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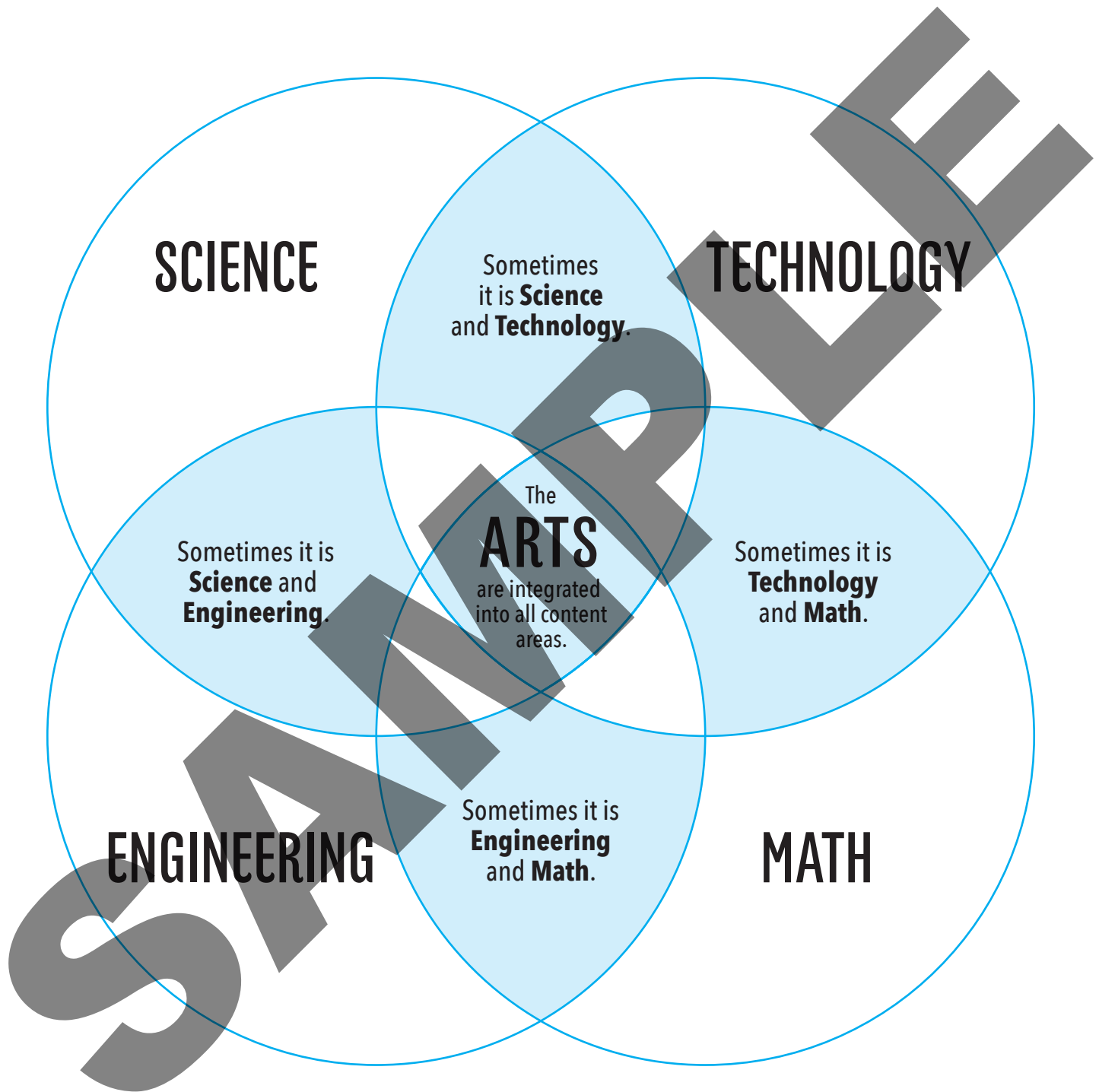
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