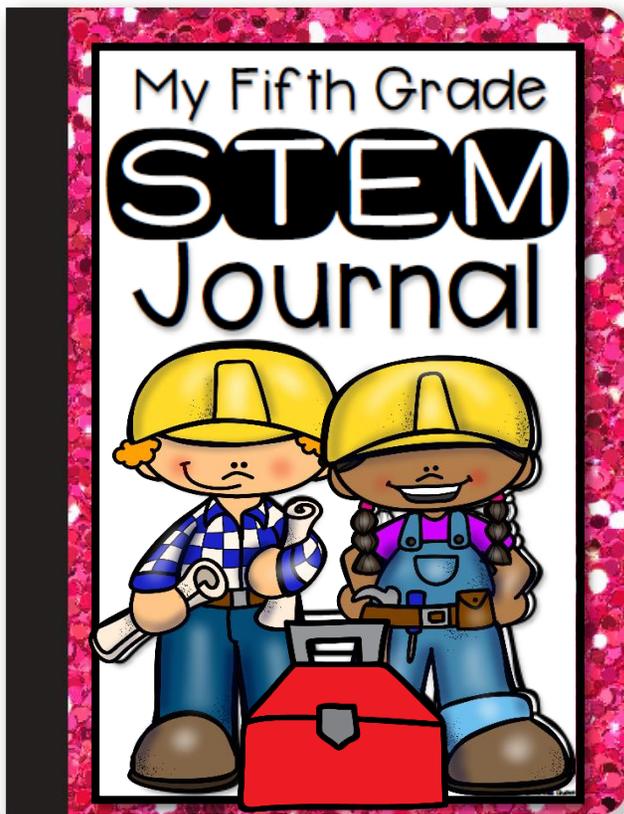


Fifth Grade

STEM

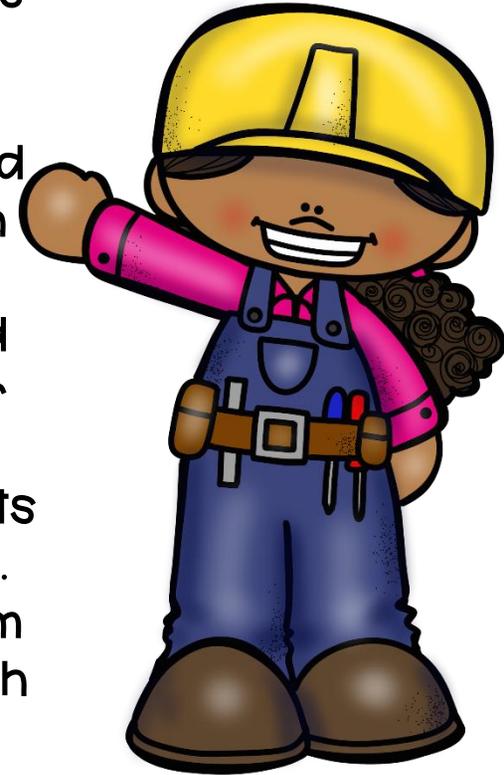


by Brooke Brown



HOW TO USE

The following materials are designed specifically for fifth grade students and align with crosscutting NGSS science, engineering and math standards. Six challenges are provided to align with major NGSS content areas. Student booklets can be cut and glued into composition notebooks (main cover provided on Page 4) or can be used as stand alone booklets by copying front to back and folding in half. Suggested materials for each challenge are inexpensive and/or found in most early childhood classrooms. Parents can also be asked to donate needed supplies. Students are encouraged to work in partners or small groups. Each challenge should be allotted 45-60 minutes from start to finish, including a whole class discussion both before and after the challenge.



Each challenge in this package contains the following items:

- *Challenge Description, Aligned NGSS Standards, Suggested Materials, and Detailed Lesson Plans
- *Photos of possible student products
- *Teacher Chart to guide whole class discussion for use on a document camera or interactive whiteboard
- *Student booklet to record prior knowledge, ideas, observations, questions, materials, blueprints, and reflections

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Page 4: Student Journal Cover

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From Molecules to Organisms: Structure and Processes

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Earth's Place in the Universe

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Earth's Systems

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Page 36: Credits



My Fifth Grade

STEM

Journal



My Fifth Grade

STEM

Journal



BALLOON CAR

NGSS Standard Alignment: 5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. CCSS.MATH.CONTENT.5.MD.P.2: Represent and interpret data.

