CREATE-A-CRITTER *Part Two*

Topic
Engineering Design Process, Adaptations

Duration
Two sessions

Vocabulary
adaptation
constraint
design
engineer
engineering design process
prototype

STANDARDS

Practices
Engaging in Argument from Evidence

Core Ideas
Structure and Function

Crosscutting Concepts
Cause and Effect

OCEAN LITERACY PRINCIPLES

OLP 5

Focus Question

What is the engineering design process?

Overview

Students recall the different adaptations living organisms possess at the rocky shore. Students recall the definition of adaptation. Students discover the engineering design process. Students design, create, and test a fictitious organism with adaptations that would allow it to survive the rocky shore ecosystem using the engineering design process. Lesson 7 and Lesson 19 are connected lessons which teachers can utilize as formative pre- and post-assessments.

Objectives

Students will be able to:

- Identify the engineering design process
- Recall the many different types of adaptations living organisms possess at the rocky shore
- Construct a fictitious rocky shore organism with adaptations using the engineering design process

Materials Needed

- Engineering Design Process activity sheet (one per student, page 168)
- Create-A-Critter Engineering Design Process activity packet (at least one per student, pages 169–171)
- 5 index cards per student for each "critter" being made
- Scissors (one per student)
- Transparent adhesive tape/tape dispensers (one per group)
- Five pound bag of rice or bird seed
- Pillowcase

Teacher Preparation

1. Each student will need a copy of the Engineering Design Process activity sheet.
2. Each student will need a copy of the Create-A-Critter Engineering Design Process activity packet.
3. Separate index cards into groups of five for each student (students may create more than one "critter").

Teacher Tips

- ★ *Warning*: If doing this extension with younger children, inform them beforehand of your intention to potentially crush their creation.
- ★ Placing the bird seed or rice in a freezer bag before tying it up in a pillowcase will decrease the possibility of "the wave" from leaking.
- ★ Testing student critters at a separate place in the classroom or a different location altogether will help to add variety and movement to the lesson.

Teacher Preparation (continued)

4. Prepare scissors—one per student.
5. Prepare transparent adhesive tape dispensers so there are enough dispensers for student groups of three to four students per group.
6. Prepare one pillowcase filled with five pounds of rice or bird seed. Make sure the pillow case is securely tied so no rice or bird seed can escape the pillowcase.
7. Teachers will need easy access to a whiteboard or interactive whiteboard to record student input.
8. If saved, teachers should refer back to the student inference list of adaptations they thought rocky shore organisms might have to survive the rocky shore ecosystem (from lesson seven).

Background

The engineering design process is a series of steps engineers follow to come up with a solution to a problem. Sources differ on the number of steps the engineering design process should have. This lesson features the five major steps of the engineering design process—ask, imagine, plan, create, and improve. **Ask**: What is the problem? What are the constraints? **Imagine**: Brainstorm ideas to solve the problem and choose the best one. **Plan**: Draw a diagram and gather needed materials. **Create**: Follow the plan and test the prototype. **Improve**: Determine what can be done to make the design better and repeat the engineering design process.

An adaptation is a body part or a behavior that helps a living thing survive in its environment. Rocky shore organisms need adaptations to survive the harsh and constantly changing environment of their rocky shore ecosystem. These challenges include some of the following: the waves, the tides, the temperatures, finding food, and evading predators. Other challenges to rocky shore organisms include the flux of salinity levels of the saltwater, various ranges of light, as well as human factors such as pollution and carelessness when visiting the rocky shore.

Some adaptations of rocky shore organisms include: thick shells, round shells, impermeable shells, the ability to retain water, holdfasts, secreted substances that allow organisms to attach well to rocks, spiny bodies, regeneration, exoskeletons, gathering in groups, camouflage, filter feeding, seeking crevices for shelter, burrowing abilities, ability to lower metabolic rates, and many more!

Extension Suggestions

- Have students brainstorm classroom problems that have the potential to be solved using the engineering design process, then have students work in pairs or in groups to attempt to solve the problem using the engineering design process.

