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EED 480  
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### Boat Building Experiment 4th Grade

**Objective:** Students will explore different materials in order to assess which material is most reliable when engineering a boat to transport blocks.

**Big Idea:** Why do we use metal so create boats? Is there a more reliable or eco-friendly alternative?

#### Setting the Stage:

In order to begin the lesson students will need to know that most boats or ships are built using steel. Alternatives such as aluminum have been used as well because they are lightweight. The students are familiar with Kevlar as well but not in the context of ship making. During this lesson students will be exploring different kinds of materials in order to see which is best to construct a boat from. Along with the engineering process students will also have to decide whether making a life-sized boat using the same material would be possible as well as explaining whether it would be practical and eco-friendly.

#### Next Generation Science Standards

**3-5-ETS1-1.** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

**3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

#### Science and Engineering Practices in the Next Generation Science Standards:

**S.2: Developing and using models.** During the lesson students will be developing models and testing them in a small box of water with occasional waves to simulate the ocean's waves to see whether the boat can survive being in water.

**S.6: Constructing explanations(for science) and designing solutions(for engineering).** After the experiment each team will be responsible for coming up with an explanation as to why their boat was successful or why it was not, and what changes if any would they have made to the engineering of their boat that could possibly help it.

**Comment [SFB1]:** Excellent inclusion of NGSS!

#### Structure and Function

Through this lesson students will learn why different materials are more reliable than others. As well as how the study of engineering and the process itself is always changing when new information is discovered. Engineering is also helpful when thinking of solving problems society may have, such as how we can engineer boats or modes of transportation that can be eco-friendly but also cost-effective. **Yes!** Students can understand how the engineering of different things all around us affects our daily lives.

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### Background Knowledge

Students have already learned about engineering and how it is a combination of science and math to design or construct things. Students will also know the factors taken into account while engineering boats. For example, the weight of materials the boat is made of, the weight of objects the boat is carrying, and geologic factors such as the ocean and waves and weathering that could occur to the materials.

### Materials

- Styrofoam
- Aluminum foil
- Popsicle sticks
- Plastic cups
- Straws
- Egg carton
- Cardboard
  
- Paper
- Glue
- Tape
- Hot glue

### Roles

Captain :0  
Materials Manager  
Recorder  
Illustrator

The Captain and groups will be assigned by the teacher. Each role after the materials manager can be chosen by the group themselves to help them practice independence as well as problem-solving if there are any discrepancies between teammates. Each team will be given a sheet of paper explaining their roles and jobs during the experiment.

**Comment [SFB2]:** You will find that this takes more time than having a coherent plan for role assignment if students are new to coop learning.

### The 5-E Framework

#### Engage( 5 minutes)

Students will discuss different ways engineering affects our lives and examples of engineering around us. After doing this students will be given a small piece of paper with their task written on it, they must read it as a group in order to begin their experiment. “Ms. Alvarez is trying to transport a few packages across a bay. She needs your help to use your engineering skills and ideas to create a boat with the two materials you will choose. Remember your boat has to be able to hold 2 blocks AND float on bumpy waters in order to be successful.”

After reading their task the **materials manager** will go collect the 2 materials they have chosen to construct their boat out of.

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Each team will also have to choose a name for their boat through a discussion facilitated by the captain.

Comment [SFB3]: I like this feature!

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### Explore (25 minutes)

Before beginning their experimenting the recorder will record the group's prediction and responses to the following questions...

- Do you think your boat will be successful? Why or why not?
- Why did you choose \_\_\_\_\_ and \_\_\_\_\_ as your two materials?
- What are other factors besides the water and waves you should keep in mind

Once the group has answered these questions they may begin constructing their boat. They will only have the time allotted to do so and will have to present what they have to be tested on the water. This is how students remain focused and on task during the experiment.

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During this time the recorder can also write down any questions the team may have regarding their materials or about construction Good. Do provide space on the experiment sheet that promotes this.

### Explain/Elaborate (7-10 minutes)

The test will be administered in this part of the lesson. The assigned Captain for every group will bring their boat to the box of water to be tested. Before putting the boat in the water the captain will tell the class their boat's name as well as what their predictions were made for their boat's success. The Captain will also explain why their team chose the materials they did and explain how they came up with the model they did and the factors they took into account while engineering their boat.

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### Evaluate(10 minutes)

After testing their boats each team will reconvene to debrief on their experiment. The recorder will write their findings answering the following questions during the process. The illustrator for each group will then draw any changes they would make to their boat as an alternative to completely reconstructing the boat.

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- Was your boat successful?
- What would you change about your engineering of the boat if you could do this again?
- Has your opinion about the materials you chose changed? Why or why not?
- Why is it important to test materials like the ones we did before making a life-sized boat?

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### Draw Conclusions. Communicate Results.:

As a class we will discuss our findings as well as the implications of our lesson. I can ask students why they think we did this experiment, and how they think changing what we make boats out of could affect us. I can also ask them whether we would be solving a problem or making one with such changes in engineering. This will conclude the lesson and students can also comment and share ideas about other groups' boats.

Comment [SFB4]: Wonderful plan, Alejandra! Engaging, integrated, cooperative! I do not see the plan for voice level or encouraging. You are also missing your formative assessments of social skills and habits of mind. I also do not see how groups will show evidence of the NGSS performance outcomes indicated at the outset—of your lesson. Do prepare and submit these with the next draft.