Challenge Description: Using a set of instructions, students will construct a model of a car that is propelled by the air inside of a balloon. They will observe that particles of air, although invisible, can be used as a form of energy. They will test their balloon cars, improve models as necessary, and measure the distances that they travel. The instructions for this challenge must be followed very carefully for the cars to function properly. Please ensure that students read and follow them as written.

Suggested Materials: Informational nonfiction books or short videos about air and wind energy, plastic Solo cups (1 per group), hole punchers (1 per group), wooden skewers (2 per group), flexible plastic straws (3 per group), Lifesaver candy mints with holes in the middle (4 per group), rubber bands (1 per group), scotch tape or masking tape, balloons (1 per group).

LESSON PLAN

1. Prime students' background knowledge about air by reading aloud an informational nonfiction book of your choice about air and wind energy or showing a short video clip. You may also choose to have students research forms of wind energy and air-powered inventions on various websites. Discuss examples of air particles that cannot be seen (air inside a balloon, air inside a basketball, wind, odors from perfume and candles, etc.) and how air might be used as a form of energy such as wind energy. Record students' responses on the provided teacher chart and have them add ideas to their individual booklets.
2. Introduce permitted materials and share the challenge. Have students brainstorm possible ways to use the provided materials to construct a car.
3. Allow students at least 45-60 minutes with partners or small groups to follow the provided instructions in their student booklets to construct and test their balloon cars, as well as record in their individual student journals. If time permits, students can hold competitions between balloon cars for the farthest distances traveled.
4. Hold a whole class closing discussion and reflection, allowing students to share what they created and what they learned about air and energy. Record their ideas on the provided teacher chart.

BALLOON CAR

Possible Product

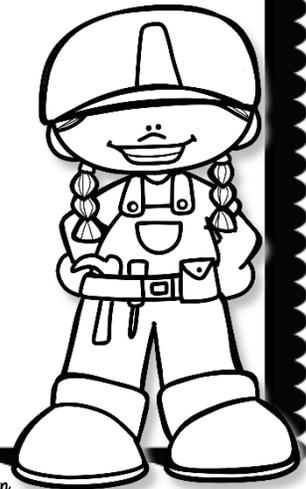


BALLOON CAR

**Examples of Air particles
that cannot be seen**

**How Air can be Used
as a Form of Energy**

What We Learned About Air and Energy



Tests

Test	Distance to nearest centimeter
1	
2	
3	
4	

one thing that was EASY:

one thing that was CHALLENGING:

one thing that I IMPROVED:

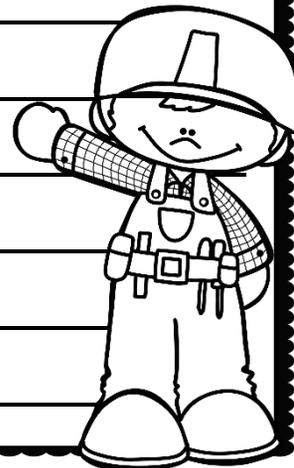
BALLOON CAR

Name: _____

THE CHALLENGE

Can you create a car that is propelled by the air inside of a balloon?

Examples of Air particles That cannot be seen



Candy CHEMISTRY

NGSS Standard Alignment: 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. CCSS.MATH.CONTENT.5.MD.B.2: Represent and interpret data.

Challenge Description: Students will test and discover physical and chemical changes by mixing a variety of candies with a solution of baking soda and water. Students will follow a provided set of criteria to determine if the change is physical or chemical.

