Smithsonian | SCIENCE *for the classroom*

HOW CAN WE STOP SOIL FROM WASHING AWAY?

Overview and Lesson Sampler, Grade 2

ENGINEERING

TEACHER GUIDE

INSIDE

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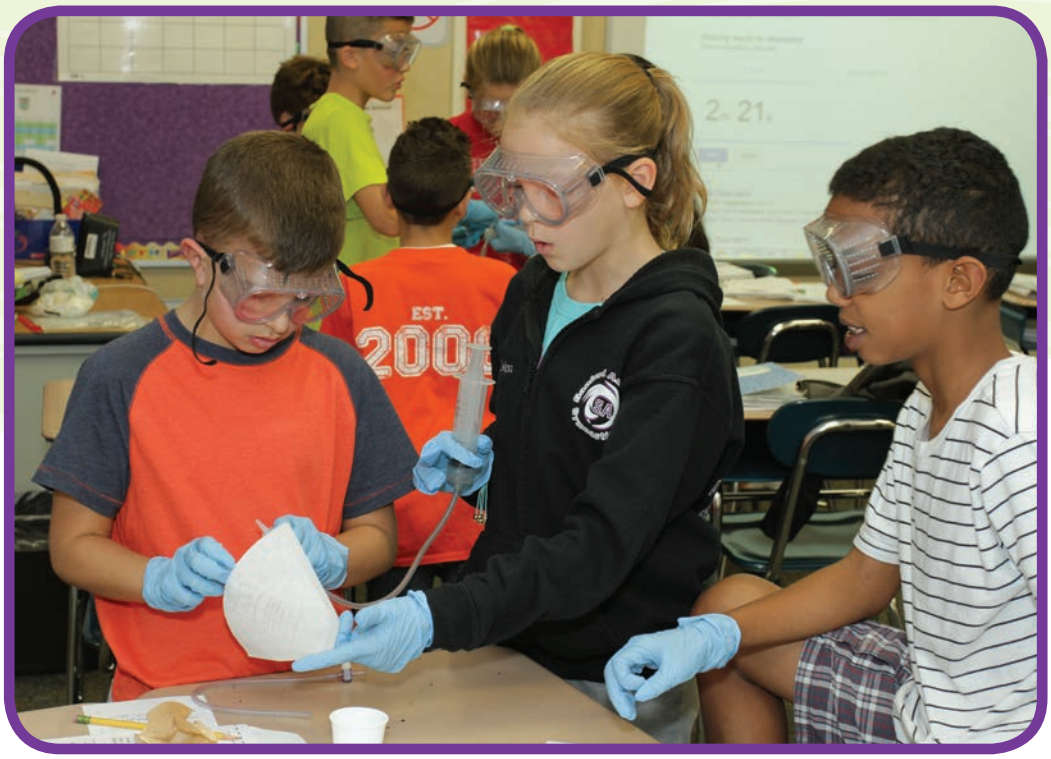
All New for NGSS—*Smithsonian Science for the Classroom*™ for Grades 1–5

For decades, the Smithsonian Science Education Center has been a leader in providing curriculum, professional development, and leadership development in support of inquiry-based science education. The release of the Next Generation Science Standards (NGSS) triggered key shifts in curriculum, instruction, and assessment.

The vision laid out by the NGSS explicitly requires performances that blend content, practices, and crosscutting concepts. The Smithsonian Science Education Center responded with a new generation of high-quality curriculum materials for Grades 1–5—*Smithsonian Science for the Classroom*.

