TABLE OF CONTENTS

GETTING STARTED

LIFE SCIENCE

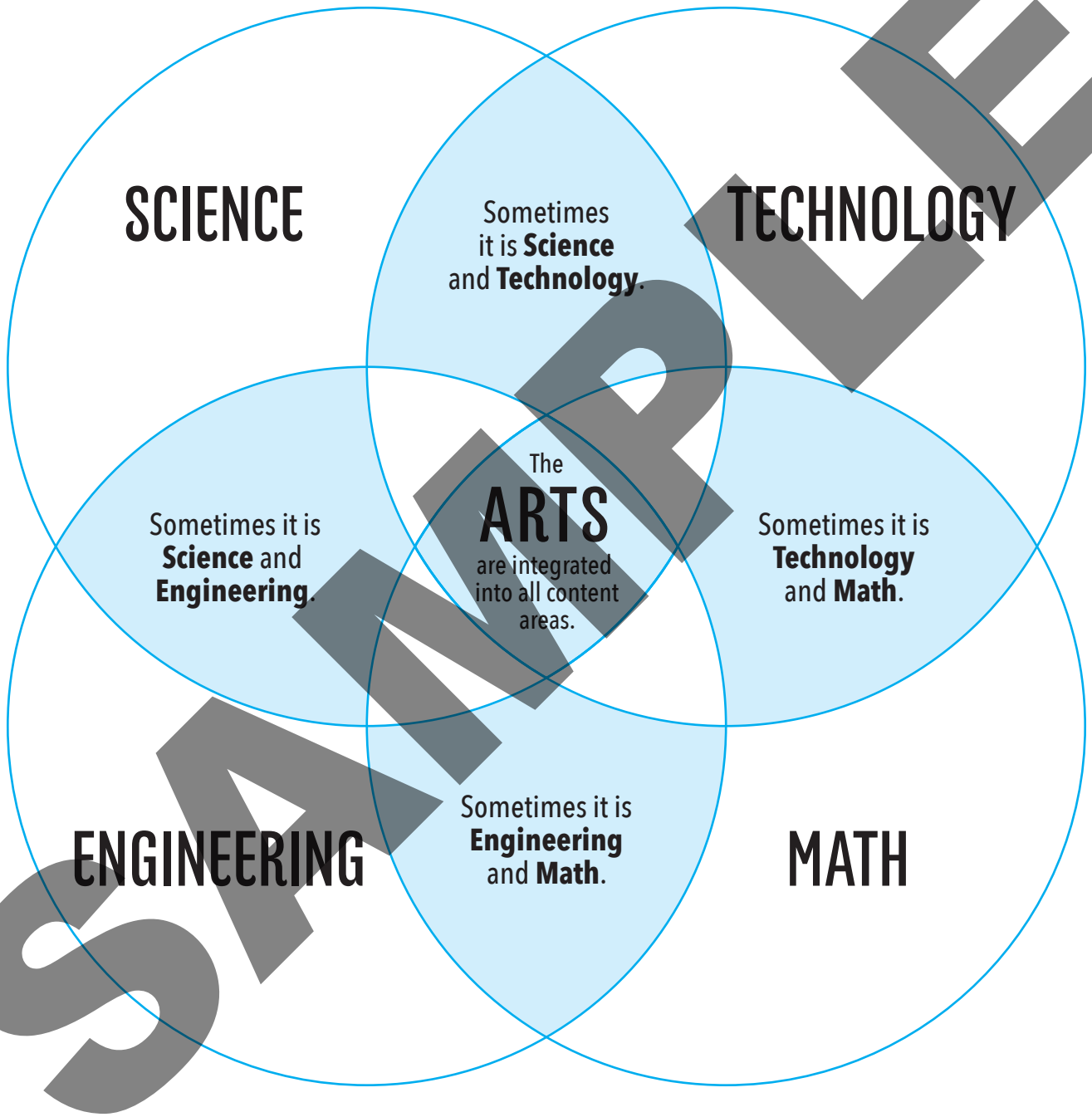
EARTH AND SPACE SCIENCE

PHYSICAL SCIENCE