Books

- *Rosie Revere, Engineer* by Andrea Beaty
- *Engineering: Feats and Failures* by Stephanie Paris

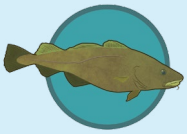
Procedure

Part One

1. Ask students how they solve problems. If necessary, provide examples of problems they might have: arguing with siblings, not understanding class work/homework, unable to perform a sports maneuver, etc.
2. Ask students what they do if they try to solve the problem and it does not work.
3. Inform students that steps they take to solve their problems are similar to steps engineers take to solve problems.
4. Inform students that an engineer is a person who designs and builds things to solve a problem. Inform students that there are different types of engineers such as mechanical, chemical, civil and electrical engineers.
5. Inform students that engineers solve problems using the engineering design process.
6. Provide each student with a copy of the Engineering Design Process activity sheet.
7. Discuss with students each step of the process, and have them record the details of each step on the Engineering Design Process activity sheet.
8. After completing the activity sheet, inform students that engineers need qualities such as patience, creativity, and grit to solve problems.

Part Two

9. Inform students that they are going to be using the Engineering Design Process to test and improve their fictitious rocky shore organism from lesson seven.
10. If possible, refer back to the student inference list created in lesson seven of the adaptations students thought rocky shore organisms might have to survive the rocky shore ecosystem.
    a. Have students compare their knowledge of the many types of adaptations they learned about in previous lessons with the inferences they made in lesson seven.
11. Provide students with the rocky shore organisms they created.
12. Ask students to examine the Engineering Design Process activity sheet and determine what step of the process they are currently on with their "create-a-critter" activity.
13. Inform students that they are now on the "create" step, and they need to test their critters to see if the adaptations they designed and constructed will help their critter to survive.



Websites

- ★ Check out the Crash Course Kids YouTube Channel episodes titled "What's an Engineer," and "The Engineering Process."
- ★ Watch a rap of the engineering design process on Baba Bomani's YouTube Channel episode titled "Engineering Design Process (lyric video)."
- ★ Check out NASA Goddard's YouTube Channel video titled "NASA for Kids: Intro to Engineering."

Scientist Notebook

- ★ Students can record the steps of the Engineering Design Process in their notebooks.