***Smithsonian Science for the Classroom* was developed to:**

- Meet the Next Generation Science Standards through intentional curriculum design
- Support for teachers as they learn to implement new standards
- Incorporate findings from education research on how students learn
- Center on coherent storylines that flow logically from lesson to lesson as students work toward explaining phenomena or designing solutions to problems
- Broaden access to world-class Smithsonian collections, experts, and resources
- Include instructional supports to ensure all students can meet the standards
- Seamlessly incorporate a comprehensive assessment system to monitor student progress



Smithsonian Science for the Classroom Curriculum Framework—Designed for the Next Generation Science Standards

Module titles introduce phenomena or define problems

Life Science	Earth and Space Systems Science	Physical Science	Engineering Design
Grade 1			
How Do Animal Parents Keep Their Babies Safe? *1-LS1-1 • 1-LS1-2 • 1-LS3-1 • K-2-ETS1-1* **Supporting:** Engineering Design	**Is a Day Always the Same Length?** *1-ESS1-1 • 1-ESS1-2 • 1-PS4-2* **Supporting:** Physical Science	**How Can We See Things in the Dark?** *1-PS4-2 • 1-PS4-3 • 1-LS1-1 • K-2-ETS1-1* **Supporting:** Life Science and Engineering Design	**How Can We Send a Message Using Sound?** *K-2-ETS1-1 • K-2-ETS1-2 • K-2-ETS1-3 • 1-PS4-1 • 1-PS4-4* **Supporting:** Physical Science
Grade 2			
How Do Plants and Animals Need Each Other? *2-LS2-1 • 2-LS4-1 • 2-LS2-2 • K-2-ETS1-1* **Supporting:** Engineering Design	**What Can Maps Tell Us About Water on Earth?** *2-ESS2-2 • 2-ESS2-3 • 2-PS1-1* **Supporting:** Physical Science	**How Do Heating and Cooling Change Things?** *2-PS1-1 • 2-PS1-2 • 2-PS1-3 • 2-PS1-4 • K-2-ETS1-1* **Supporting:** Engineering Design	**How Can We Stop Soil From Washing Away?** *K-2-ETS1-1 • K-2-ETS1-2 • K-2-ETS1-3 • 2-ESS2-1 • 2-ESS1-1* **Supporting:** Earth and Space Science
Grade 3			
What Explains Similarities and Differences Between Organisms? *3-LS1-1 • 3-LS3-1 • 3-LS3-2 • 3-LS4-2 • 3-ESS2-2* **Supporting:** Earth and Space Science	**How Do Weather and Climate Affect Our Lives?** *3-ESS2-1 • 3-ESS2-2 • 3-ESS3-1 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Can We Predict Patterns of Motion?** *3-PS2-1 • 3-PS2-2 • 3-PS2-3 • 3-PS2-4 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Can We Protect Animals When Their Habitat Changes?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 3-LS4-1 • 3-LS2-1 • 3-LS4-3 • 3-LS4-4* **Supporting:** Life Science
Grade 4			
How Can Animals Communicate with Light and Sound? *4-LS1-1 • 4-LS1-2 • 4-PS4-1 • 4-PS4-2 • 4-PS4-3 • 3-5-ETS1-1* **Supporting:** Physical Science and Engineering Design	**How Is the Ring of Fire Evidence of a Changing Earth?** *4-ESS1-1 • 4-ESS2-1 • 4-ESS2-2 • 4-ESS3-2 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Does Motion Energy Change in a Collision?** *4-PS3-1 • 4-PS3-3 • 4-LS1-1 • 3-5-ETS1-1* **Supporting:** Life Science and Engineering Design	**How Can We Provide Energy to People's Homes?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 4-PS3-4 • 4-PS3-2 • 4-ESS3-1* **Supporting:** Physical Science and Earth and Space Science
Grade 5			
How Can We Predict Change in Ecosystems? *5-LS1-1 • 5-LS2-1 • 5-PS3-1* **Supporting:** Physical Science	**How Can We Use the Sky to Navigate?** *5-ESS1-1 • 5-ESS1-2 • 5-PS2-1 • 3-5-ETS1-1* **Supporting:** Physical Science and Engineering Design	**How Can We Identify Materials Based on Their Properties?** *5-PS1-1 • 5-PS1-2 • 5-PS1-3 • 5-PS1-4 • 5-LS2-1* **Supporting:** Life Science	**How Can We Provide Freshwater to Those in Need?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 5-ESS2-1 • 5-ESS2-2 • 5-ESS3-1* **Supporting:** Earth and Space Science