ENGINEERING DESIGN

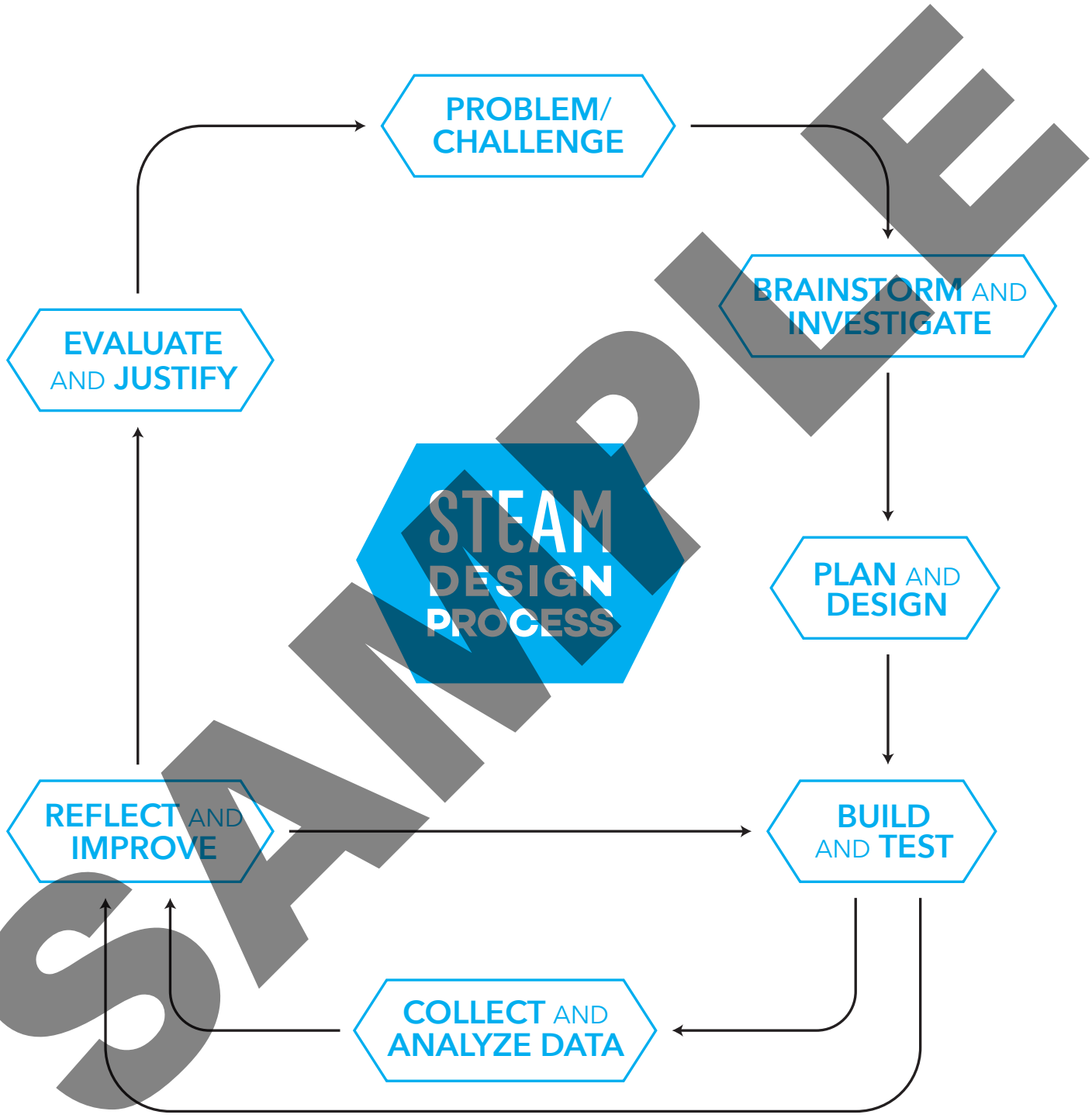
APPENDIX

INTEGRATION IN THE ENGINEERING DESIGN CHALLENGE



Sometimes it is all five!

