

TABLE OF CONTENTS

GETTING STARTED

Introduction	5
How to Use This Book	6
The Standards	13
Integration in the Engineering Design Challenge	14
STEAM Design Process	15
Recording Information in a Science Notebook	16



EARTH AND SPACE SCIENCE

Block That Blizzard	20
I Can See Clearly Now	26
Please Rain on My Parade	32
Stellar Sundials	38



ENGINEERING DESIGN

Build a Better Bridge	44
Honk for Hybrids	50
Orca Overcast	56
Stow for the Crow	62



LIFE SCIENCE

Critter Creations	68
Help! I'm Hungry!	74
Invasive Invaders	80
Pesky Pythons	86



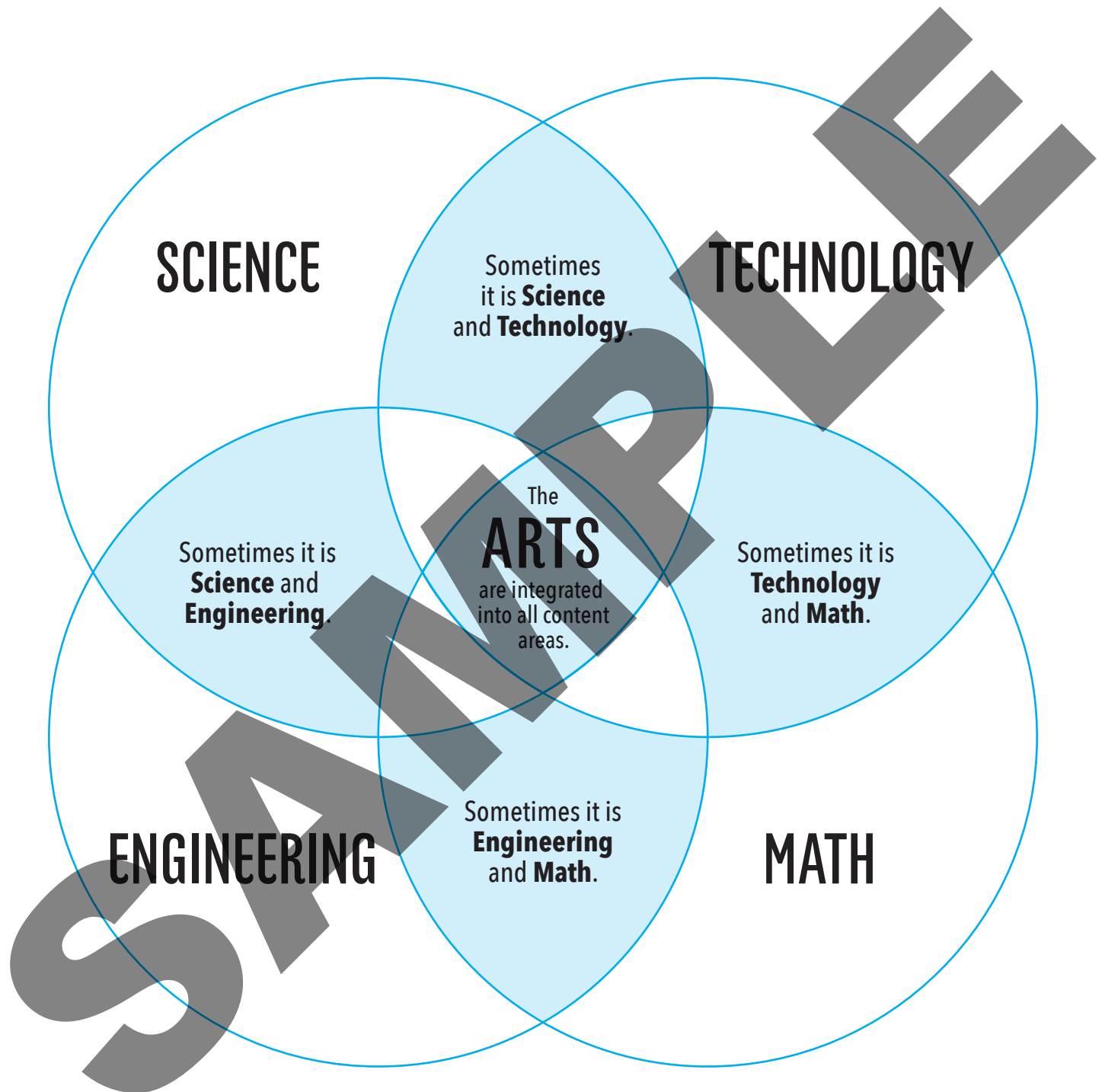
PHYSICAL SCIENCE

Blast Off!	92
Eggstra Safe Cars	98
Greenhouse Gadgets	104
Make It Stick	110
On Target	116
Wacky Waterslides	122

