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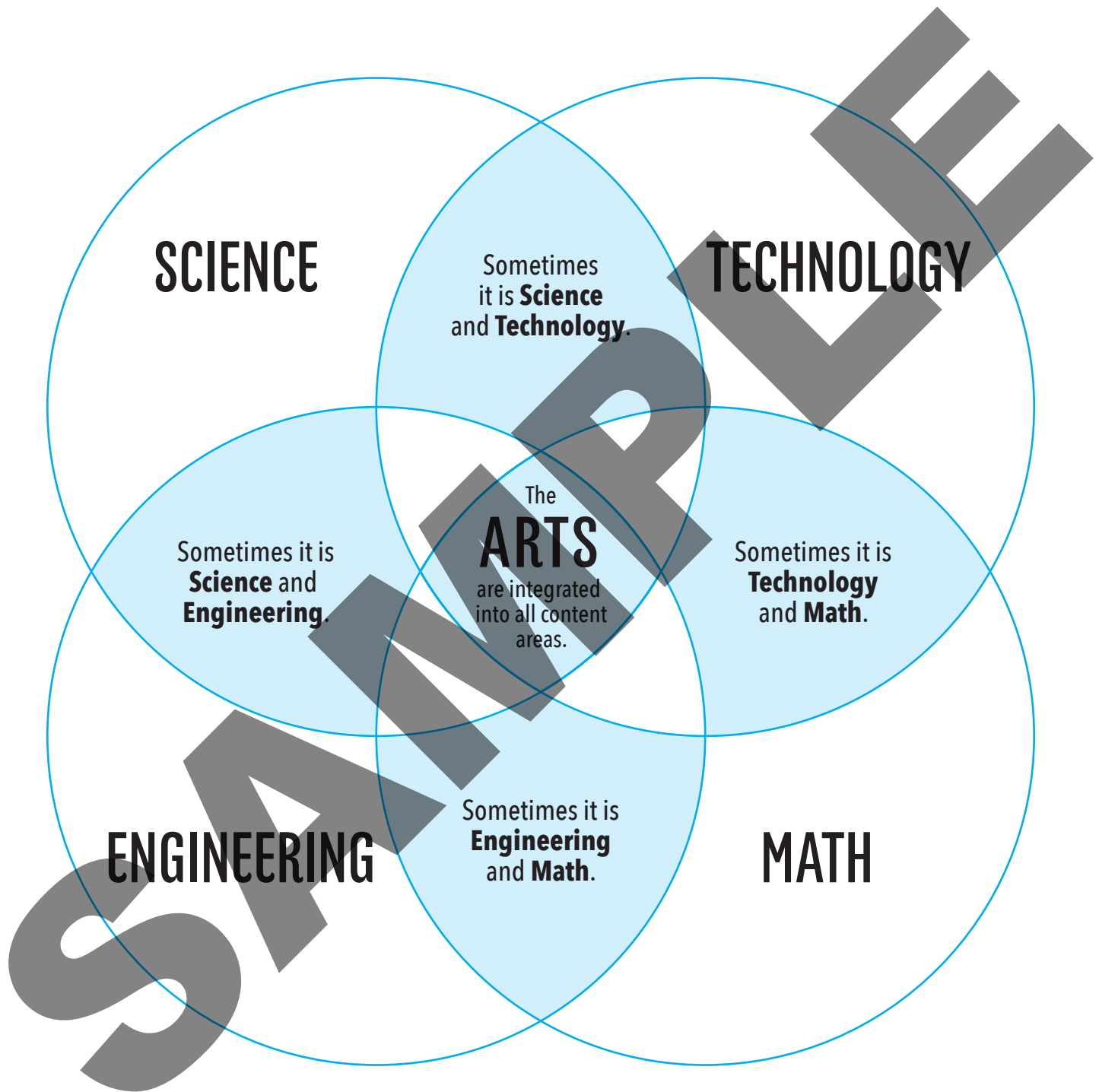
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