STEAM DESIGN PROCESS



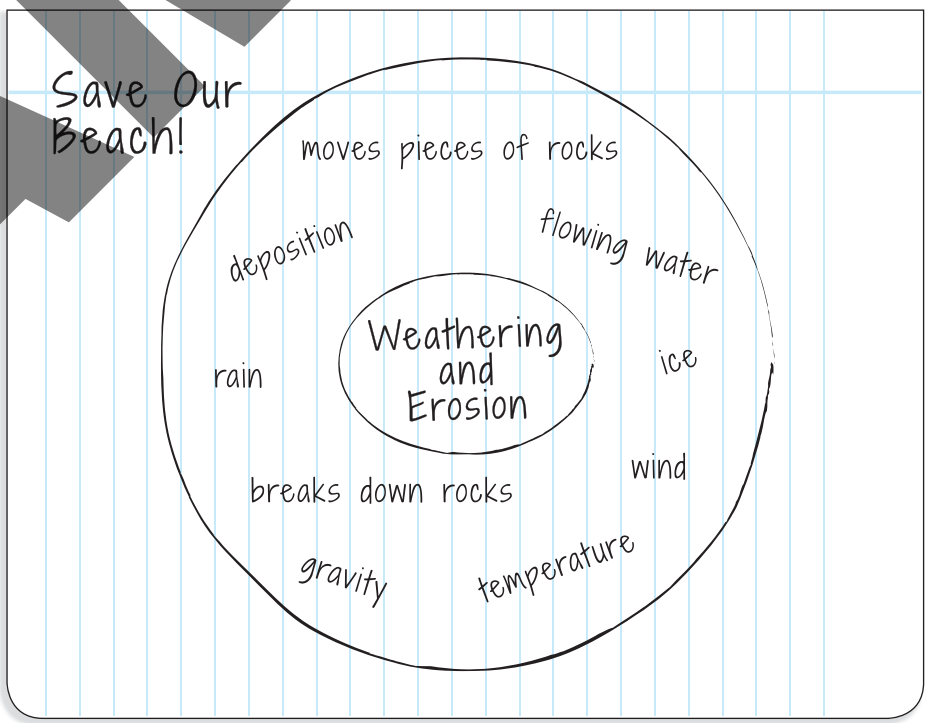
RECORDING INFORMATION IN A SCIENCE NOTEBOOK

Students will record their thinking, answer questions, make observations, and sketch ideas as they work through each design challenge. It is recommended that teachers have students designate a section of their regular science notebooks to these STEAM challenges or have students create a separate STEAM science notebook using a spiral notebook, a composition book, or lined pages stapled together. A generic science notebook cover sheet has been provided in the Appendix.

