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TRY Engineering

Microplastic Clean-Up Challenge


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What do you see?

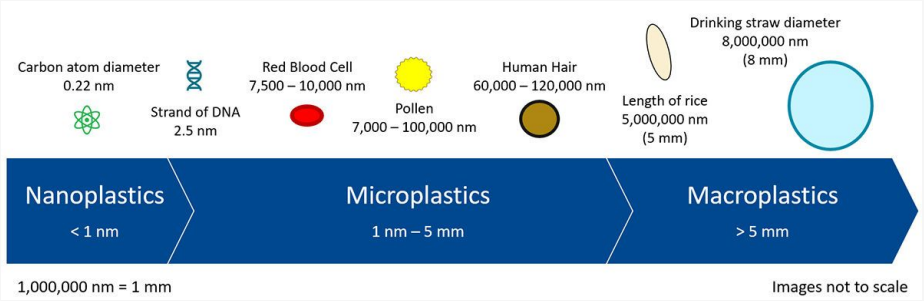
Source: NOAA

Microplastics

Source: NOAA

This image shows **microplastics** collected by NOAA from the Gulf of Mexico.

Microplastics are very small pieces of plastic, usually less than 5 millimeters (mm) in size.



Source: Illinois Environmental Protection Agency

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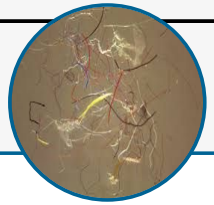
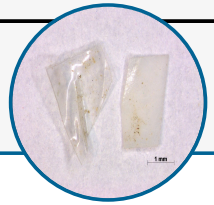
What are microplastics?

Source: NOAA

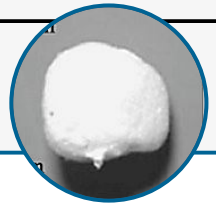
Types of Microplastics



Fibers
Threads from synthetic fabrics like polyester or nylon.



Film
Thin plastic sheets from bags or wrappers.

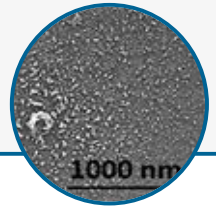


Foam
Bits of polystyrene (styrofoam) from containers, or packaging.

Fragments
Broken pieces of larger plastic items.

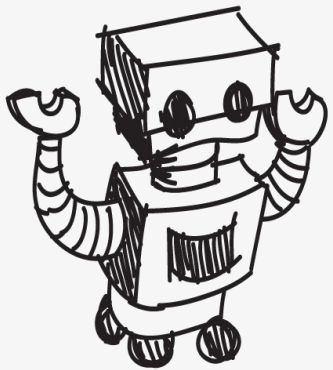
Microbeads
Tiny plastic spheres from cosmetics or cleaners.

Pellets
Raw plastic feedstock used in manufacturing.



Nanoplastics
Extremely small plastic particles, often invisible to the eye

The Design Challenge



The Design Challenge

You work at an ocean engineering facility that received a directive from NOAA to tackle a pressing environmental challenge. Microplastics are present throughout the ocean, threatening marine life.

NOAA has asked your team to **design a prototype for a microplastic cleaning device that can remove these pollutants from the ocean**. Your facility will conduct trials to ensure the device is effective before NOAA deploys it in the ocean.

Source: The Ocean Cleanup

Criteria

- Your device must collect at least 1 of every microplastic type

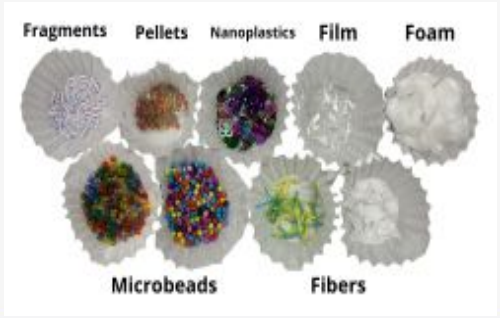
Constraints

- Use only the materials provided
- The device must have a handle
- You only have 10 seconds to collect microplastics

Materials

- Paper & Pencil (for brainstorming)
- Your “ocean”
  - Clear bucket or container
  - Water
- Plate (1 per team for inventory)
- Microplastics
  - Snipped yarn and/or coffee filter (fibers)
  - Shredded plastic wrap or sandwich bags (film)
  - Cut up foam cups and/or cotton balls (foam)
  - Small chopped straws (fragments)
  - Pony beads (microbeads)
  - Sequins (nanoplastics)
  - Mini beads (pellets)
- Required for Cleaning Device:
  - Popsicle sticks, rulers, plastic utensils, or cardboard (handle)

