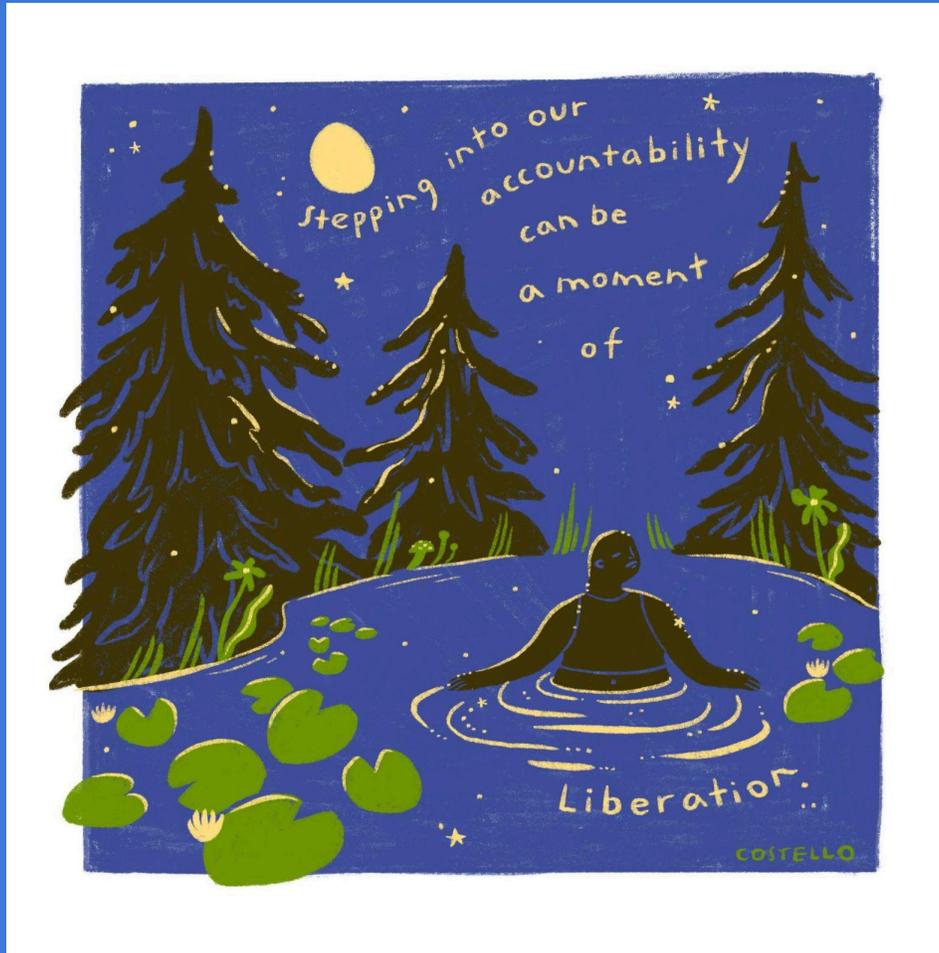


HOW CAN WE TRANSFORM WASTE TO ENERGY?

Investigate wastewater treatment processes and evaluate waste utilization for energy.

→ Treating wastewater is very expensive and takes a lot of energy. In fact, about 3% of the U.S. energy budget is used to treat wastewater. However, wastewater contains about five times more energy than what is needed to treat it! Instead of consuming energy, wastewater treatment plants could use MFCs to produce energy and provide electricity to homes.



[What produces waste?](#)

[Contaminated water in Ohio](#)

[What is anaerobic digestion?](#)

[What is fuel cell energy?](#)

[Biomass energy examples](#)

Throughout your work on this project, complete the following portfolio. For mastery, you will need to submit three things:

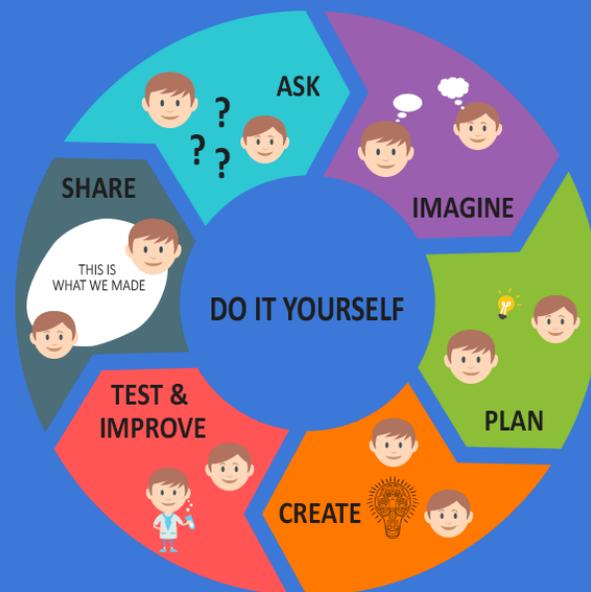
- This guide
- A presentation of your materials
- A reflection

This process will look like:

- Completing initial research over chosen topic.
- Meeting weekly check-ins with instructors to work through the design process.
- Developing a final product.
- Reflecting on one's group, project, and overall skills fostered during the project.
- Participating in expo night to showcase work.