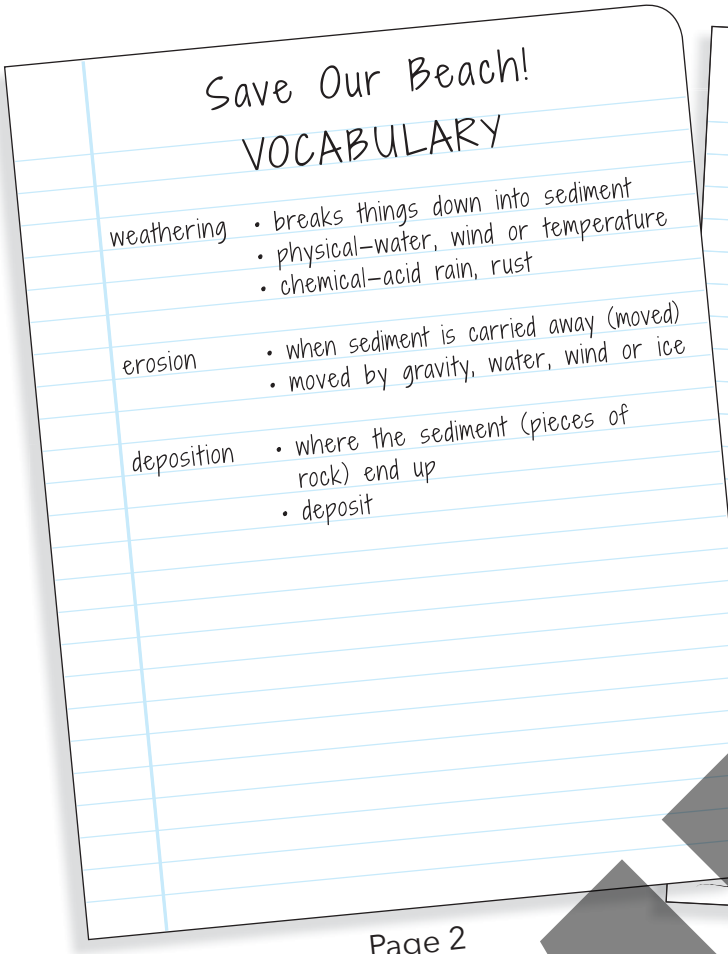
Have students set up their notebooks based upon the natural breaks in the lesson. Remind students to write the name of the design challenge at the top of the page in their notebooks each time they prepare their notebooks for a new challenge.

Pages 1–3 Background Information

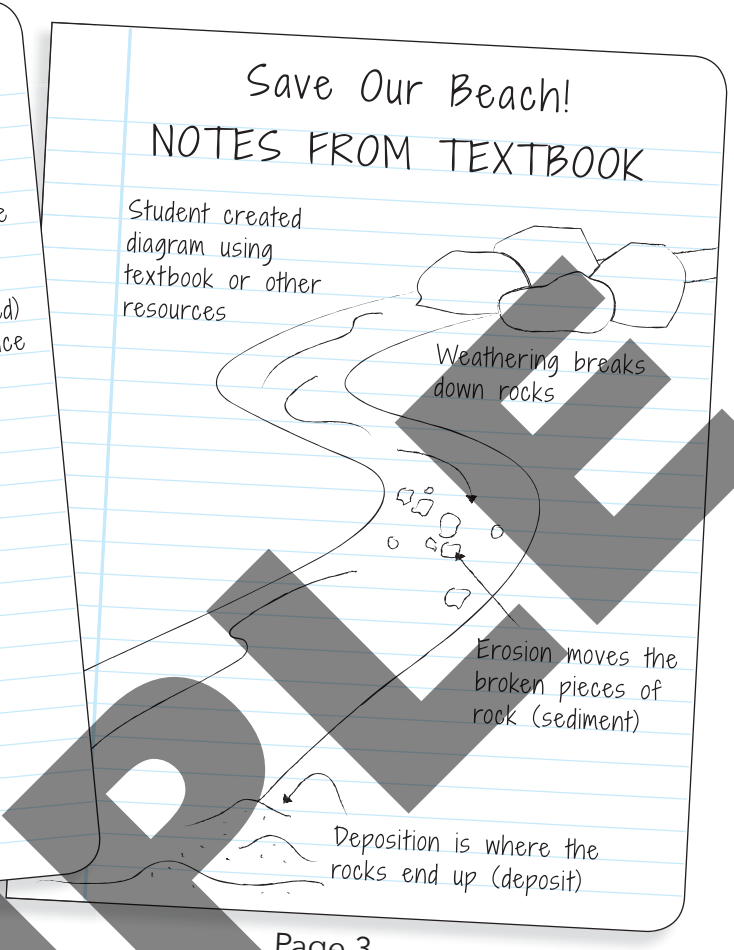
- Students record notes from any information provided by the teacher during whole-group instruction.
- Students record related vocabulary words and their definitions.
- Students record notes from their own independent research, including information gathered through literacy connections and existing background knowledge.