- Table of Possibilities (for cleaning device):
  - Mesh/netting
  - Nylon
  - Gauze
  - Muslin
  - Coffee Filters
  - Spoons
  - Sponges

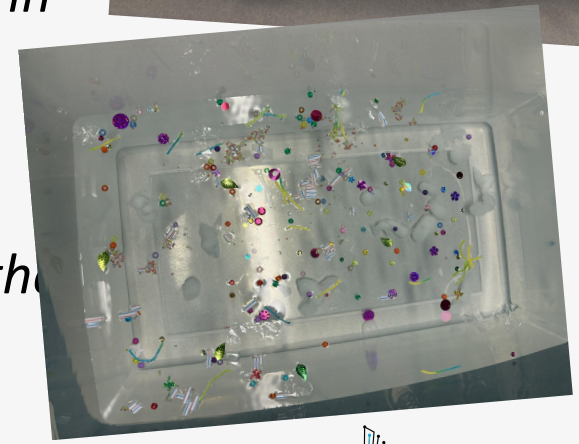


Observe

Fill the ocean with microplastics.

Consider these questions:

- *Do the microplastics float, sink, or hang in between?*
- *How do the microplastics interact with each other?*
- *How do the microplastics interact with the water?*

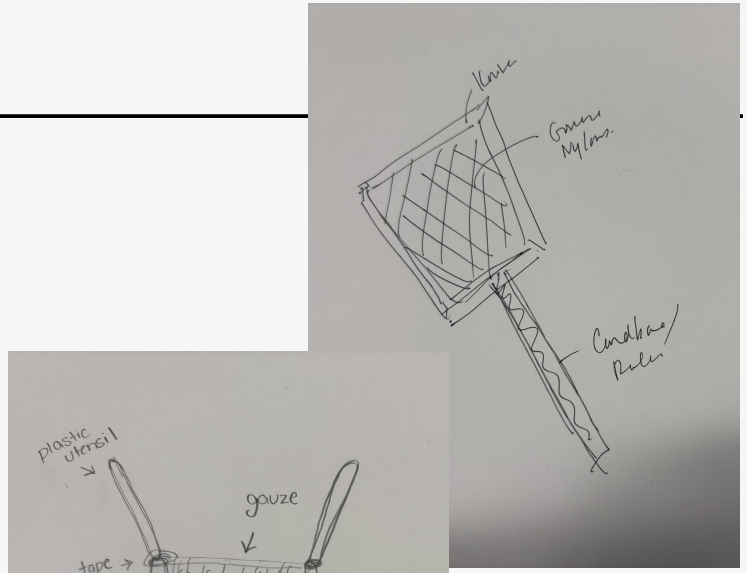


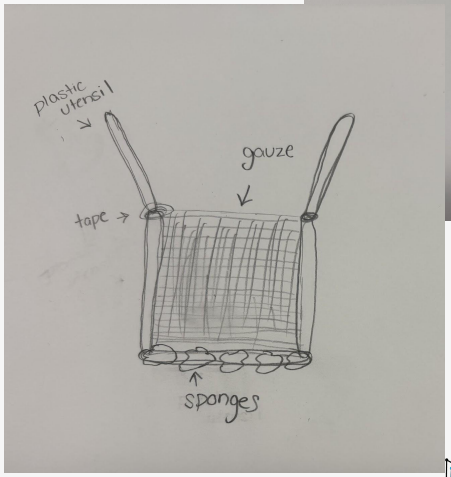
Brainstorm & Design

Look at the table of possibilities.

- *How do you plan to build your device?*
- *Which materials do you plan to use?*
- *What will it look like?*

Create a sketch of your device. Label your sketch with the material(s) you plan to use.





Keep in mind, your device must have a **handle**!

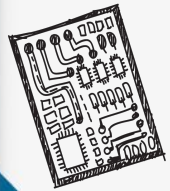
Build

Collect your materials and start designing!