Smithsonian Science for the Classroom Curriculum Overview

20 Hands-On Inquiry Modules that:

Bring Phenomena-Based and Problem-Based Learning to Your Classroom

- Life, Earth, and Physical Science module titles present questions about natural phenomena—students construct explanations
- Engineering Design modules present problems—students design solutions

Incorporate Three-Dimensional Learning into Every Investigation

- Investigations blend Disciplinary Core Ideas with Science and Engineering Practice and Crosscutting Concepts
- Investigations invite students to construct scientific explanations or design solutions for real-life problems

Provide Four Modules at Each Grade Level to Meet all NGSS Grade-Level Performance Expectations

- One interdisciplinary module per grade level in Life, Earth, and Physical Science strands
- Engineering Design modules integrate engineering and science together, never treating engineering design in isolation from the scientific knowledge it is based on

Provide Everything You Need to Meet the NGSS Standards

- Teacher support, step-by-step investigations, guiding questions, literacy, assessment, and hands-on materials

Bring the expertise of the Smithsonian's world-class collections, experts, and resources into your classroom.

Lesson design supports the NGSS teacher

Keep an Eye Out!

What to Look for in a *Smithsonian Science for the Classroom* Module:

Coherent Learning Progression

- Concepts and Practices Storyline shows how concepts build from one lesson to the next within the module using the 5-E model

NGSS Support at Point of Use

- Explanations at point of use explicitly define how students are engaging in the Science and Engineering Practices and Crosscutting Concepts

Literacy and Math

- ELA and Mathematics connections to Science overlap with student engagement in the science and Engineering Practices
- *Smithsonian Science Stories* On-Grade and Below-Grade Literacy Series
- STEM Notebooks

Misconception Identification

- Reveals common misconceptions students may have and offers ways to address them in the lessons

Technology Integration

- A balance between hands-on investigation and technology

Grade 2

Smithsonian | SCIENCE *for the classroom*

HOW CAN WE STOP SOIL FROM WASHING AWAY?

ENGINEERING

TEACHER GUIDE

Summary

In this module, students will explore and collect evidence on the fast and slow ways water and wind can change the shape of the land. Students will examine photographs and models of certain changes in the land caused by flowing water and blowing wind. They will engage in a literacy activity that highlights the successful and unsuccessful ways people have attempted to minimize the impact water and wind have on the land. Then they will use a stream table as a model to compare multiple solutions designed to prevent water from changing the shape of the land. The end-of-module summative performance assessment asks students to apply the evidence gathered in previous lessons to a scenario-based engineering design challenge.

Concepts and Practices Storyline

Featured sample lesson

Lesson 1: Soil and Sand
Define the problem of erosion.

Students use evidence to make a claim about the similarities and differences between soil and sand.

Lesson 2: Wind and Water
Wind and water can change the land.

Students develop a model for representing land and how it is affected by wind and water. They carry out an investigation to provide evidence for how wind and water can change the shape of the soil and sand.

Lesson 3: Earth Events
Some events happen quickly; others happen slowly.

Students analyze and interpret data about soil loss on a construction site to provide evidence for a claim about its cause.

Lesson 4: Modeling Materials
Making observations is helpful in thinking about problems.

Students analyze the effectiveness of models for four materials that could be used to prevent or slow down erosion based on the structure and function of each model and the material it represents.

Lesson 5: Built to Last
Designs are useful in communicating ideas for a solution.

Students carry out an investigation into how different materials might slow down erosion using models to represent the real materials. They analyze and interpret data from four tests to determine if and how each material could slow down erosion.

Lesson 6: Creative Solutions
There is always more than one possible solution to a problem.

Students develop a measurement scale to determine how much sand is washed away by water during tests. They use understanding of all components in the system and their relation to each other to design and test two solutions to the erosion problem.

Lesson 7: Lessons Learned
Problems are situations people want to change and can be solved through engineering.