Suggested Materials: informational books or short videos about physical and chemical changes, baking soda, plastic cups (6-8 per group), variety of candy (including several sour candies such as Sweet Tarts or Nerds), water, popsicle sticks for stirring (2 per group)

LESSON PLAN

1. Prime students' background knowledge about physical and chemical changes by showing a short video clip or reading aloud an informational book of your choice. Discuss the differences and examples for a chemical change and physical change. Record their ideas and examples on the provided teacher chart and have them add ideas to their individual booklets as follows (examples can be generated by students):
 - ***PHYSICAL CHANGE:** involves new shape or form/phase of matter / **EXAMPLES:** ice melting, paper cut in half, clay is molded into a new shape
 - ***CHEMICAL CHANGE:** involves 2 or more of the following: produces odor, produces heat or light, changes color, forms bubbles or gas, forms a solid / **EXAMPLES:** rust forms on a nail, bread becomes toast, baking a cake
2. Introduce permitted materials and share the challenge. Allow students 45-60 minutes with partners to experiment with the candy varieties and record results in their STEM journals.
3. Hold a whole class closing discussion and reflection, allowing students to share what they discovered about physical and chemical changes. Record their ideas on the provided teacher chart and have them finish their individual booklets.

candy CHEMISTRY

Possible Products



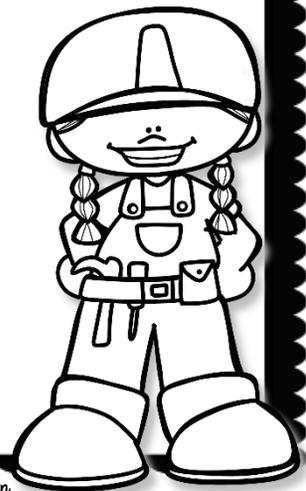
Candy CHEMISTRY

What is a physical change?

What are Examples of physical changes?

What is a chemical change?

What are Examples of chemical changes?



Draw and label a picture of one of the PHYSICAL changes that you observed.

Candy CHEMISTRY

Name: _____

THE CHALLENGE

Can you create physical and chemical changes with candy and baking soda?

Draw and label a picture of one of the CHEMICAL changes that you observed.

What is a physical change?

What are examples of physical changes?



Signs of a Chemical Change

1. _____
2. _____
3. _____
4. _____
5. _____

What are examples of chemical changes?

INSTRUCTIONS

1. Fill each cup half way with water. Add one spoonful of baking soda to each cup and stir.
2. Add a piece of candy to the cup. Observe and record the changes and determine whether or not there was a physical change or chemical change.
3. Repeat with other pieces of candy.

Candy Chemistry Tests

Candy	What Happened	(P) Physical or (C) Chemical Change

PERFECT PARACHUTE

NGSS Standard Alignment: 5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. CCSS.MATH.CONTENT.5.MD.B.2: Represent and interpret data.

Challenge Description: Choosing from a variety of materials, students will construct a parachute and basket for a LEGO mini figure that will drop in the slowest amount of time and land without the basket tipping over. By designing an effective parachute, they will attempt to reduce the strength of gravitational pull and reduce the speed at which objects fall.

Suggested Materials: Parachute material choices – coffee filters, plastic tablecloth cut into small squares, tissue paper – index cards (for students to create baskets), LEGO mini figures (1 per group), yarn, fishing line, hole punchers, scotch tape, pennies (to adjust weight and balance of basket), timers (1 per group)
-For Heavy and Light test (various student school supplies such as scissors, pencils, books, and glue sticks)

LESSON PLAN

1. Project or display real Google images of parachutes. Discuss the purposes and designs of parachutes, as well as similarities and differences between various designs. Have them define gravity in their own words, similar to the following: **Gravity – the force of attraction of objects to the Earth's surface and planet's center. Objects that fall slowly: feather, piece of paper, flower petal, etc.**
2. Many students might have the common misconception that heavier objects fall faster than light objects. Student groups will engage in the "Heavy and Light" test with school supplies of their choice to discover these concepts on their own. Fill in the blanks with students as follows: **MASS and WEIGHT do not affect gravitational pull. Gravitational pull is affected by RESISTANCE and FRICTION. Air resistance, or DRAG, will slow down the drop of the parachute.**
3. Share the challenge, rules, and permitted materials with students. Brainstorm ways that the materials might work and fit together to create an effective parachute design.
4. Allow students at least 45 minutes with partners or small groups to create and test parachutes, as well as record in their STEM journals.
5. Hold a whole class closing discussion and reflection, allowing students to share what learned about parachutes and gravitational pull. Record their ideas on the provided teacher chart and have them finish their individual booklets.