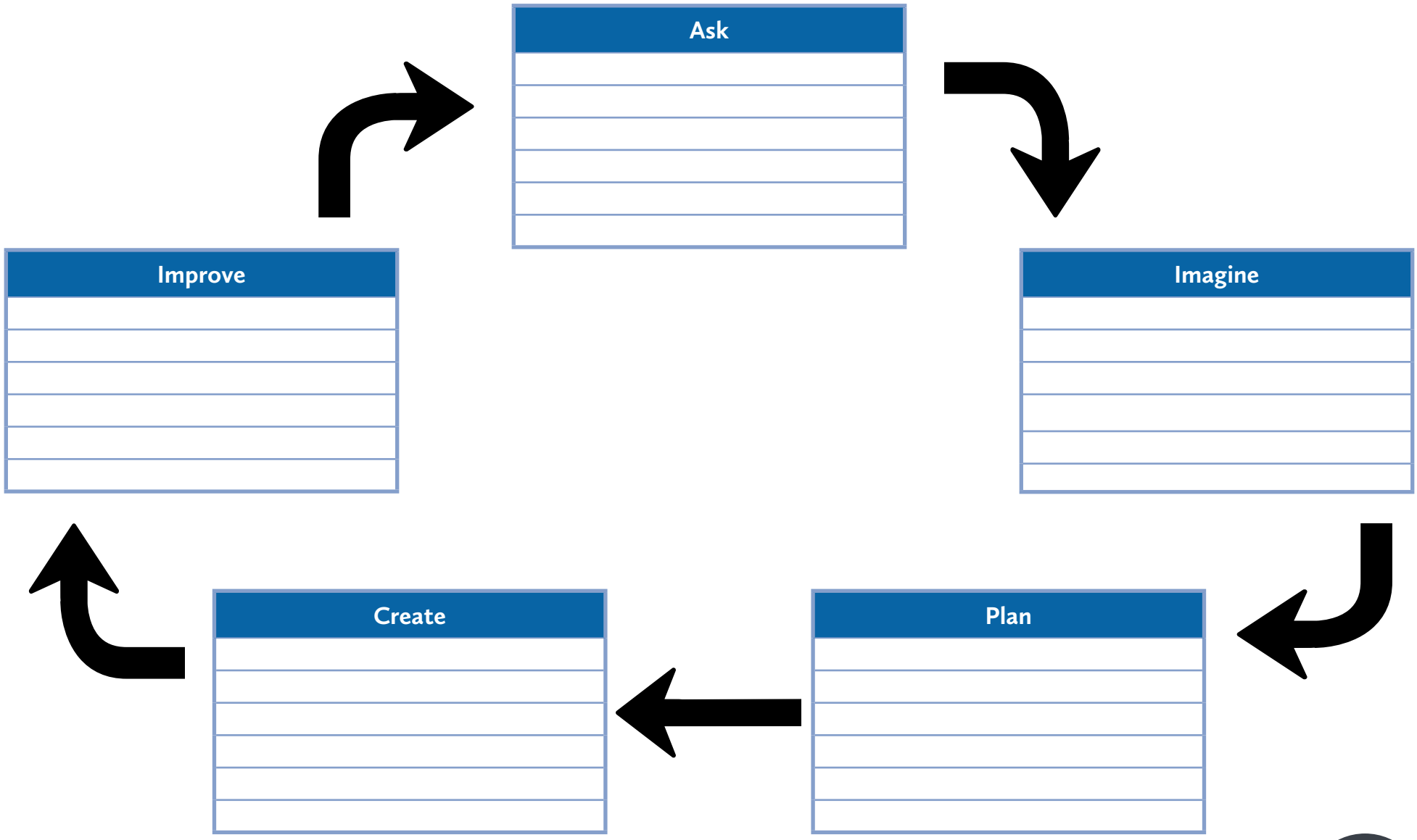
Procedure (continued)

14. Inform students that you will be testing each critter's adaptations by having a "wave" crash on top of it.
    a. Show students "the wave," which is the pillowcase filled with rice or birdseed.
    b. Have each student come up one-by-one with their critter and drop "the wave" onto their critter from a standing or elevated position.
    c. After each student's critter is crashed upon by "the wave," have students show thumbs up (survived), thumbs down (did not survive) or thumbs sideways (not sure), to indicate how they feel the student's critter fared.
    d. The majority vote should determine whether or not the critter survived in every circumstance, unless you as the teacher feel as though students are not being accurate or are too indecisive.
15. After the testing using "the wave" is complete, have students gather into groups of four and provide them with the Create-A-Critter Engineering Design Process activity packet.
16. Have students fill out the packet and complete every step of the Engineering Design Process, including testing their new critter with "the wave."