APPENDIX

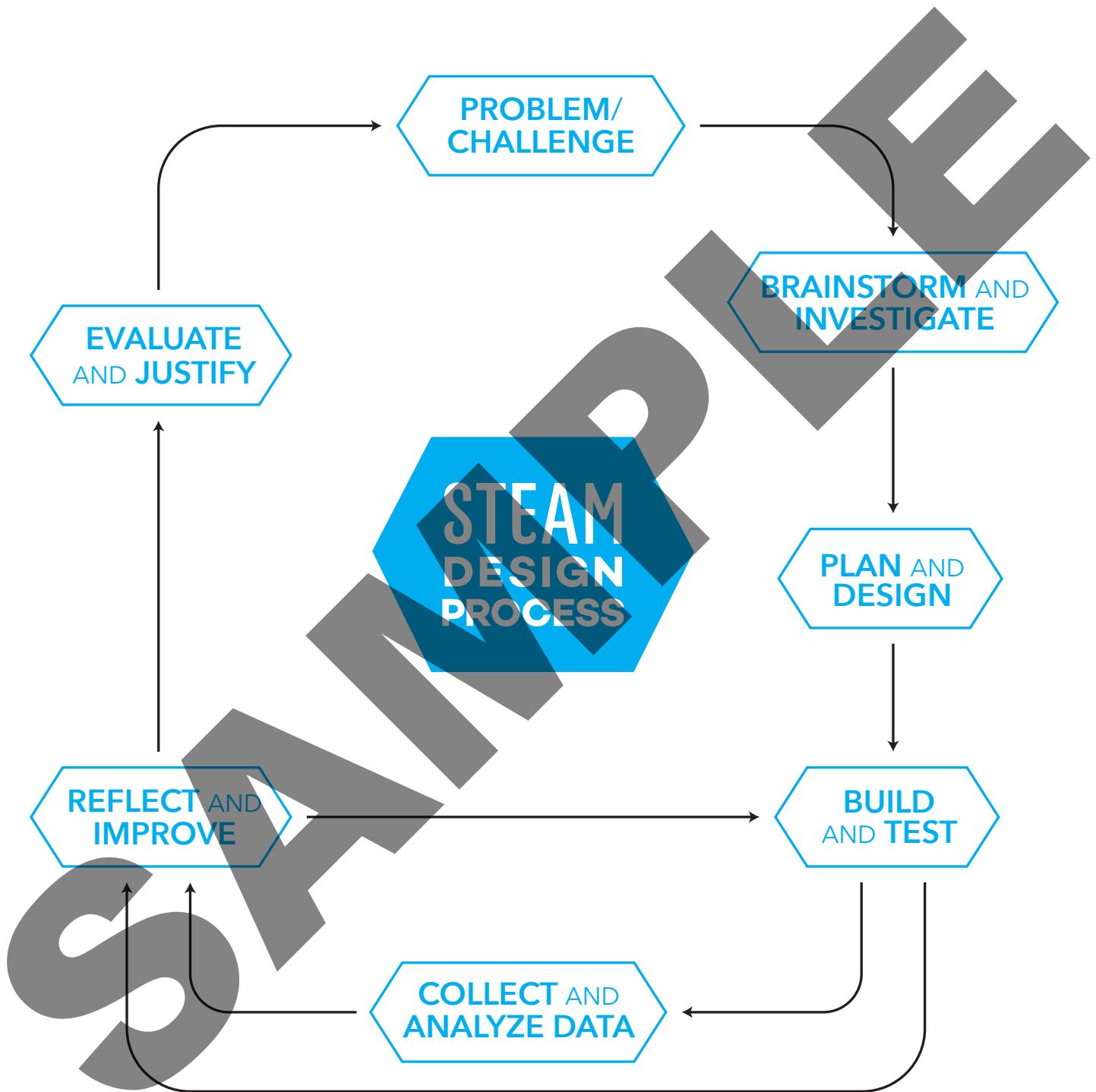
Lesson Plan-Specific Reproducibles	129
Individual Blueprint Design Sheet	136
Group Blueprint Design Sheet	137
Graph	138
Budget Planning Chart	139
STEAM Job Cards	140
Science Notebook Cover	141
STEAM Money	142
STEAM Rubric	144
Glossary	146
Bibliography	151

INTEGRATION IN THE ENGINEERING DESIGN CHALLENGE



Sometimes it is all five!