Failure is Part of the Process

- **Failure is part of the process!** Engineers test, fail, troubleshoot, and redesign until they reach the best solution.
- **Iterate again and again:** test, fail, redesign– each cycle brings you closer to success.
- **Document your journey:** sketch ideas, record iterations, and note measurements or calculations.
- **Celebrate multiple solutions:** there's no single "right" answer– creativity leads to diverse possibilities

Ready, Set, Let's Engineer!

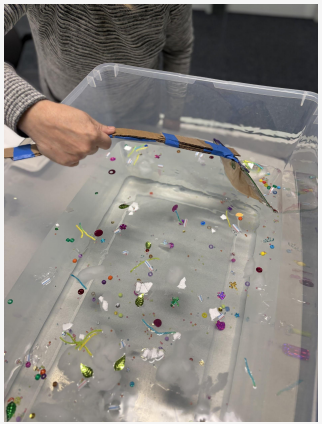


Test

Each pair of ocean engineers will have **10 seconds to test their device** in the ocean and collect as many microplastics as possible.

Your device is successful if you collect at least 1 of every microplastic.

After testing your device, keep your micropollutants on a plate until everyone is done testing.

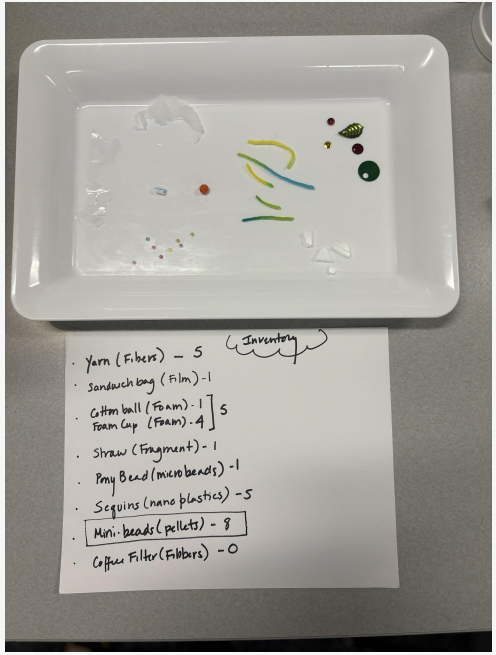


Inventory

Now it's time to see what your device collected!

Organize your microplastics and record how many of each microplastic type you collected.

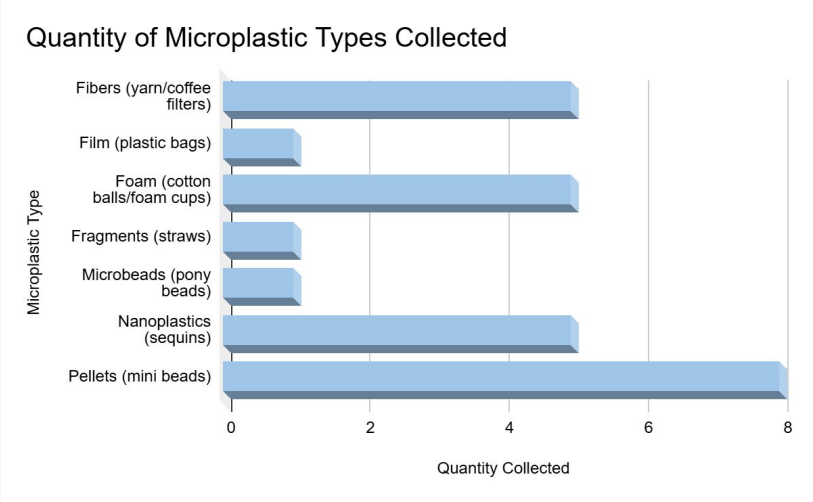
Microplastic	Quantity Collected
Fibers (*yarn/coffee filters)*	
Film *(plastic bags)*	
Foam *(cotton balls/foam cups)*	
Fragments *(straws)*	
Microbeads *(pony beads)*	
Nanoplastics *(sequins)*	
Pellets *(mini beads)*	



Graph Your Results

Turn your microplastic inventory into a bar graph. Graph the types and amounts of microplastics your team found.