PERFECT PARACHUTE

Possible Product



PERFECT+ PARACHUTE

What is Gravity?

**What DOES NOT affect
Gravitational pull?**

**What DOES affect
Gravitational pull?**

**How our parachutes
Reduce Gravitational pull**



parachute tests

TEST	TIME	Did the basket land upright?
1		
2		
3		
4		

PERFECT PARACHUTE

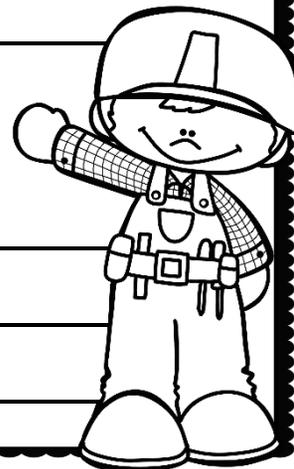
Name: _____

THE CHALLENGE

Can you design a parachute with basket that will drop in the slowest amount of time and land upright?

What is Gravity?

Examples of Objects That Fall Slowly



How Did the Design of Your Parachute Reduce Gravitational Pull?

PLANT ESSENTIALS

NGSS Standard Alignment: 5-LS1-2: Support an argument that plants get the materials they need growth chiefly from air and water. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. CCSS.MATH.CONTENT.5.MD.P.2: Represent and interpret data.

Challenge Description: Students will construct four plant models to determine what's most important for plant growth: air, water, sunlight, or soil. In each of their models, they will eliminate one "need" for two weeks and observe/analyze the results. Through these experiments, students will discover that plants primarily get the materials they need for growth from air and water.

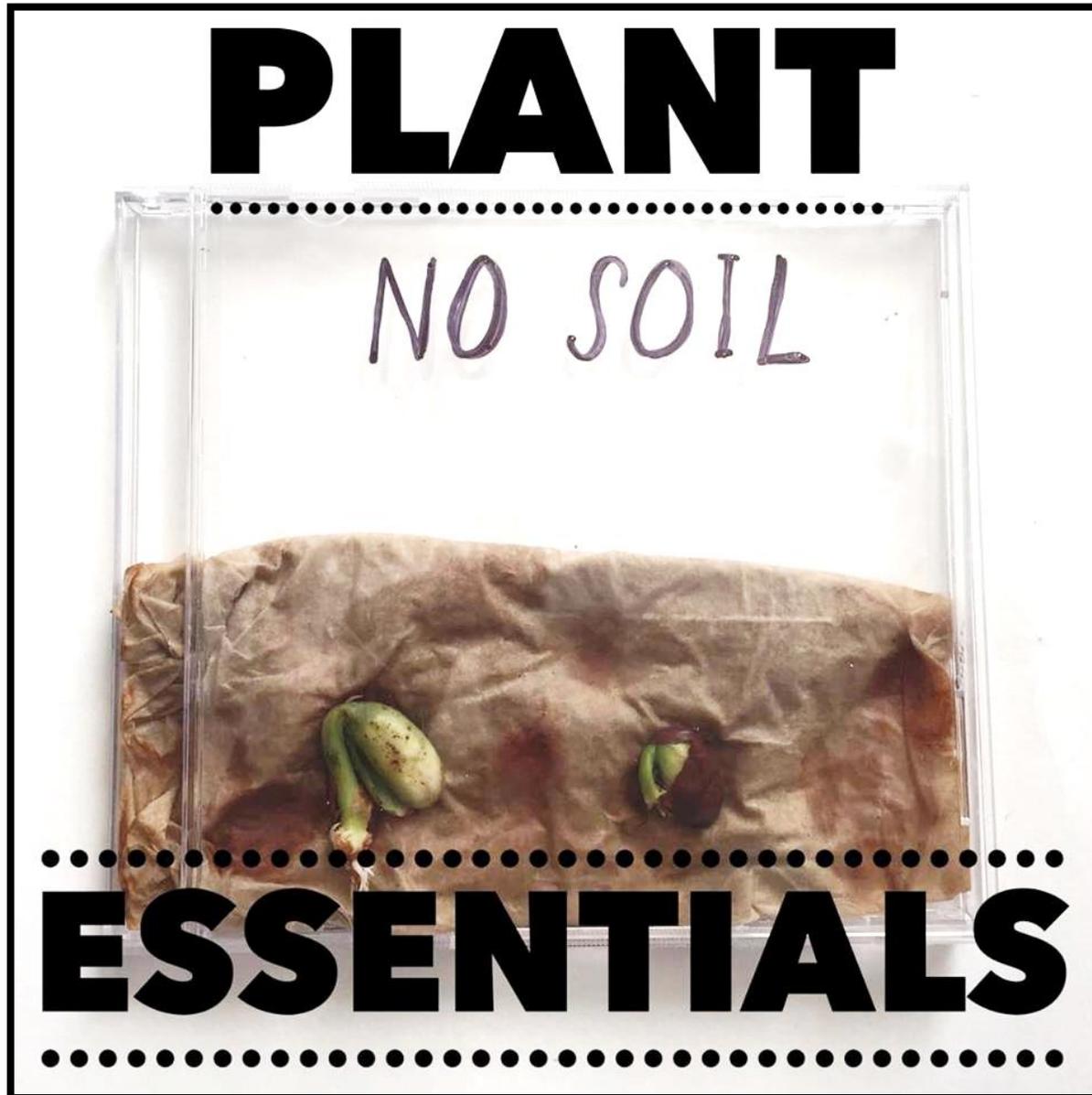
Suggested Materials: clear plastic CD cases OR quart-sized plastic baggies (4 per group), paper towels, dry pinto beans, soil, clear plastic wrap (if using CD cases), spray bottles with water, sunny display area such as a window or windowsill, permanent markers