STEAM DESIGN PROCESS



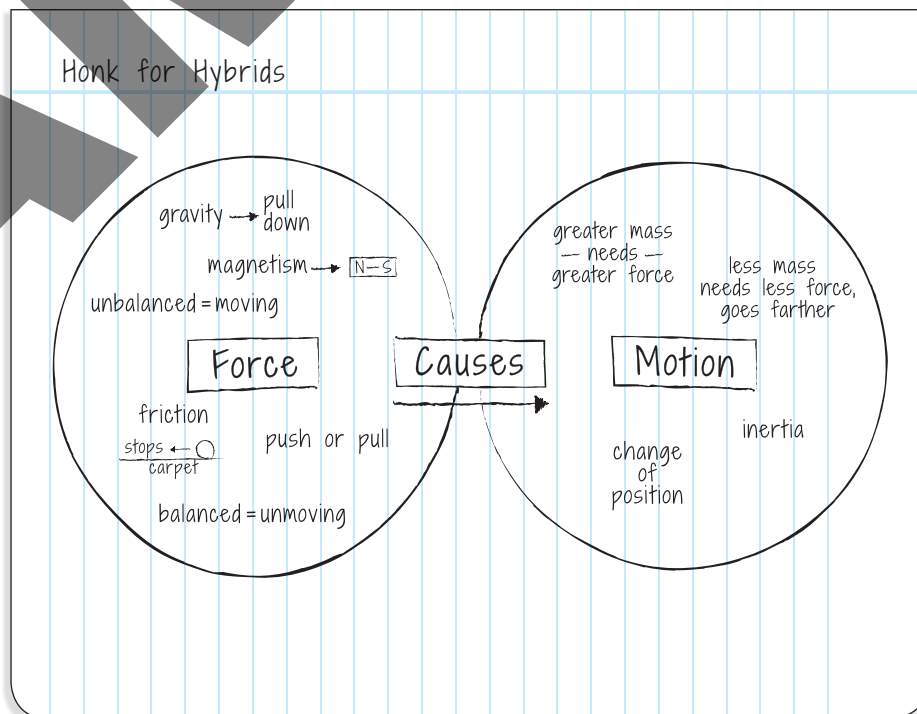
RECORDING INFORMATION IN A SCIENCE NOTEBOOK

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.



Honk for Hybrids VOCABULARY

- force • A push or pull that changes the speed or direction of an object's motion.
- motion • The act of changing place or position.
- gravity • The force that pulls objects or bodies toward other objects or bodies.
- magnetism • Force created by the motion of electric charges. This creates attractive and repulsive forces between objects.
- unbalanced forces • Forces of unequal magnitude acting on an object to create acceleration.
- balanced forces • Two forces of equal magnitude acting in opposite directions on an object.

Page 2

Honk for Hybrids NOTES FROM TEXTBOOK

p. 74 There are many forces that cause motion. Some forces even oppose motion.

p. 75 A force is a push or pull. Think of a tug-of-war contest, each side pulling the opposite ends of a rope, trying to move the flag and win the contest.

76 Balanced forces happen when the forces acting on an object are equal and opposite, no movement. In a tug-of-war, the flag doesn't move. Unbalanced force means that one force acting on an object is greater than another force that causes motion.

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.

Honk for Hybrids



DILEMMA ENGAGE

Due to the high cost of gasoline and its damaging effects to the environment, car companies are now targeting alternative sources of energy to fuel their hybrid cars. Many of the newest cars being created work off of electricity and other forms of energy rather than on 100% gasoline.

The CEO of Honk for Hybrids, Mr. Don T. Pop, is searching for a new design team to come up with something outside the box. He wants to put a vehicle on the market that is not only cost effective but also uses alternative energy to run.

MISSION

Construct and name your balloon-powered car. The design team with the prototype that travels the farthest using only balloon power will have the opportunity to secure the contract to work for Honk for Hybrids and put their design on the market.

Page 4

INDIVIDUAL BLUEPRINT DESIGN SHEET

TEAM MEMBER NAMES	PROS OF DESIGN	CONS OF DESIGN
Sam	<ul style="list-style-type: none"> looks like a vehicle secured with tape on all parts 	<ul style="list-style-type: none"> only one balloon for power only one person can power the car there may not be enough tape to secure the pieces
Regina	<ul style="list-style-type: none"> looks like a vehicle unique design 	<ul style="list-style-type: none"> not enough tape to secure the pieces
Marco	<ul style="list-style-type: none"> uses two balloons for power 	<ul style="list-style-type: none"> doesn't look like a car
Kimiko	<ul style="list-style-type: none"> uses two balloons for power unique design 	<ul style="list-style-type: none"> doesn't look like a car

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.

