Activity 4: Identify Criteria and Constraints

Objectives

- Students will identify the criteria and constraints of the solution for their design problem by considering scientific principles and potential impacts on people and the environment.

Next Generation Science Standards (NGSS) Performance Expectation

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Time 35 minutes

Materials

- Engineering is Bringing Fish Up from the Deep video (5:19)
- Engineering for Good student notebook (or PDF version)

Essential Question

What are the criteria for success and the constraints on your design?

Introduction/Hook

1. Review the engineering design process graphic on page 3 of the student notebook. Discuss that the second step of the process is identifying constraints on a solution and also the criteria for its success.
2. Explain the terms “criteria” and “constraints.” Criteria are things the design needs to do in order to be successful--its requirements. Constraints are limitations on the design. These may be materials available, the cost of the materials, the amount of time they have to develop the solution, etc.
3. Recall the marshmallow challenge. Discuss the criteria and constraints for that challenge. Alternatively, you can list the criteria and constraints from the challenge in random order and have the students identify if each is either a criterion for success or a constraint.
    a. Criteria: The structure had to be free-standing, stable, as tall as possible and hold a marshmallow at the top.
    b. Constraints: Students could only use the materials provided—spaghetti, string and tape. They had 15 minutes to build their design.

Guided Practice

1. Watch the video Engineering is Bringing Fish Up from the Deep. Have students pay attention to the specific problem the engineers and scientists are working to solve. Pause the video at 2:22 to define the problem as a class. (*The scientists needed a way to capture fish at pressure, keep them at pressure and then slowly decompress them when they got to the surface so that the fish wouldn't die.*)
2. As students watch the remainder of the video, have them record the criteria and constraints the scientists and engineers were working with in the table on page 10 of their notebooks.
3. Discuss their findings as a class. *(Criteria: the device needs to be able to go underwater, collect fish and keep them at pressure; be small enough to take on a dive, sturdy, sleek, lightweight and able to handle the immense pressure of the deep ocean. Constraints: inexpensive, off-the-shelf materials)*

Independent Practice

1. Have students work in their small groups to identify the criteria and constraints on their design. In doing so, they should think about potential effects on people and the environment. Students can record the criteria and constraints on the bottom of page 10 in their notebooks.
2. Have each group rank their criteria and constraints from most important to least important. Students should think about which are absolutely necessary and which would be nice to have.

Assessment/Reflection

Were students able to identify appropriate criteria for success and constraints on their design? Did they rank them by order of importance?