Page 1



Page 2

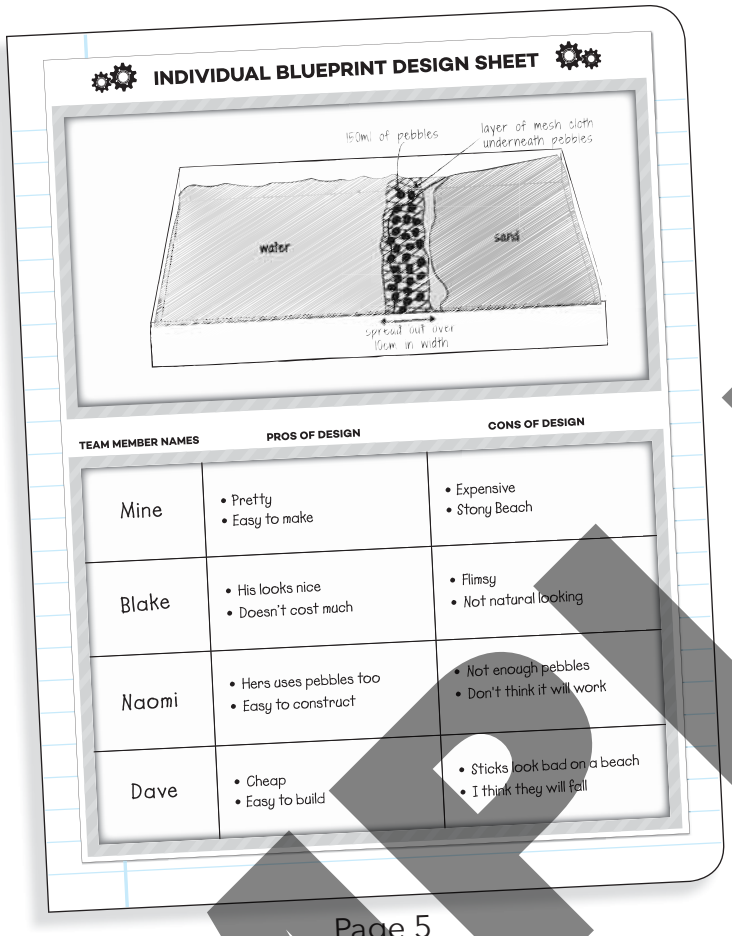


Page 3

Page 4 Dilemma and Mission

- Display the dilemma and mission for students to record.
- Or make copies of the dilemma and mission for students to glue into their notebooks to use as a reference.

