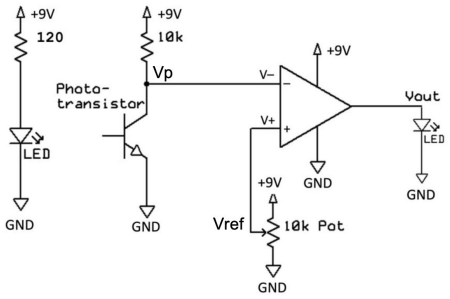
You should have a bag of parts as shown below:

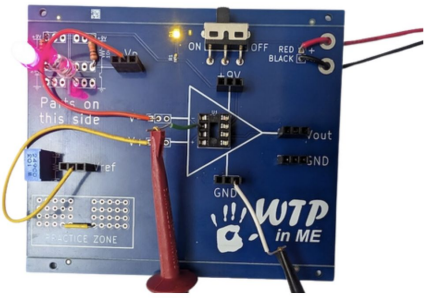


Simple Tachometer

Congratulations! You have created a tachometer! **Please ask staff for one of the hand drills to observe your tachometer in action.**

Completed Circuit (you may have wired and Vref differently than shown below, which is fine!)

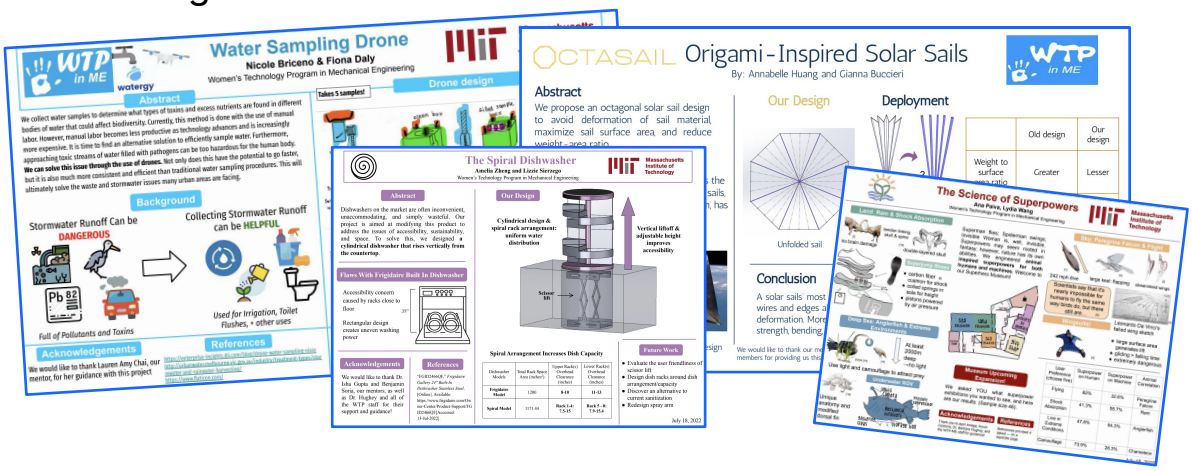




Acknowledgement: Many thanks to Steve Banzaert for design and fabrication of the new WTP cirucit board! *June, 2024*

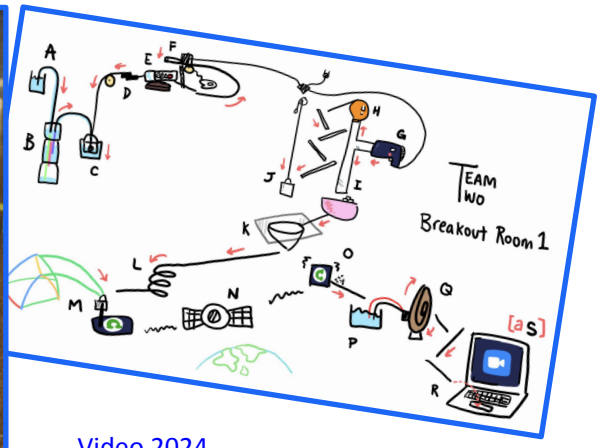
Research Projects

WTP students work in pairs with MIT mentors on projects in a wide range of areas tailored to their interests



Rube Goldberg

Bringing it all together to create something new



Video 2024

Program Impact

"I love the learning environment that is encouraged at WTP. I've learned so much not just from class lectures, but also from productive collaboration in a dynamic environment with some of my (now) closest friends."

Guest Speakers

“The guest speaker lunches made me think about the real life applications and jobs available to those studying engineering”

Confidence

“I realized that with cooperative support from staff, I can learn anything, even without former background”

Impact on Staff

“I learned through WTP that I enjoy teaching and making a difference in the girls' lives. I can't see myself teaching professionally, but I would love to be involved in something similar to WTP on the side in the future.” *WTP Staff Member 2011*

What our students say

Testimonials
From Our Students!

WTP 2023, attending Columbia in EE

"WTP was the most impactful experience I had during my entire high school career. This experience made all the difference in my college application process."

WTP 2016, grad UIUC Bioengineering

"WTP helped to broaden my idea of what engineering looks like. It's creative, it's collaborative. I went from never considering engineering to committing to it in my college apps with no reservations."

Testimonials

WTP 2019, graduated Olin College in Computer Engineering

My high school lacked any engineering-based courses or extracurriculars like robotics teams. WTP provided me with a unique and eye-opening introduction to the field of engineering through its Mechanical Engineering track. It was during this experience that I discovered my passion for engineering and knew it was the path for me."

WTP 2018, graduated Harvard in Architecture/Design and Energy

"WTP opened the door for me and allowed me to see many incredible possibilities for my future that I had never considered. I felt empowered to pursue higher education at an elite institution and considered myself able like never before."

WTP 2018 graduated Harvey Mudd College

"WTP made engineering accessible to me and gave me the confidence to pursue engineering as my major. If it wasn't for my time at WTP, I would have counted myself out. It's been 6 years since I attended and I still think about my experience that summer as it truly set me up for the rest of my education and career."

WTP 2023 attending Carnegie Mellon

"Engineering seemed impossibly not-for-me, but I realized through WTP that assumptions can be beat through real experience and connection."

Acknowledgements

- Former Dean of the School of Engineering Thomas Magnanti for expanding the program to Mech. Eng.
- Former and current deans of the School of Engineering
- Former and current Department Chairs for the Departments of Electrical Engineering and Computer Science and Mechanical Engineering at MIT
- Center for Material Science and Engineering at MIT
- Brit d'Arbeloff (WTP-ME major donor)
- Sandra Huffman, M.S. and Miranda Kotidis Titus, M.S. for curriculum revisions
- WTP Instructors, Tutors, Residential Advisors
- WTP Alumni
- Cynthia Skier for inspiring WTP students and staff for 20 years