Microplastic	Quantity Collected
Fibers (*yarn/coffee filters)*	5
Film *(plastic bags)*	1
Foam *(cotton balls/foam cups)*	5
Fragments *(straws)*	1
Microbeads *(pony beads)*	1
Nanoplastics *(sequins)*	5
Pellets *(mini beads)*	8

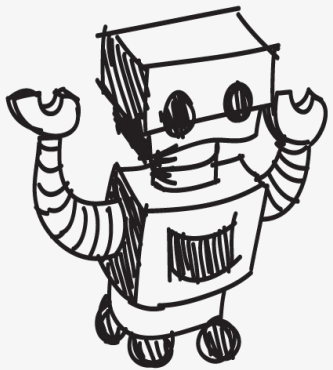


Redesign & Optimize

Change or modify your design to make it better!

Retest your device to see if it collects more microplastics than your original design.

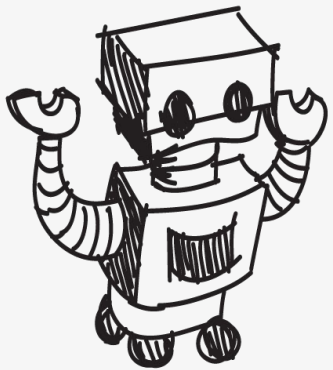
Reflect & Debrief



Reflection

- Was your device successful? Why or why not?
- How did your team decide which materials to use?
- What challenges did you run into creating and/or testing your device?
- Would you change anything about your device if you were to conduct a second test?
- Why is it important that engineers and scientists work together to address pollution in our oceans?
- What role do YOU play in keeping our oceans clean?

Background Concepts



Where do microplastics come from?

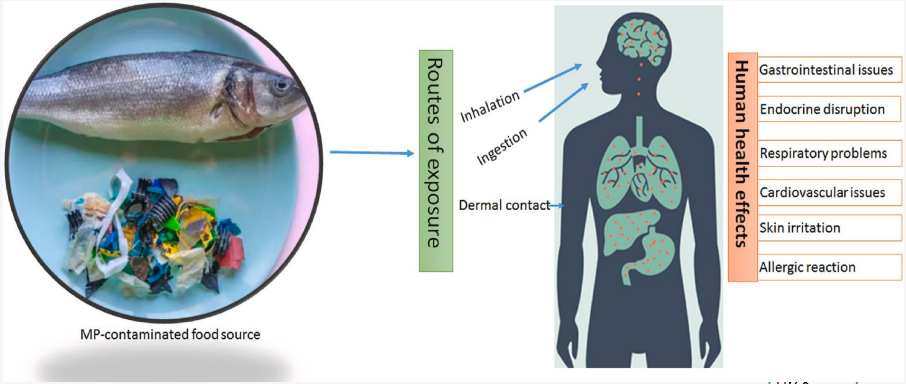
Microplastics are everywhere!

- Washing clothes made of synthetic fibers
- Using makeup or face wash with microbeads
- Plastic packaging from food and other items breaking down over time.
- Factories and construction sites where items like paint and insulation are not disposed of properly.

Source: Wayne State University

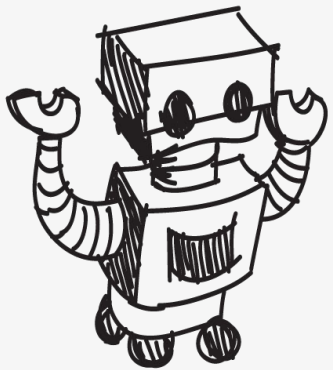
How do microplastic affect us?

- Microplastics carry pollutants in the water and release harmful chemicals.
- Wildlife (fish, mussels, even whales) often mistake microplastics for food.
  - According to lab studies by NOAA, the chemicals in microplastics may delay an animals' development
- When we eat these animals, we ingest microplastics too.



Source: Cell Press Journal

Dig Deeper



Dig Deeper

Resources:

- "What are microplastics?" by NOAA
- "What are the impacts of microplastics?" by NOAA
- "All types of microplastics you should know" by EuroPlas
- "A Guide to Plastic in the Ocean" by NOAA

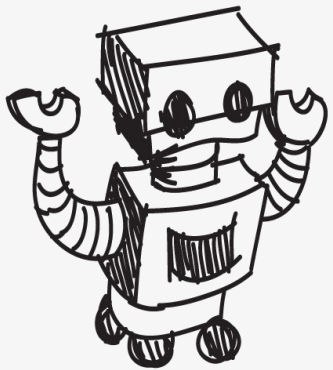
Extension Activities:

- Try the lesson plan "A Century of Plastics" by TryEngineering
- Read the eBook "Ocean Engineering Heroes: Making the Oceans and the World a Better Place" by TryEngineering