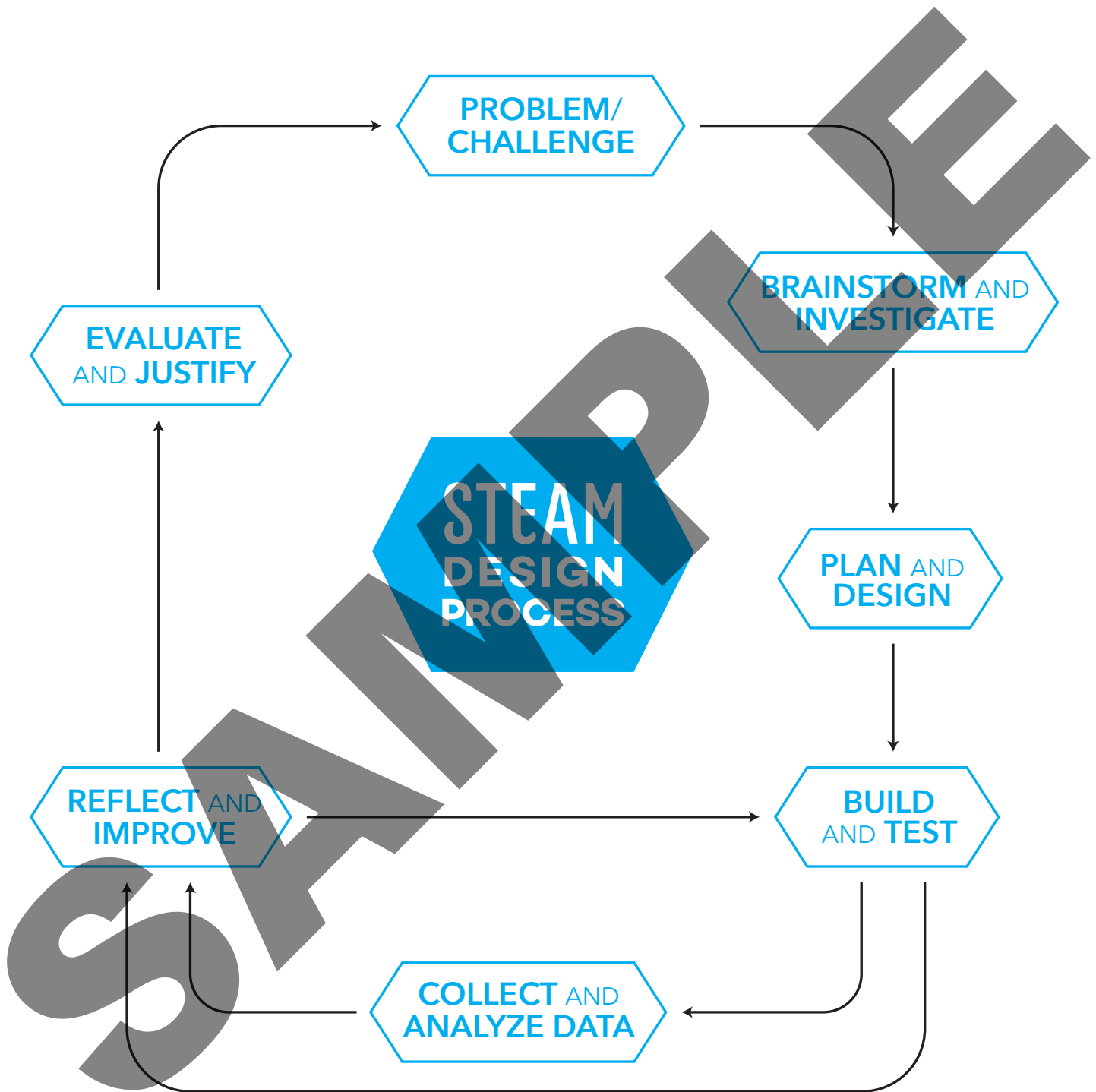
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INTEGRATION IN THE ENGINEERING DESIGN CHALLENGE