Students obtain and evaluate information from text to compare multiple solutions designed to reduce the ways water and wind have changed the shape of the land.

Lesson 8: Castle on the Edge
Before beginning to design a solution, it is important to understand the problem.

Students analyze and interpret data to construct an explanation for what caused a castle to end up right on the edge of a river. They develop two possible solutions to the problem of preventing the castle from eventually toppling and communicate ideas through a sketch.

Design Challenge

Lesson 9: Save the Sand Towers Part 1
Designs are useful in communicating ideas for a solution to the erosion problem.

Students define the problem of saving the sand towers from destruction caused by water. They design a solution that is based on understanding of all the components of the system the sand towers are a part of and that works within set limits and is based on evidence from prior tests.

Lesson 10: Save the Sand Towers Part 2
It is useful to compare and test designs for the erosion problem.

Students use evidence to optimize their original design to save the sand towers by considering the effect of changing one component. They communicate how the final design attempted to solve the problem of saving the sand towers by keeping them stable.

Every module ends with a performance task

LESSON 2: **WIND AND WATER**

Daily NGSS support

Explore

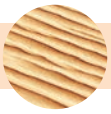
Class periods: 1

Preparation time: 20 minutes

Vocabulary:
engineer
erosion
water
wind

Student Objectives	Misconceptions	Disciplinary Core Ideas
Develop a model for representing land and how it is affected by wind and water. Carry out an investigation to provide evidence for how wind and water can change the shape of the soil and sand.	A model must be an exact "replica" of an object. Air isn't anything, so it can't affect anything.	**ESS2.A:** Wind and water can change the shape of the land. **ETS1.A:** A situation that people want to change or create can be approached as a problem to be solved through engineering.

Good Thinking! videos for misconception support @ ScienceEducation.si.edu/goodthinking


Science and Engineering Practices*	Crosscutting Concepts*	ELA and Math Connections	Extension(s)
Developing and using models Carrying out investigations **Constructing explanations** Engaging in argument from evidence Defining problems	**Stablity and change**	**Speaking and listening** Comprehension and collaboration (SL.2.1)	**Literacy: "Wind and Water Wonders"** Students think about how the actual phenomena they are reading about compare to the models used in the lesson.

Daily ELA and math support

* Science and Engineering Practices and Crosscutting Concepts that are assessed in the lesson are in bold.

Teacher notes:

Developing and using models

2

LESSON 2: WIND AND WATER

Lesson Question:
How can wind and water change the land?

Class periods: 1

Objectives

- **Develop a model for representing land and how it is affected by wind and water.**
- **Carry out an investigation to provide evidence for how wind and water can change the shape of the soil and sand.**

E Explore

Lesson Background Information

Students will engage in a discussion about how scientists and engineers use models, like a toy truck, by focusing on the similarities and differences between the model and the real thing. Students will then explore the ways soil and sand can be changed when water is dropped or when air is blown on a sand tower and then a soil tower. Students should observe that while sand and soil may look slightly different, they behave in similar ways when wind and water are applied. They will use the evidence from their investigations to consider whether sand could be a good model for soil.

Vocabulary

engineer
erosion
water
wind

Figure 2.1 Model toy truck

Materials

For the teacher

- 1 Model toy truck

For each student

- STEM notebook*
- 1 Lesson 2 Notebook Sheet A
- 1 Lesson 2 Notebook Sheet B

For each group of two students

- 1 Large plastic cup, 16 oz
- Water*
- 2 Small plastic cups, 4 oz
- 1 Paper plate
- 2 Straws
- 2 Large plastic bags
- 1 Water dropper
- 2 Blank index cards, 3"x5"*
- Paper towels*
- Soil
- Sand

*needed but not supplied

Preparation

1. Write the lesson question and lesson title on the board.
2. Plan to have students work in pairs.
3. Prepare one bag of soil and one bag of sand for each pair of students.
4. To prepare a bag of sand, mix one large cup of sand and one small cup of water in a plastic bag.
5. To prepare a bag of soil, mix one large cup of soil and one small cup of water in a plastic bag.
6. Prepare one paper plate and two index cards for each pair of students.
7. Prepare one water dropper and two drinking straws for each pair of students.
8. Make sure you have one model truck for the class.
9. Make a copy of the Lesson 2 Notebook Sheet A and Notebook Sheet B for each student.