More Resources:

- Explore "Ocean Plastic Pollution Explained" by The Ocean Cleanup
- Watch "Ocean Plastics" by National Geographic
- Watch "Exploring with GIS: Following Plastic from Land to Sea" by National Geographic
- Watch "Tracking Plastics from Sea to Source" by National Geographic

Vocabulary



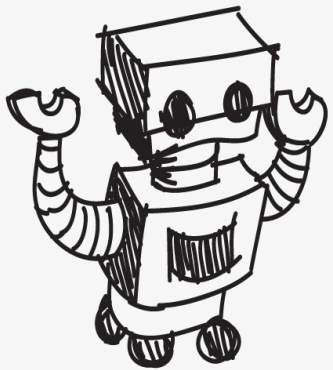
Vocabulary

- **Biodegradable -** able to break down naturally in the environment without causing harm
- **Fibers -** threads from synthetic fabrics like polyester or nylon
- **Filter / Filtration -** a method of separating solids from liquids using a barrier
- **Film -** thin plastic sheets from bags or wrappers
- **Foam -** bits of polystyrene (styrofoam) from containers or packaging
- **Fragments -** broken pieces of larger plastic items
- **Marine Life** - animals and plants living in the ocean

Vocabulary

- **Microbeads** - tiny plastic spheres from cosmetics or cleaners
- **Microplastics -** plastic particles smaller than 5 millimeters
- **Nanoplastics -** extremely small plastic particles, often invisible to the eye
- **Pellets (Nurdles) -** raw plastic feedstock used in manufacturing
- **Pollutants -** harmful substances introduced into the environment

Engineering Fields



What is Engineering?

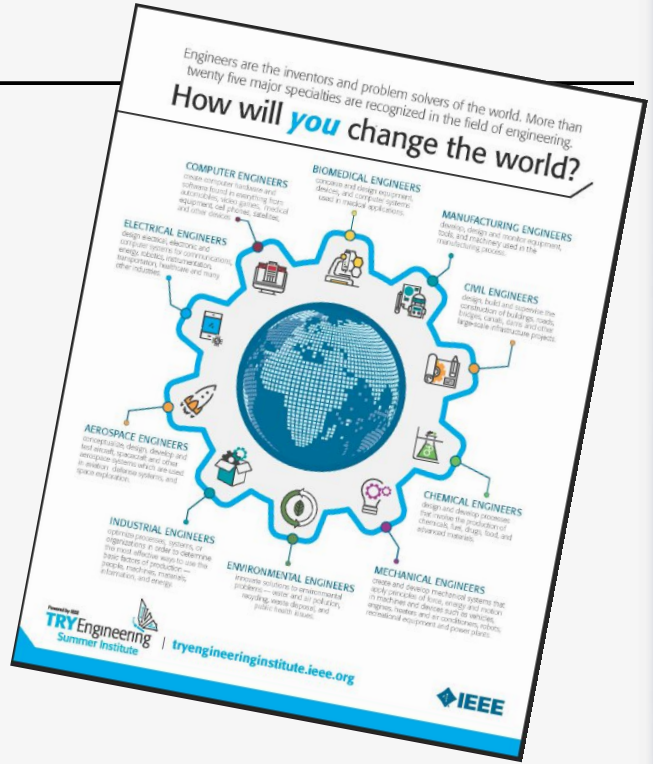
Learn about engineering and how engineers are creative problem solvers and innovators who work to make the world a better place.
(Video 3:43)

Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

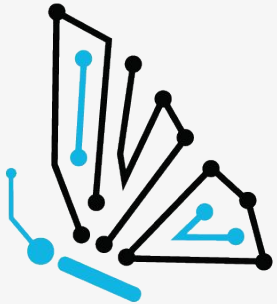
Related Engineering Fields

- There are several types of engineering fields that are involved with the ocean. Here are just some of the related engineering fields.
  - Ocean Engineering
  - Environmental Engineering
  - Civil Engineering

- Explore the Engineering Fields Infographic - How will **YOU** change the world?
  Engineers are the inventors and problem solvers of the world! More than twenty five major specialties are recognized in the field of engineering. **Engineers make the world a better place!**



For more engineering lesson plans and resources like games, engineering careers, and STEM opportunities visit IEEE's TryEngineering.org



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