Sometimes it is all five!

STEAM DESIGN PROCESS





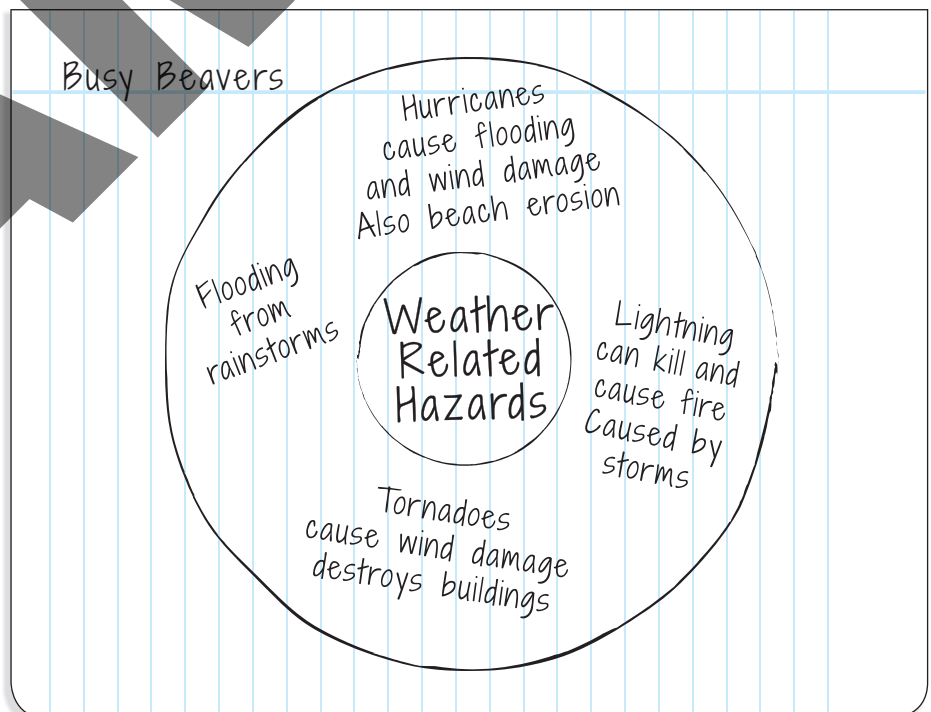
RECORDING INFORMATION IN A SCIENCE NOTEBOOK

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.



Busy Beavers

VOCABULARY

- dam - a barrier built by man or in nature (like a beaver dam) to slow down or stop the flow of water from a stream or river.
- engineer - someone who designs and builds a structure or material in order to solve a problem or make something work better.
- hazard - something that can be a risk or cause harm to a person, to property, or to the environment.

Page 2

Busy Beavers

NOTES FROM TEXTBOOK

- p.16 - Floods
Floods can happen anywhere but usually happen when it rains for a very long time or rains a huge amount in a very short time.
- p.17 - Drought
A drought is the shortage of water over a long period of time. It can be the cause of brush fires and wildfires.
- 18 - Winds
Winds that are over 40 mph can be dangerous and cause damage. They can occur during thunderstorms, hurricanes, blizzards, and tornadoes.
- Lightning
Lightning usually occurs during summer thunderstorms but can occur at any time of the year. Lightning is dangerous. It can kill people and cause fires.

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.

Busy Beavers



DILEMMA ENGAGE

Baxter, head beaver of the Dam Construction Project, has noticed that there has been increased flooding from excessive rainfall in the wetlands. The rain is sweeping away the dam that the beavers have been working on over the past three months. Baxter needs your help! Heavy rainfall is becoming more common in this habitat, and he needs to design a sturdier and effective dam that will keep these busy beavers safe from predators! The dams that they build are also a place for the beavers to store food for their families.

MISSION

Create a dam that allows the least amount of flooding water to pass through it in order to save the beaver habitat and protect these creatures.

Page 4

INDIVIDUAL BLUEPRINT DESIGN SHEET

\$50

10 craft sticks	\$20
cereal box	\$10
5 straws	\$10
string	\$5
\$45	

TEAM MEMBER NAMES	PROS OF DESIGN	CONS OF DESIGN
Mine	<ul style="list-style-type: none"> • Less than \$50 • Place for food 	<ul style="list-style-type: none"> • Some gaps that water might go through • Only \$5 left for redesign
Madeleine	<ul style="list-style-type: none"> • No gaps • Meets budget 	<ul style="list-style-type: none"> • No place for food storage • No money left
Jenny	<ul style="list-style-type: none"> • \$25 left • No gaps 	<ul style="list-style-type: none"> • Tape will get wet and ruined • I think that water will go over it.
Fred	<ul style="list-style-type: none"> • Under budget • Place to store food 	<ul style="list-style-type: none"> • Gaps • Only \$5 left

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.

Busy Beavers

REFLECTIONS	EXPLAIN & ELABORATE
AFTER TEST TRIAL 1	How much water was in the bucket after the "flood"? Which team had the least amount of water in the bucket? Did certain materials or design features make a difference?
ANALYSIS	What changes can you make to your prototype to allow less water to flow through your dam?
AFTER TEST TRIAL 2	Did you have more or less water in the bucket after your redesign? If you could change out some of your materials, what would you use this time? Why?
ANALYSIS	What changes do you need to make in order to have less water in the bucket? Why?
AFTER TEST TRIAL 3	Which team of engineers had the dam that let through the least amount of water? What features made this prototype most effective?