LESSON PLAN

1. With students, brainstorm a list of things that plants need (AIR, WATER, SUNLIGHT, SOIL) and why they think plants need might need them. Record their responses on the provided teacher chart as students record in their STEM journals. Ask students to make a hypothesis about which need or needs are MOST important for plant growth and why.
2. Share the challenge, rules, and permitted materials with students.
3. Allow students about 30 minutes to follow the provided instructions and set up their four plant models. Ensure that students use permanent markers to label each plant with their names and the need that they are eliminating (i.e. PLANT 1: NO WATER).
4. About every other day for 2-weeks, Allow students 10-15 minutes to observe and record observations for each plant.
5. After 2 weeks, hold a whole class closing discussion and reflection, allowing students to share what they learned about plant growth and what is most important. Students will have determined that air and water are most essential for growth.

PLANT ESSENTIALS

Possible Products

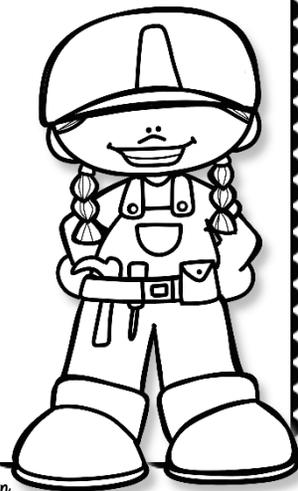
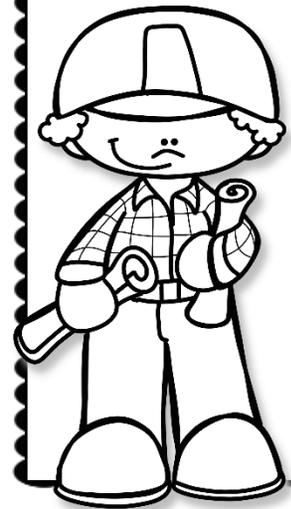


PLANT ESSENTIALS

What Plants Need

Why They Need It

**What is MOST Important for Plant Growth
and why?**



Final observations

Plant 1	
Plant 2	
Plant 3	
Plant 4	

What are the factors that are MOST important for plant growth and WHY?