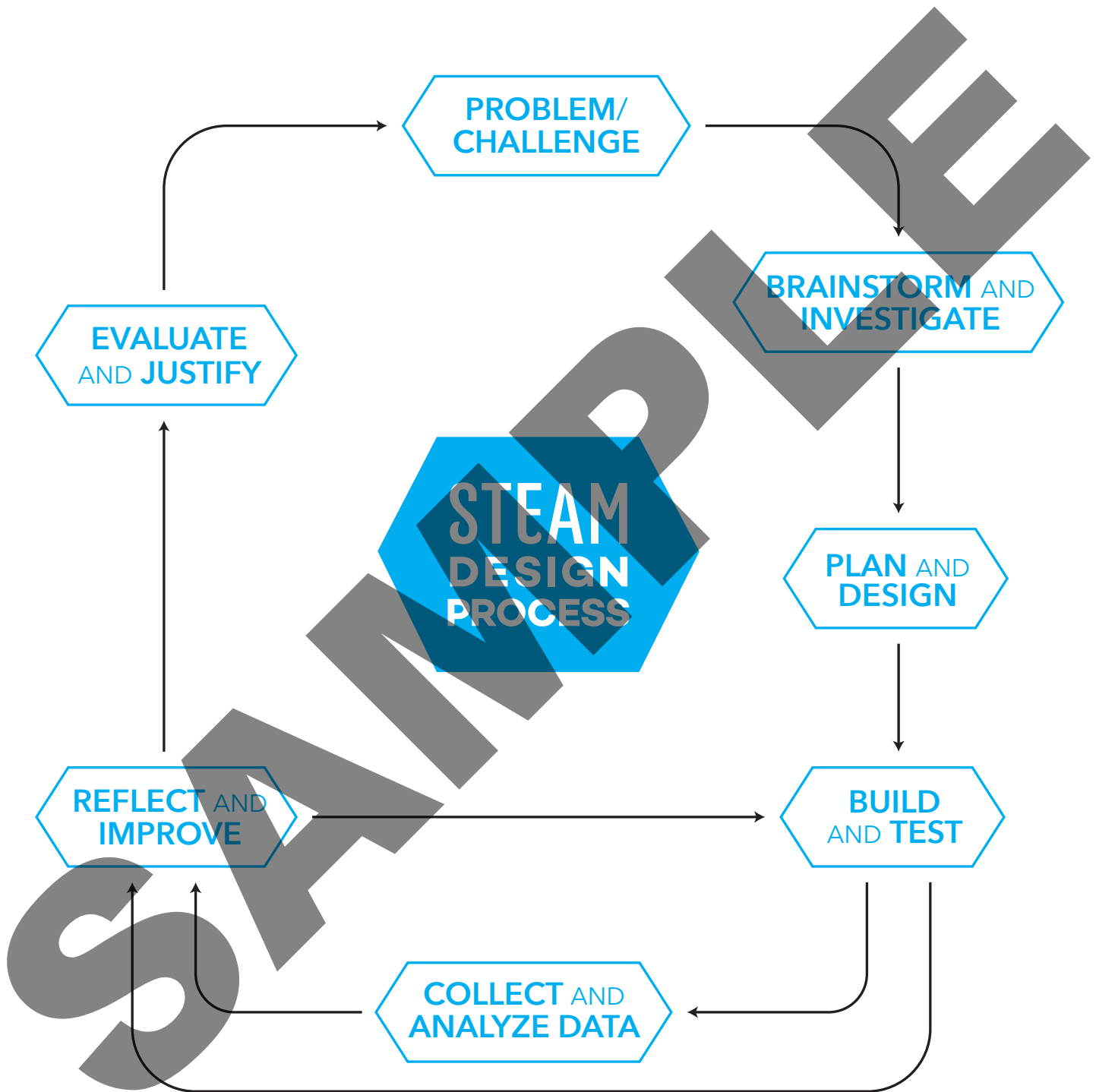
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INTEGRATION IN THE ENGINEERING DESIGN CHALLENGE