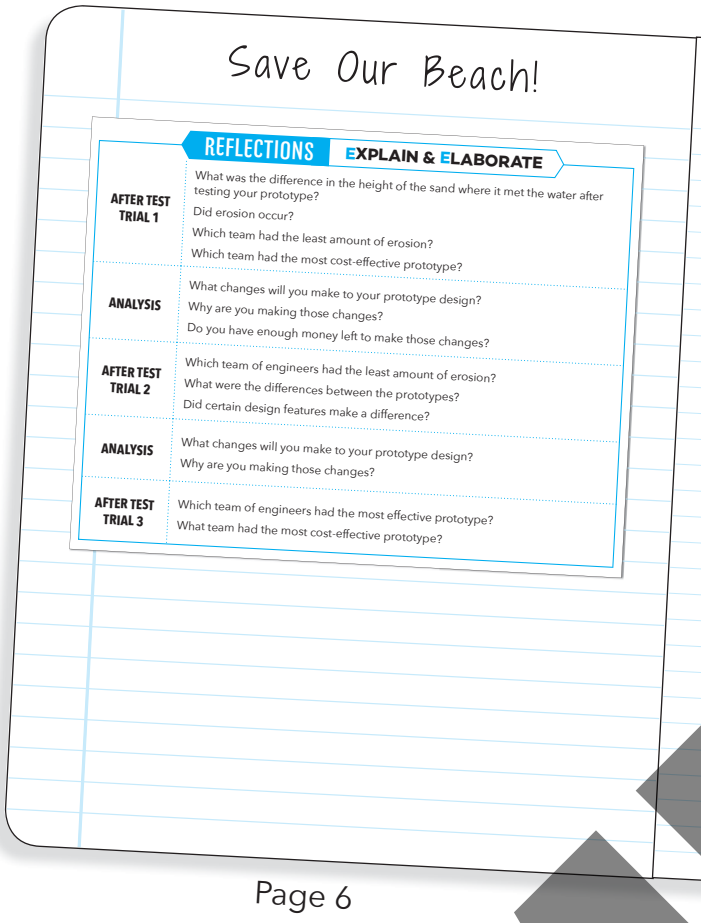
Page 4



Page 5

Page 5 Blueprint Design

- Students draw their own suggested design. Then students write the pros and cons of both their and their teammates' designs.
- Or make copies of the Individual Blueprint Design Sheet for students to complete and glue into their notebooks.

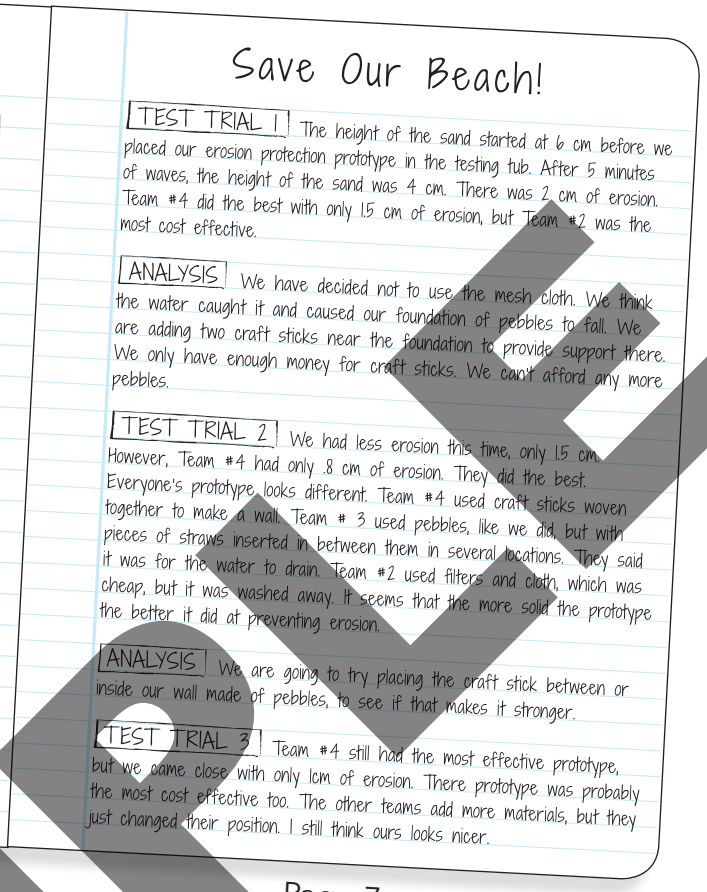


Save Our Beach!

REFLECTIONS EXPLAIN & ELABORATE

AFTER TEST TRIAL 1	What was the difference in the height of the sand where it met the water after testing your prototype? Did erosion occur? Which team had the least amount of erosion? Which team had the most cost-effective prototype?
ANALYSIS	What changes will you make to your prototype design? Why are you making those changes? Do you have enough money left to make those changes?
AFTER TEST TRIAL 2	Which team of engineers had the least amount of erosion? What were the differences between the prototypes? Did certain design features make a difference?
ANALYSIS	What changes will you make to your prototype design? Why are you making those changes?
AFTER TEST TRIAL 3	Which team of engineers had the most effective prototype? What team had the most cost-effective prototype?