PLANT ESSENTIALS

Name: _____

THE CHALLENGE

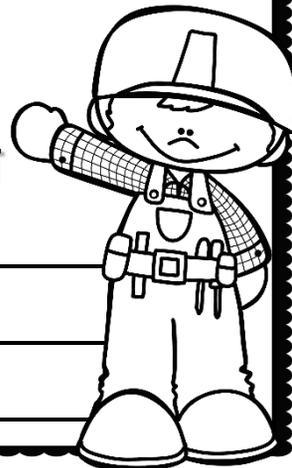
Can you conduct a controlled experiment to determine which factors are most essential for plant growth?

What do plants need to grow?

1. _____
2. _____
3. _____
4. _____

MY HYPOTHESIS:

Which factor or factors are MOST important for plant growth?



INSTRUCTIONS

Plant 1: NO WATER

1. Fill the baggie or box 1/3 full with soil.
2. Push 2-3 beans down into the soil.
3. If you're using a baggie, make sure that it is open halfway the top.
4. Tape or prop your baggie or box very close to a window.

Plant 2: NO AIR

1. Fill the baggie or box 1/3 full with soil.
2. Push 2-3 beans down into the soil.
3. If you're using a baggie, seal it closed. If your using a box, wrap around it very tightly with plastic wrap to seal out the air.
4. Tape or prop your baggie or box very close to a window.
5. Make sure to water your plant daily by giving it 2-3 squirts.

Plant 2: NO SOIL

1. Put 2-3 beans inside the baggie or box.
2. Soak a wet paper towel and fold it into a small rectangle. Place the paper towel inside the baggie or box.
3. If you're using a baggie, make sure that it is open halfway at the top.
4. Tape or prop your baggie or box very close to a window.
5. Make sure to water your plant daily by giving it 2-3 squirts on the paper towel.

Plant 2: NO SUNLIGHT

1. Fill the baggie or box 1/3 full with soil.
2. Push 2-3 beans down into the soil.
3. If you're using a baggie, make sure that it is open halfway at the top.
4. Place your plant inside a dark closet or cabinet.
5. Make sure to water your plant daily by giving it 2-3 squirts.

Plant Observations

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

Plant Observations

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

Plant Observations

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

Date:	Observations
Plant 1	
Plant 2	
Plant 3	
Plant 4	

SHADOW CLOCK

NGSS Standard Alignment: 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. CCSS.MATH.CONTENT.5.MD.P.2: Represent and interpret data.

Challenge Description: Students will design a "shadow clock" to record the changes and movement of the sun and shadows during different times of the day. They will go outside and use a paper plate with a pencil in the center to trace and measure the shadow and the time for 3-5 different times of day. Students will observe and discuss how the sunlight and shadows change depending on the time of day and position of the sun in the sky.

Suggested Materials: informational books or short video clips about sunlight and shadows, paper plates, pencils, crayons, rocks, rulers

LESSON PLAN

1. Prime students' background knowledge about sunlight and shadows showing a short video clip or reading aloud an informational book of your choice.
2. Hold a class discussion, allowing students to share what they already know about shadows and the earth's rotation around the sun. Have students record the two ways that the Earth moves in their booklets: 1) **It rotates on its axis.** 2) **It revolves around the sun.** Record their ideas on the provided teacher chart and have them add ideas to their individual booklets.
3. Introduce permitted materials and share the challenge instructions. Model the use of the shadow clock and take students outside for 3-5 tests every 1.5 hours or so during the school day.
4. Allow students time to trace their shadows with different crayon colors, write the times to match, measure the shadows and record in their STEM journals. Have them mark their starting point with a rock at the top so that they place their plate in the same spot each time.
5. Hold a whole class closing discussion and reflection, allowing students to share what they discovered through their shadow clock tests. Ask students why they think that shadows move and grow longer/shorter throughout the day. Discuss the rotation and orbit of the earth around the sun and how it seems like the sun is always moving, when in fact it is the Earth. Record their ideas on the provided teacher chart and have them finish their individual booklets.