Sometimes it is all five!

STEAM DESIGN PROCESS





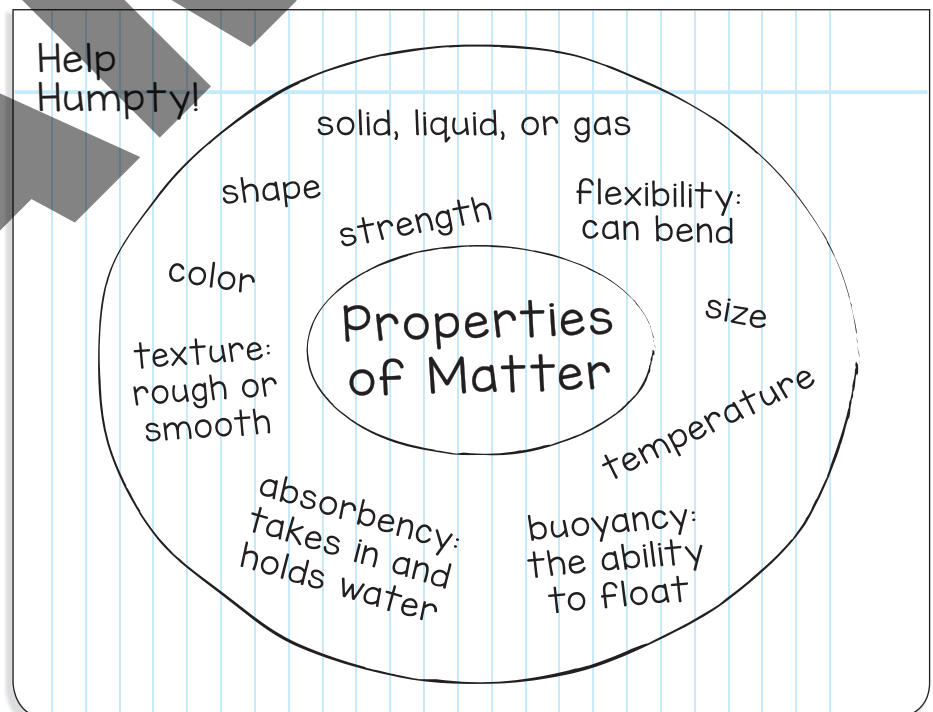
RECORDING INFORMATION IN A SCIENCE NOTEBOOK

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.



Help Humpty! VOCABULARY

- absorbency the ability of an object to take in and hold water
- flexibility an object's ability to bend without breaking
- hardness the ability to resist changing shape
- strength the ability to support a weight or load without breaking
- texture describes how rough or smooth an object is

Page 2

Help Humpty!

NOTES FROM SCIENCE BOOK

p.53 Matter

Matter is everything that you see around you. Matter is everything that has volume and takes up space.

p.54 States of Matter

Matter is commonly found in three states. They are solid, liquid or gas. A solid object has a definite shape and a definite volume. A liquid has an indefinite shape because its shape depends on the container. But, it has a definite volume that does not change when its container changes. A gas has both an indefinite shape and an indefinite volume. It also takes the shape of its container. However, its volume will change when the container changes.

Properties of Matter

Properties of matter are the characteristics used to describe matter. They include the states of matter, color, shape, size, texture, strength, volume, weight, buoyancy, flexibility, and absorbency.

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.

Help Humpty!



DILEMMA ENGAGE

Read aloud *Humpty Dumpty Climbs Again* by Dave Horowitz.

Humpty's friends need his help! But ever since his fall in front of all the king's horses and all the king's men, Humpty has been feeling embarrassed and doesn't want to come out of his house. He is afraid of falling to pieces again and doesn't want to humiliate himself a second time. Humpty really wants to help his friends,

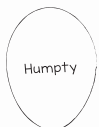
but he knows how fragile and clumsy he is. Humpty needs your help in building a device that will keep him safe in case he accidentally falls again.

MISSION

Build a device that will keep Humpty from cracking when he falls from a distance of at least 4 ft.

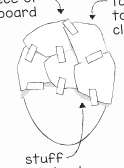
Page 4

INDIVIDUAL BLUEPRINT DESIGN SHEET



Humpty

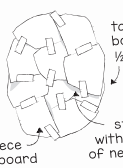
Place Humpty in 1st piece of cardboard



1st piece of cardboard

tape top 1/2 closed

stuff with 1 sheet of newspaper



tape bottom 1/2 closed

stuff with 1 sheet of newspaper

2nd piece of cardboard

Place 2nd piece of cardboard around 1st piece so that Humpty can't be seen. Tape closed.

TEAM MEMBER NAMES	PROS OF DESIGN	CONS OF DESIGN
Me	<ul style="list-style-type: none"> • Protected top/bottom • Low cost materials 	<ul style="list-style-type: none"> • Loose on sides • Can't reuse the paper
Jason	<ul style="list-style-type: none"> • Newspaper protected by plastic wrap • Under budget 	<ul style="list-style-type: none"> • No protection on top • Egg might slip out
Emily	<ul style="list-style-type: none"> • Protected on all sides • Under budget 	<ul style="list-style-type: none"> • Can't reuse the paper
Edwardo	<ul style="list-style-type: none"> • Newspaper protected by plastic wrap • Looks fancy 	<ul style="list-style-type: none"> • The egg can slip out • Over budget

Page 5

Page 5 Blueprint Design

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

Help Humpty!