Page 6



Save Our Beach!

TEST TRIAL 1 The height of the sand started at 6 cm before we placed our erosion protection prototype in the testing tub. After 5 minutes of waves, the height of the sand was 4 cm. There was 2 cm of erosion. Team #4 did the best with only 1.5 cm of erosion, but Team #2 was the most cost effective.

ANALYSIS We have decided not to use the mesh cloth. We think the water caught it and caused our foundation of pebbles to fall. We are adding two craft sticks near the foundation to provide support there. We only have enough money for craft sticks. We can't afford any more pebbles.

TEST TRIAL 2 We had less erosion this time, only 1.5 cm. However, Team #4 had only .8 cm of erosion. They did the best. Everyone's prototype looks different. Team #4 used craft sticks woven together to make a wall. Team # 3 used pebbles, like we did, but with pieces of straws inserted in between them in several locations. They said it was for the water to drain. Team #2 used filters and cloth, which was cheap, but it was washed away. It seems that the more solid the prototype the better it did at preventing erosion.

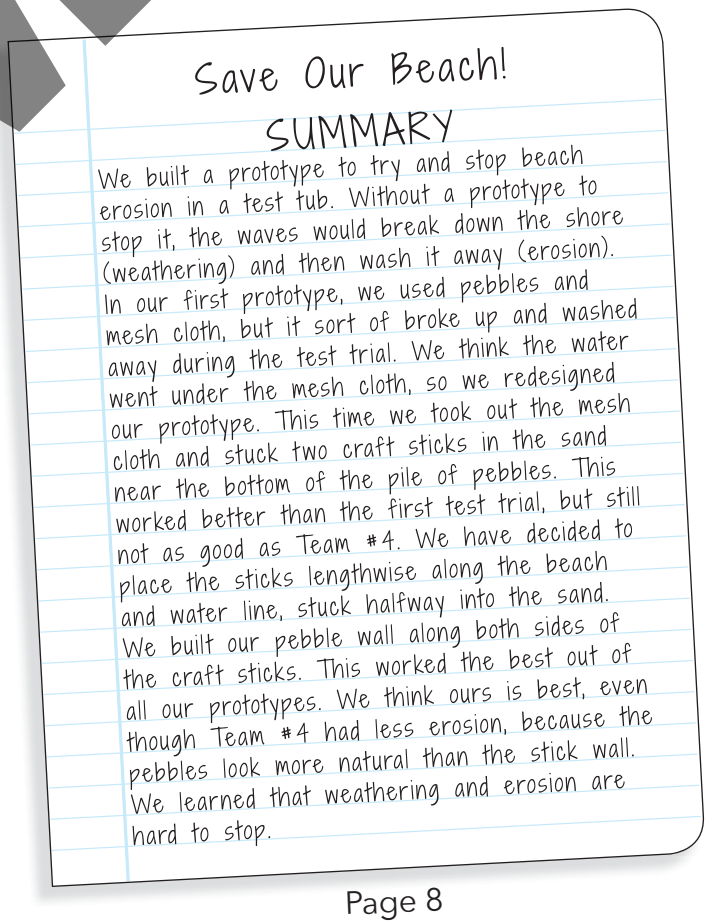
ANALYSIS We are going to try placing the craft stick between or inside our wall made of pebbles, to see if that makes it stronger.

TEST TRIAL 3 Team #4 still had the most effective prototype, but we came close with only 1cm of erosion. There prototype was probably the most cost effective too. The other teams add more materials, but they just changed their position. I still think ours looks nicer.

Page 7

Pages 6–8 Engineering Task, Test Trial, Analyze, Redesign

- Students record analysis questions from the teacher and then record their answers. Or provide copies of the questions for students to glue into their notebooks.
- Record their reflections on the components of the prototypes that were successful and those that were not.
- Include additional pages as needed to allow students to record any notes, observations, and ideas as they construct and test their team prototype.



Save Our Beach!

