Search and Rescue Mission

<table>
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<th>High School</th>
<th>Standard(s): HS-PS2-2; HS-ETS1-2, 1-3, 1-4; CCSS.L1, CCSS.L4</th>
<th>Topic: Designing a search and rescue mission</th>
<th>Developed by: ASNE with materials from Coast Guard</th>
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**Overview:** Students will design a solution to an engineering problem in groups (15-20 minutes) and share those results (10 minutes). Then, students will interact with the same engineering problem through FLEET (30-45 minutes).

**Sample Lesson Flow**

1. Design a solution to an engineering problem (15 min), share results (10 min), attempt FLEET search and rescue mission (15 min), share-out of FLEET work (5 min)
2. Design a solution to an engineering problem (25 min), share results (15 min), attempt FLEET search and rescue mission (45 min), share-out of FLEET work (5 min)

**Prior Student Knowledge Required:**
- Engineering Design Process

**Student Learning Objective:**
- Design a ship that will be able to rescue shipwrecked sailors.

**Materials:**
- Notetaking/Sketch materials for warm-up engineering challenge
- (Optional, Step #1) Technology to play YouTube video
- Computers set up with FLEET

**LESSON PLAN – (This uses the 5-E Model)**

**Engage**

1. Start with students in groups and remind them of your engineering design process. Today’s engineering process is:
   - Design a ship that can quickly save shipwrecked sailors that are miles away from harbor. You will pitch your design to the Coast Guard in a one-minute presentation.
     - This design is an idea students will sketch and describe (you do not need boats or materials).
     - Tell students the Coast Guard will want to know what variables students considered and how students plan to test their design.
     - (Optional) If you already have many students that have engaged with the Search and Rescue mission, you may want to tweak the initial engineering task by asking the groups to design a system that will allow the Coast Guard to know when a ship is wrecked within America’s territorial waters (12 nautical miles from shore). You could also use this NOAA video in your wrap up discussion: https://www.youtube.com/watch?v=xNQt4Q1vV64

**Explore**

2. Students should be able to independently work on these problems at this point. If you would like to guide the discussions, you could ask questions like:
   - What data will you collect to evaluate your design?
   - Are you thinking about forces and acceleration in your designs? How will you use this knowledge to improve your design?
   - What can you do to make your design better?
   - What would you do to test your design?

**Explain & Elaborate**

3. Have students share their process and ask each group one follow up question that asks how they addressed a step in your design process.
4. (Optional) If you want to choose a winner, score the teams’ plans on how they address each step of your engineering process.

Explore

5. Hopefully a group suggested testing using a simulator as well as in real-life. Simulators are a common way engineering groups of all types save resources while testing their designs. Now your engineers will test and re-test designs in the simulator, FLEET.

6. Have students log into FLEET and create a ship for the Search and Rescue mission. Students can read the mission description by clicking the book in the upper right corner and then selecting the “Missions & Achievements” tab. We included that text here so you can have it handy as you walk around. In particular, ask students what the objectives are (these are the engineering design goals, so students must keep them in mind).
   a. Design and build a stable ship that can rescue a group of shipwrecked mariners. Make sure you stay under budget, stay close to design displacement, and have all the necessary equipment. Remember, you need to get the men out of the water as quickly as possible. Salvaging their sinking ship is a bonus.
   b. Objectives
      i. Find the fishing boat.
      ii. Recover the mariners.

7. Be sure to show students how the color changes as they address problems the design requirements.

8. These missions could take a very long time (20+ minutes). That is ok. Students are exploring what works and what doesn’t work and using that information for the next test. Once a student has gathered data on their design solution, they may choose to restart the mission without completing it. Today is a day where students may feel like they don’t have enough time to do all the testing they want. An engineer’s biggest problem!

9. NOTE: If students need an additional challenge, show them how to change the Environment from “Sunny” to “Storm”.

10. Save 5 minutes for a wrap-up discussion by asking students to share their data and design solutions. The next class will be the final class and the first half of class will be spent improving and perfecting this design.

Additional Resources

A. The United States National Search and Rescue Supplement (link below) has 243 pages describing Search and Rescue missions. The glossary of terms on page xiii is particularly good: https://kyem.ky.gov/InlandSARPlanning/Documents/National%20SAR%20Supplement%20(NSS).pdf

B. If you have the ability to play a video on mute while students are working in FLEET, we suggest this GoPro video of a U.S. Coast Guard rescue swimmer. Probably worth muting the clip since the only real noise is the helicopter. https://www.youtube.com/watch?v=-IPERJ-p4qU

C. Search and Rescue as a job is shown by this report by ABC in Virginia Beach. You can make connections between the practice of these professionals with the testing done by engineers because both give feedback and experience used to create a great final product.
   https://www.youtube.com/watch?v=Io_c_GxiwAM