Procedure

Getting Started

1. Hold up the model truck. Ask the students what it is and how it is similar to and different from the real thing. Encourage students to respond to each other (not just you), share prior experiences, and build on what others have to say. Use the following guiding questions for the discussion:

   - **What is this?**
     (It's a toy truck, model truck, a toy.)
   - **How is it similar to and different from a real truck?**
     (I think the shape is the same, the wheels and axles might be the same, the way it rolls is the same, the texture of the wheels may be the same. The size and way it doesn't move on its own are different.)
   - **If we wanted to test how a truck rolls down a hill, why might we want to use this model truck instead of a real truck?**
     (It's smaller, cheaper, and easier to test the model truck than a real truck.)
   - **How is this model truck NOT like a real truck?**
     (It is much smaller. It doesn't have an engine. There are other parts the real truck has that the model truck doesn't have.)

2. Hold up the model truck again and state that a model is something similar to but not exactly like the real thing. Models can help us understand how the real thing acts. They can be a lot of different things, like a picture, a diagram, or an object like this model truck.

3. Tell the students that models are also not perfect. The toy truck is a great example. It doesn't have an engine, which means we can't test to see how this toy truck will respond to speeding up on ice. That being said, it will tell us a great deal about how a real truck will travel down a hill or respond to a bump in the road.

Comprehension and collaboration

Developing and using models

Students are asked to consider a simple model, the real object it represents, and consider when it might be a good model and when it might not be a good model.

Misconception support

Good Thinking!

Misconception

Many students think that a model must be an exact replica of an object — the classic example being a toy or "model" truck or boat (5). This lesson is designed to deal head-on with this assumption by having students consider what aspects of a model are important to a scientist or engineer based on the questions they are trying to answer or the problems they are trying to solve.

4. Remind the students that yesterday they tested to see how similar soil and sand were. Today they are going to continue that investigation to see how soil and sand behave when wind and water are applied to them.
5. Hand out the Lesson 2 Notebook Sheet A and Notebook Sheet B.
6. Ask the students to cluster around one centrally located table set up to discuss the activity.

Activity

1. Tell the class that they will be investigating if wind and water can change soil and sand.
2. Tell the class that they are going to build sand towers and soil towers and then gather evidence on how wind and water impact them.
3. Demonstrate how they will set up their towers. The first step is to place the paper plate flat on the table. The second step is to open the plastic bag of sand and use the small cup to scoop out a cup full of sand. Tell the students to press the sand down until it is firmly in the cup. Students will follow the same steps to set up the soil tower.

Teacher tip

You may want to read the instructions and have a student model these steps for the class.

4. Students will put the index cards on top of the small cups and flip them over onto the paper plate. Once the small cups are resting, the students will need to slide the index cards out from under the small cups. Figure 2.2 shows an example of a completed sand tower with straw.

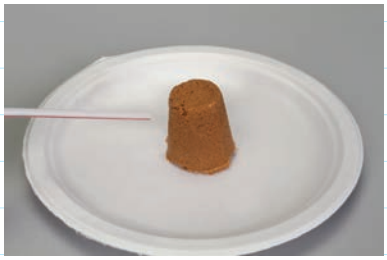


Figure 2.2 A sand tower with a straw for the wind test

Good Thinking!

Misconception

A common misconception students have is that air isn't anything, so it can't affect anything (6, 7). By blowing air on the sand tower, students will have a chance to see air as something that can cause change. Discuss the importance of not touching the straw to the tower so students know for sure it was only the air acting.

Safety

For health reasons, tell students not to share the straws. Make sure you have extra straws in case students drop them on the floor.