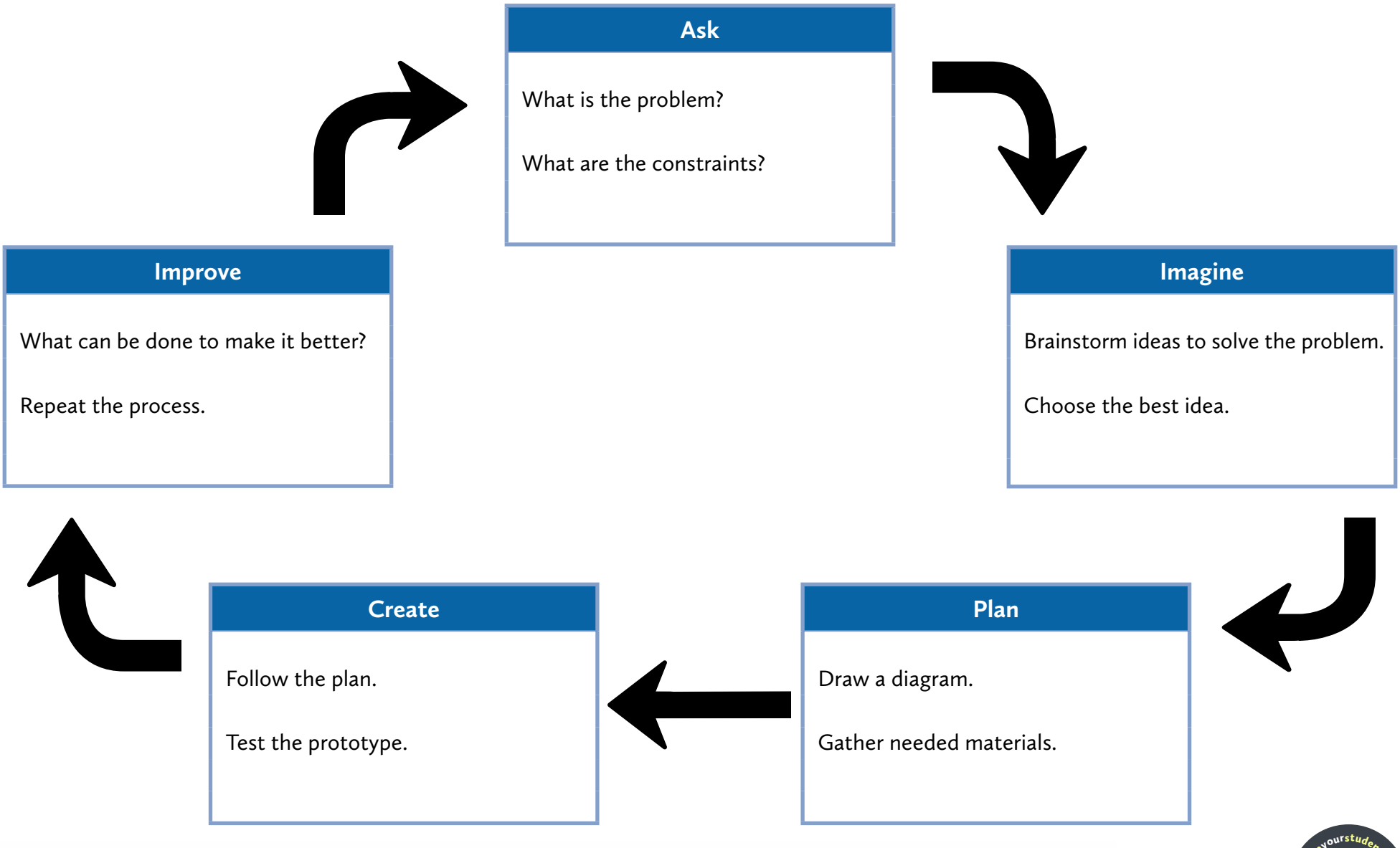
Wrap-up

- ★ Ask students to identify the steps of the engineering design process.
- ★ Ask students to recall adaptations of rocky shore organisms that enable them to survive their harsh environment.
- ★ Encourage students to continue using the engineering design process to create more critters at home (with their parents' permission), as well as to solve other problems.

ENGINEERING DESIGN PROCESS



ENGINEERING DESIGN PROCESS

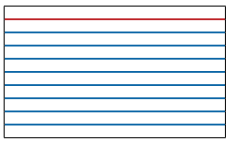


CREATE-A-CRITTER

Engineering Design Process

Name: _____

Date: _____



Ask

What is the problem?

What are the constraints?

Imagine

Ways to solve the problem:

1.

2.

3.

What is the best idea?

CREATE-A-CRITTER

Engineering Design Process

Plan

Draw a diagram of the best idea.

Gather needed materials.

CREATE-A-CRITTER

Engineering Design Process

Create

Follow the plan (the best idea).

Test the prototype.

What worked well?

What did not work well?

Improve

What can be done to the prototype to make it better?

Repeat the engineering design process!