	REFLECTIONS	EXPLAIN & ELABORATE
AFTER TEST TRIAL 1	Did your egg survive the fall without cracking? Did your prototype stay intact?	
ANALYSIS	What parts of your design helped to protect the egg? What changes could you make to your prototype to make sure the egg is safe during the next fall?	
AFTER TEST TRIAL 2	Did your egg and your prototype both stay intact after the fall? Did other prototypes work more effectively than yours?	
ANALYSIS	What were some parts of other teams' prototypes that helped keep their eggs safe? Why did these designs work better than others?	
AFTER TEST TRIAL 3	What part of your prototype could you change to keep the egg safe during a fall from a greater height? Which materials were most effective in this challenge?	

Page 6

Help Humpty!

TRIAL 1

Our egg did not survive the fall even though it was protected on all sides. Our structure did well though. It did not fall apart like some of the other teams' prototypes did.

Analysis: The way our structure was made worked well. It fit together around our egg. Our newspaper is ruined and we can't use it again. We have enough money to buy two more sheets of newspaper and one sheet of plastic wrap to protect our newspaper if our egg breaks again. We won't squish our paper together. Instead of 10 cm thick, it will be 15 cm. We think this will provide more cushion.

TRIAL 2

Our egg did NOT break! Success! Two other teams were successful too. They were not more effective because we all were successful. Analysis: We all used cardboard on the outside and newspaper on the inside. The team that was not successful used plastic wrap and newspaper taped into a sort of ball, no cardboard container.

TRIAL 3

I think our container would work from a greater height. But, if I could afford more materials, I would add another layer of newspaper and another layer of cardboard.

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.

Help Humpty!

SUMMARY

Today, we learned how different properties of matter can affect objects. In this case, we were trying to protect an egg from breaking. We needed to bend the newspaper to make them the shape we needed for insulating our egg. They were flexible. We needed a strong container to protect the egg from the impact of hitting the floor. We used cardboard. Overall, our prototype was very successful because we stayed under budget and we helped keep Humpty from breaking.

Page 8

BURIED TREASURE



1-2
HOURS
TIME FOR
COMPLETION

S>t>E>A>m



DESIGN CHALLENGE PURPOSE

Create a treasure map that includes all the parts of a map as well as different landforms.

TEACHER DEVELOPMENT

This challenge asks students to create a model that includes landforms.

Models are used when something is too large or too expensive for scientists to study. A **map** is a model that represents a real place.

A **physical map** includes features such as lakes, mountains, rivers, and forests. In order to meet the standards, teams will need to be specific and detailed when they create their treasure maps.

STUDENT DEVELOPMENT

Review the concepts of models, landforms, and the parts of a map (e.g., title, scale, compass rose, and key) to prepare for this challenge.

Lesson Idea: Play pictionary! In advance, prepare a set of cards for each group by writing the name of a different landform (e.g., *lake, river, forest, or mountain*) on

each card. Place students into groups of four. Place the stack of cards facedown. Students will take turns choosing a card, not showing it to anyone, and drawing a picture of the landform to get his or her team members to correctly identify it. As an added challenge, set a timer and have teams try to correctly identify all the cards in the pile before time runs out.

STANDARDS

SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATH	ELA
2-ESS2-2		K-2-ETS1-1 K-2-ETS1-2 K-2-ETS1-3	Creating #1 Creating #2 Creating #3		CCSS.ELA-LITERACY.W.2.3

SCIENCE & ENGINEERING PRACTICES

Developing and Using Models: Develop a model to represent patterns in the natural world.

CROSSCUTTING CONCEPTS

Patterns: Patterns in the natural world can be observed.

Stability and Change: Things may change slowly or rapidly.



TARGET VOCABULARY

- compass rose
- key (on map)
- landform
- map
- model
- physical map
- scale (on map)
- title (on map)



MATERIALS

- white paper
- sticky notes
- colored pencils
- rulers
- markers
- gold coins
- brown paper bag cut apart or brown craft paper
- various maps for reference

Note: Make this mission more challenging by providing several reference maps of different areas. Make it less challenging by giving the same reference map to each team.



LITERACY CONNECTIONS

How I Became a Pirate
by Melinda Long

NOTES