Honk for Hybrids

REFLECTIONS	EXPLAIN & ELABORATE
AFTER TEST TRIAL 1	Which team of engineers had the prototype that traveled the farthest? How far (in centimeters) did your balloon car travel? What were some of the differences between the prototypes?
ANALYSIS	What changes will you make so your prototype will go farther?
AFTER TEST TRIAL 2	Did the changes you made result in a more effective car? How much farther did your car travel this time (in centimeters)?
ANALYSIS	What changes did the most successful design team make to its prototype? What other changes will you make so your car prototype will go farther?
AFTER TEST TRIAL 3	Did the changes you made result in a more effective car? Which team had the most effective prototype?

Page 6

Honk for Hybrids

TRIAL 1

Team number two's prototype traveled the farthest (98 cm).

Our prototype traveled 75 cm.

Some prototypes used two balloons and others only used one.

We are going to use one straw and one balloon. The force from the air pushing out made our prototype off balance. We'll need tape to adjust our prototype.

TRIAL 2

Our prototype went much farther this time (94 cm).

It increased by 19 cm.

Using one balloon made the air push our car in one direction so it traveled farther.

We are going to try blowing up our balloon with more air.

TRIAL 3

Our prototype was great! It went 101 cm.

But team two had the farthest-traveling prototype with 108 cm.

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.

Honk for Hybrids

SUMMARY

I learned that the air pushing out of the balloon caused the car to travel in the opposite way and more force increased the distance.

Page 8

BLOCK THAT BLIZZARD



TIME FOR COMPLETION

TEST TRIALS CAN BE TESTED OVER SEVERAL DAYS

S>t>E>A>M



DESIGN CHALLENGE PURPOSE

Design a gingerbread house made from graham crackers, following the specifications provided, that will withstand simulated blustery Arctic winds.

TEACHER DEVELOPMENT

Earth has four major systems. They are the **atmosphere** (air), the **geosphere** (land), the **biosphere** (life), and the **hydrosphere** (water). The geosphere, also referred to as the **lithosphere**, consists of soil, sediments, molten rock, and solid rock. The atmosphere contains all of the earth's air. The hydrosphere includes both

water and ice. The biosphere is made up of all living things. These systems interact with each other in a multitude of ways that shape and affect the earth's surface and processes. This design challenge focuses on both the atmosphere and the biosphere.

STUDENT DEVELOPMENT

Introduce the earth's four major systems outlined in the teacher development section. Have students share what they already know about these systems. Tell them that by talking and listening, they have been interacting with each other in order to deepen their understanding of the earth's systems. Explain that the earth's systems interact with each other as well, which results in changes that affect the earth's surface and its processes. For example, the atmosphere and the hydrosphere interact as part of the water cycle. As water is evaporated from the hydrosphere, it becomes a gas and then becomes part of the atmosphere, where it eventually condenses into clouds, becoming part of the hydrosphere again.

Lesson Idea: Write down the earth's four major systems. Assign students to work together in groups of four.

Give each team of students a large piece of construction paper folded into four sections. Assign each student on the team one of the four systems. Give each student on a team a different colored marker representing a different system. Using different colored markers will help you assess individual understanding. Have students discuss the different ways the systems could interact with each other. Next have student use their markers to write the name of their system in one of the sections on the construction paper. Students will take turns drawing arrows from their system to other systems, labeling the arrows with the type of interaction. For example, a student might draw an arrow from the biosphere to the hydrosphere and label it, "Land mammals need fresh water to survive." Collect the papers and check for understanding.

STANDARDS

SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATH	ELA
5-ESS2-1	ISTE.1	3-5-ETS1-1	Creating	CCSS.MATH.CONTENT.3.MD.A.2	CCSS.ELA-LITERACY.W.5.3.A
	ISTE.4	3-5-ETS1-2	Anchor Standard #1	CCSS.MATH.PRACTICE.MP2	CCSS.ELA-LITERACY.SL.5.1.C
		3-5-ETS1-3		CCSS.MATH.PRACTICE.MP5	

SCIENCE & ENGINEERING PRACTICES

Developing and Using Models: Develop a model using an example to describe a scientific principle.

Using Mathematics and Computational Thinking: Describe and graph quantities such as area and volume to address scientific questions.

CROSSCUTTING CONCEPTS

Scale, Proportion, and Quantity: Standard units are used to measure and describe physical quantities such as weight and volume.

Systems and System Models: A system can be described in terms of its components and their interactions.



TARGET VOCABULARY

Arctic
atmosphere
biosphere
environmentalist
geosphere
hydrosphere
shelter



MATERIALS

- graham crackers
- various small candies
- icing
- plastic spoon or knife
- butcher paper or newspaper to cover the workspace
- straws
- tape
- 5 index cards
- ruler
- Testing Materials:
fan or hair dryer for the whole classroom



LITERACY CONNECTIONS

*Extreme Weather:
Surviving Tornadoes,
Sandstorms,
Hailstorms, Blizzards,
Hurricanes, and More!*
by Thomas M. Kostigen

NOTES