

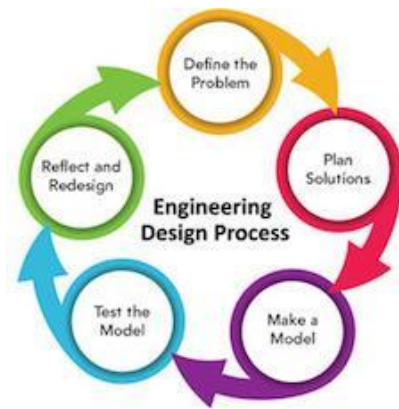
Digital Shipbuilding STEM: Recyclable Submarine Challenge

Background Knowledge

Aim: Design a functioning submarine from recyclable household materials for Earth Day!

Problem & Career Focus: Early submersibles were developed in the 1600s before the first known military submarine was built in 1775. Named the “Turtle”, it held one person and was controlled underwater independently, the first submarine capable of doing so! Using the engineering design process, your task is to work with your team of mechanical engineers, naval architects, and welders to design, model, and prototype a working submarine prototype with recyclable materials!

Engineering Design Process: STEM professionals use the engineering design process as steps to help solve real-world problems. With your team: define the problem, discuss solutions, design, build, test, and improve a prototype of your solution. One of the most important steps of the engineering design process includes reflection and redesigning- if your team notices your submarine prototypes aren't working- improve the design! Use the engineering design process steps to guide your exploration during the Recyclable Submarine Challenge.



Investigating Questions	Materials
<ul style="list-style-type: none">• How can you ensure the submarine will sink when submerged in water?• How does the length of the overall design affect the prototype?• What other recyclable materials could be used to construct your submarine?	<ul style="list-style-type: none">• Empty plastic bottle• Tape• Bendable straw• Rubberbands• Coins• Scissors• Additional plastic bottles (for propellers, etc.)

Digital Shipbuilding STEM: Recyclable Submarine Challenge

Background Knowledge

Educational Standards Correlations: Engineering Design, Motion, Energy, Physics, Mathematics

Vocabulary:

Friction: force resisting motion of solid surfaces; slows a moving object.

Buoyancy: the ability to float in water or some other fluid.

Gravity: invisible force that pulls objects toward each other.

STEM Career Connections:

Mechanical Engineer	Naval Architect	Welder
<p>Are professionals that design power-producing machines, such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines</p> <p>They: use physics, principles of science, and mathematics to solve problems!</p>	<p>Are professionals that design, build, and maintain ships, from aircraft carriers to submarines and from sailboats to tankers</p> <p>They: are responsible for the ship design, including the form, structure, and stability of hulls</p>	<p>Are professionals that join metal parts together. They may also fix holes in metal objects as well.</p> <p>They: work on the metal components of various structures to include pipelines, bridges, power plants, buildings, refineries, automobiles, or ships</p>

Real World Applications: A submarine (or sub) is a watercraft capable of independent operation underwater. It differs from a submersible, which has more limited underwater capability. Submarines were first widely used during World War I (1914–1918), and are now used in many navies large and small.





Digital Shipbuilding STEM: Recyclable Submarine Challenge Activity Directions

Aim: Design a functioning submarine from recyclable household materials for Earth Day!

Investigating Questions

- How can you ensure the submarine will sink when submerged in water?
- How does the length of the overall design effect the prototype?
- What other recyclable materials could be used to construct your submarine?



Materials

Empty plastic bottle
Bendable straw
Coins

Tape
Rubberbands
Scissors

Additional plastic bottles (for propellers, etc.)

Criteria & Constraints:

Engineering design challenges (EDCs) are great opportunities for open-ended activities to grow critical thinking and problem-solving skills. EDCs do not use a list of directions to build a specific design, rather suggest a framework of designing a solution based on the problem and goal. How your team chooses to address the problem and goal is entirely up to you!

- Discuss as a family the design of submarines. Watch videos on how submarines submerge under water. How does this happen? (*Define the Problem*)
- Lay out all materials and items available for the challenge. Plan to give time for your team to discuss the problem relating to your background knowledge. How will you use the materials provided to make your submarine based on what you've learned from the video links and background information? (*Define the Problem*)
- Discuss, sketch, and determine what order you will use the materials to build your submarine (*Plan Solutions*).

- Using your sketches and discussions, begin creating the submarine from your model from materials available. Family adults: allow your child(ren) to experiment with the materials and help them build problem-solving skills (*Make a Model*)
- What materials will help the submarine sink and float?
- As you are building your model, test out the prototype to make sure they can move/work in water. (*Test the Model*)
- With your team, continue to discuss and work through problems with your designed models along the way. What adjustments can your team make to improve your design? If you were to make a new submarine with different equipment, what materials would you use or how would your model be different? (*Reflect and Redesign*)

Ideas to Increase Difficulty:

-Create a mechanism to submerge and lift your submarine!

-Add a propeller to your submarine. Can you create a mechanism to make your submarine move?

-Limit the number of materials that will be used!