SUMMARY

We built a prototype to try and stop beach erosion in a test tub. Without a prototype to stop it, the waves would break down the shore (weathering) and then wash it away (erosion). In our first prototype, we used pebbles and mesh cloth, but it sort of broke up and washed away during the test trial. We think the water went under the mesh cloth, so we redesigned our prototype. This time we took out the mesh cloth and stuck two craft sticks in the sand near the bottom of the pile of pebbles. This worked better than the first test trial, but still not as good as Team #4. We have decided to place the sticks lengthwise along the beach and water line, stuck halfway into the sand. We built our pebble wall along both sides of the craft sticks. This worked the best out of all our prototypes. We think ours is best, even though Team #4 had less erosion, because the pebbles look more natural than the stick wall. We learned that weathering and erosion are hard to stop.

Page 8

DON'T FREAK OUT!

1-2 HOURS
TIME FOR COMPLETION

STEAM

SETTING THE STAGE

DESIGN CHALLENGE PURPOSE

Design and construct a house prototype that will remain intact during a simulated earthquake.

TEACHER DEVELOPMENT

The earth is made up of four layers: the inner core, the outer core, the mantle, and the crust. The crust and the top part of the mantle make up the surface of the earth. Cracks along the surface of the earth are called **faults**. This is where earthquakes occur. **Earthquakes** are natural disasters consisting of sudden violent shaking or rolling movement on the earth's surface. Earthquakes usually do not last long, often less than a minute. However, they can cause immense damage in that short period of time. Humans cannot stop these natural disasters from occurring, but they can work to lessen their impact. A scientist who studies earthquakes is called a **seismologist**.

STUDENT DEVELOPMENT

Review the vocabulary words in the teacher development section with students to ensure they understand them.

Lesson Idea: Have students collaborate to research the causes and effects of earthquakes. Alternatively, show a short video or read a short article about earthquakes to deepen students' understanding of their causes and impact on humans. Discuss what humans do to overcome the effects of earthquakes. Demonstrate the sudden movement of an earthquake using your earthquake shake table (see Materials) prior to presenting the STEAM challenge.

STANDARDS

SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATH	ELA
4-ESS3-2	ISTE.3	3-5ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Creating #1	CCSS.MATH.CONTENT.4.MD.A.3	CCSS.ELA-LITERACY.W.4.9

SCIENCE & ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

CROSSCUTTING CONCEPTS

Cause and Effect: Cause-and-effect relationships are routinely identified, tested, and used to explain change.

TARGET VOCABULARY

earthquake
fault
geology
plate tectonics
seismic activity
stability
structure

LITERACY CONNECTIONS

Time for Kids: Earthquakes!
by Editors of TIME For Kids

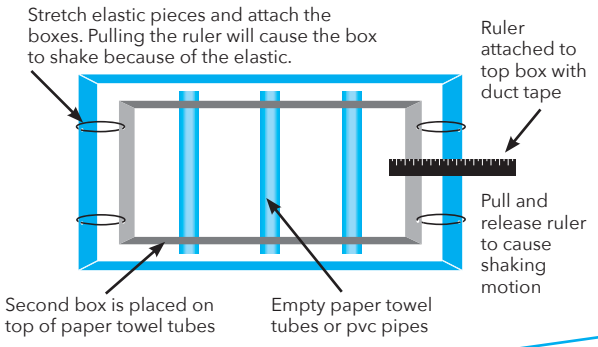
MATERIALS

Earthquake Shake Box:

- 2 thick pieces of cardboard (2 large shirt box pieces with corners taped flat works great)
- 2 paper towel tubes (or pvc pipes)
- 2 large rubber bands
- wooden ruler (or similar stick shape)
- duct tape

House Building (one per team):

- 25 straws
- 5 pipe cleaners
- 4 sheets of newspaper
- 5 rubber bands
- 2 meters of string
- glue
- 4 hollow tubes (toilet paper tubes)
- 10 craft sticks
- rulers
- scissors



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