Shadow Clock Possible Product



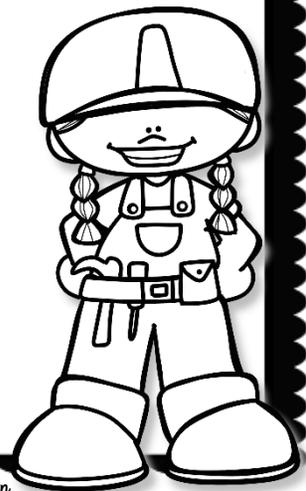
Shadow Clock

How the Earth Moves

How the sun changes

**How shadows change
throughout the day**

What we LEARNED



Shadow CLOCK

Name: _____

How did the shadows change?

Why did the shadows change?

Why might it be useful to understand
the changes in sunlight and shadows
during the day?

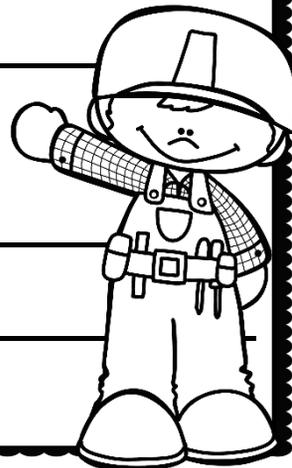
THE CHALLENGE

Can you create a shadow
clock that tracks the movement
of the sun in the sky?

How Does the Earth Move?

1 _____

2 _____



EARTH in a BOTTLE

NGSS Standard Alignment: 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and atmosphere interact. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Challenge Description: Students will create a physical model to represent the Earth's geosphere, biosphere, hydrosphere, and atmosphere. They will fill the bottle with items to represent each system, then label each system with a permanent marker. They will also hold a discussion with partners and group members about the influence of each system on other systems.

Suggested Materials: Informational books or short video clips about Earth's systems, empty plastic 2-liter bottles (1 per group), items from nature (brought from home or gathered outdoors at school), permanent markers.

LESSON PLAN

1. Prime students' background knowledge about Earth's four systems by showing a short video clip or reading aloud an informational book of your choice.
2. Hold a class discussion to list the four systems and describe them as follows:
 GEOSPHERE: solid and molten rock, soil, sediment
 BIOSPHERE: living things (plants, animals, humans)
 HYDROSPHERE: water and ice
 ATMOSPHERE: air
 Discuss examples of how the four systems interact with one another. Record student ideas on the provided teacher chart and have them record in their student journals.
3. Introduce permitted materials and share the challenge instructions. Allow students 45-60 minutes for students to gather natural materials outdoors, create and label their models, and record in their STEM journals.
4. Hold a whole class closing discussion and reflection, allowing students to share what they learned about Earth's four systems and how they interact. Record their ideas on the provided teacher chart and have them finish their individual booklets.

EARTH in a BOTTLE

Possible Product



Earth in a Bottle

What are the systems of the Earth and what do they include?

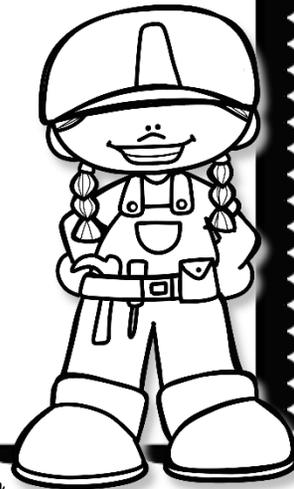
1

2

3

4

How do Earth's systems interact with one another?



How do the following systems interact with each another?

Biosphere and Geosphere

Biosphere and Atmosphere

Biosphere and Hydrosphere

Geosphere and Atmosphere

Geosphere and Hydrosphere

Hydrosphere and Atmosphere

EARTH in a BOTTLE

Name: _____

THE CHALLENGE

Can you construct a model to represent Earth's four systems?

What are Earth's systems?

1. _____
2. _____
3. _____
4. _____



credits

Thank you for your
purchase!

Created by Brooke Brown



<https://sites.google.com/site/climatetypes>