Page 6

Busy Beavers

TEST TRIAL 1

Our team had almost 1 gallon of water get past our dam into the bucket. No one was successful at stopping the water from getting past their dams.

ANALYSIS

We are going to try and use craft sticks to support our straw structure. We are going to replace tape with string.

TEST TRIAL 2

We had less water after the second trial. We only lost $\frac{1}{2}$ gallon of water into the bucket. We would like to change some of our "woven" straws for craft sticks to make the structure stronger.

ANALYSIS

We have just enough money to buy 2 more craft sticks. We are going to swap them for two of our straws to make our structure more stable. The water keeps bending our structure and going over it. We think adding craft sticks will help.

TEST TRIAL 3

Our final design let the least amount of water through than anyone else's, only 2 cups of water. I think that it was effective because our design did not have any gaps. We used straws to make a tight weave. We added craft sticks to provide support and stability.

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.

Busy Beavers

SUMMARY

I learned that flooding or flowing water can be a powerful force. It knocked down, went through, or went over everyone's prototypes during the first test trial. In order to succeed in slowing down the water flow, we needed to make our structure as secure and steady as possible.

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BUSY BEAVERS



3-4 HOURS
TIME FOR COMPLETION

STEAM

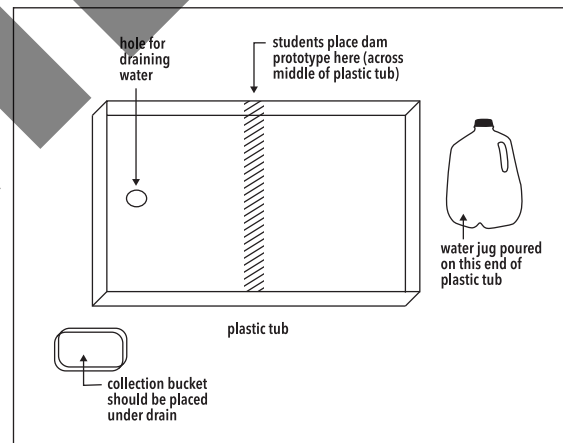


DESIGN CHALLENGE PURPOSE

Design a beaver dam to slow flooding water.

TEACHER DEVELOPMENT

Beavers play an important role in the upkeep of the wetlands environment. Wetlands are home to a variety of animal species. Wetlands absorb large amounts of water, which counteracts the effects of heavy rainfall and can prevent potential floods. Beaver **dams** can act as natural filters that keep sediment and toxins from flowing into streams and oceans. Beavers create dams in order to protect themselves from predators.



STUDENT DEVELOPMENT

Prior to beginning this lesson, students should research and obtain information on ways in which humans and animals, such as beavers, can reduce the impact of weather-related hazards. Have students participate in a discussion about weather-related hazards. Facilitate the discussion with questions such as *What types of damage can be caused by weather-related*

hazards? What impact do these weather-related hazards have on the environment? How can we help design solutions to protect our environment from the weather?

Note: Visit the website listed on the inside front cover for information about ways humans and animals can reduce the impact of weather-related hazards.

STANDARDS

SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATH	ELA
3-ESS3-1	ISTE.2 ISTE.3	3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3	Creating #1	CCSS.MATH.CONTENT.3.NBT.A.2	CCSS.ELA-LITERACY.W.3.7 CCSS.ELA-LITERACY.SL.3.1

SCIENCE & ENGINEERING PRACTICES

Obtaining, Evaluating, and Communicating Information: Obtain and combine information from books and other reliable media to explain phenomena.

Engaging in Argument from Evidence: Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

CROSSCUTTING CONCEPTS

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



TARGET VOCABULARY

- dam
- engineer
- hazard



LITERACY CONNECTIONS

The Busy Beaver
by Nicholas Oldland



MATERIALS

Dam:

- craft sticks
- cereal boxes
- masking tape
- glue
- drinking straws
- yarn
- string
- construction paper
- toothpicks
- index cards
- cornstarch
- coffee filters

Flood Model:

- large plastic tub with hole in one end for draining water
- measuring cups or graduated cylinder
- gallon jug
- water collection container
- timer
- Optional: Budget Planning Chart (page 141)

NOTES