Design

Design process will be a cycle of **asking, imagining, planning, creating, testing, improving, and sharing** and repeating. Using the space below, take notes and insert photos of your progress each week.



- **In your notes**, please detail the research or progress you made that week towards the final project. What went well? What didn't go as planned? Additionally, comment on what was learned and what you have questions about. **Please write at least 100 words for each note.**
- Complete weekly supplemental work and link to the work.

Check-in #1: **Investigate** where waste comes from in our lives and in our ecological environment.

Notes:

Supplemental:

Check-in #2: **Discover** regulatory agencies and current soil and water management strategies.

Notes:

Supplemental:

Check-in #3: **Compare and contrast** Springfield's wastewater treatment plant and Young's Dairy wetlands filtration system.

Notes:

Supplemental:

Check-in #4: **Determine** your waste to fuel energy sources.

Notes

Supplemental:

Check-in #5: **Monitor** energy produced from your fuel cell.

Notes:

Supplemental:

Check-in #6: **Evaluate** data collected from your fuel source and compare to other fuel sources.

Notes:

Supplemental:

Check-in #1: **Investigate** where waste comes from in our lives and in our ecological environment.

Group members:

Recorder:	Scientist:
Investigator:	Presenter:

1. Research your water footprint using the following link:

<https://www.watercalculator.org/wfc2/q/household/>

Record your results;

2. What's the issue? The EPA has documented water quality in Springfield. Use the EPA files provided in class to answer the following questions to determine the main impairments, if any, in our waterways.

- a. The EPA evaluated biological health and water quality of the watershed and determined several impairments that were identified in the Introduction. What were the identified impairments?

- b. What does TMDL stand for?

- c. Ohio's WQS provides explanation to what is being evaluated. What are the three Beneficial Use Criteria? What are the four Numeric Criteria?

- d. What is the current TMDL of Nitrates in Buck Creek (above East Fork Buck Creek)? What is the current TMDL of Fecal Coliform in Buck Creek (below Beaver Creek to Mad River)?

- e. What does QHEI stand for?

- f. What is the QHEI in Mad River below Chapman Cr. to above Buck Cr.

[except Moore Run]?

3. What's the solution? Your team has been tasked to find solutions to the current water usage and water pollution issue in Springfield. Identify a narrowed down issue and begin researching and brainstorming below your possible strategy to solve the problem.

→ Check-in #2: **Discover** regulatory agencies and current soil and water management strategies.

1. What's your solution? Consider your possible solutions that you brainstormed from Check-in #1, narrow down to 3 possible ideas.

2. What is being done? The EPA, USGS, Ohio Soil and Water Conservation, The Clean Water Act (CWA) Section 303(d), H2Ohio are all organizations and agencies that are aiming to regulate water quality and protect water here in Ohio and around the United States. Choose two agencies to research and provide an explanation of their current strategies.

- a. Organization 1:

- b. Organization 2:

3. What is your team's final solution plan? Now that you have discovered past and current strategies to manage waste and water quality. Solidify your final plan for how you will transform a current waste in Springfield.

- a. What is the name of your solution?

- b. What is the final "product"?

- c. Will you need any supplies from me? Create an initial list here.

- d. Will you be finished with this project by May 15th?

→ Check-in #3: **Compare and contrast** Springfield's wastewater treatment plant and Young's Dairy wetlands filtration system.

1. Young's Jersey Dairy: **Young's Dairy Water Management**

- a. How do Young's manage their waste water on-site? What are the benefits? What are the challenges?

- b. Is this an example of taking a waste product and turning it into an alternative product? How?

- c. How does this relate to your project?

2. Springfield WasteWater Treatment Plant: **Springfield WWTP**

- a. How do Springfield WWTP manage their water in Springfield before it is released back into the environment? What are the benefits? What are the challenges?

- b. How is this recycling a product into an alternative product?

- c. How does this relate to your project?

→ Check-in #4: **Determine** your waste to fuel energy sources.

1. We have learned about waste created in homes and on farms that eventually ends up back in our ecological environment. How can we utilize this waste and transform it to energy? Is there one type of source that is more productive than another?

a. You are going to choose your own organic material to use as a fuel source. What is that source?

b. Why do you think this source of biofuel will be useful to recycle or more productive than another?

c. Use the following lab guide to set up your microbial fuel cell;

 LAB: Energy using Microbial Fuel Cells

→ Check-in #5: **Monitor** energy produced from your fuel cell.

1. Prepare a data table using Google Sheets and track daily measurements of energy created. Insert your data table below.

→ Check-in #6: **Evaluate** data collected from your fuel source and compare it to other fuel sources.

1. Graph your data that you collected. Insert graph(s) below.

2. Insert the graph that was compiled with all class data.

3. Conclude on your results. What do the results indicate? What were any errors in your experiment? What are further research questions based on what you found? How is this relevant to real-world applications?

Reflection

The last step of this project will be to reflect on what you've done, what your group members have contributed, and what you've learned throughout this project. Write or illustrate a reflection with a description on what you've done and what you've learned. (Final measurements that show if your strategy to answer the question was successful).