5. The first test the students will complete is the wind test. Students will use the straws to blow air toward the top of the sand tower and then the soil tower. Tell students to put something flat, such as a notebook or sheet of paper, on the opposite side from where the air is being blown. This will reduce the amount of sand or soil being blown around the room.
6. Students will blow 10 strong puffs with the straw. Emphasize to the students that they should get the straw as close as possible to the sand *without touching* it.
7. No direct contact between the straw and the towers is allowed because we want to be sure we are seeing the effect of *only* the wind. (If you push on it with the straw, you could knock it over, but it wouldn't be because of the wind!)
8. Once the students complete testing on both towers, they will be asked to draw what they did and then what changed.

Tech tip

Ask students to use their mobile phone or tablet cameras to take a before and after picture of their sand towers.

Integration of technology

Point-of-use teacher support

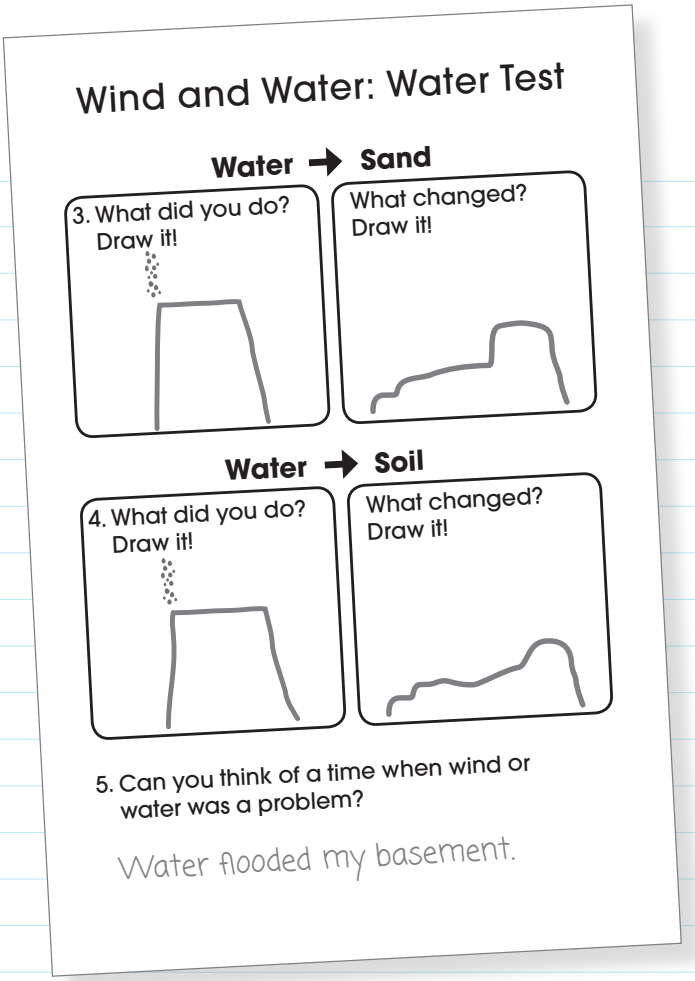


Figure 2.3 Example of student data

Connections to the nature of science

Students see that sketches can be a useful way to record and communicate their science ideas.

9. This evidence of change could be in the form of color, size, shape, or height of each tower. Write down the evidence they could identify in their drawing on the board.

10. Students will put the first sand tower back into the bag of sand and the soil tower back into the bag of soil. They will build another tower of each material for the water test using the same procedure from Steps 3 and 4.

Teacher tip

It will make a big difference if the students drop the water or blow the air in the same spot over and over again or sprinkle it around the top of the sand tower. This is fine! Have groups share and compare their method to other groups to see reasons for different outcomes.

11. For the water test, students will use the water dropper to apply the water. Students will apply 10 drops of water to the top of their sand tower and then 10 drops of water to the top of the soil tower. Once again, make sure students understand that they should not touch the water dropper directly to the sand or soil.

Bringing It All Together

1. When students have completed both tests, ask them to clean up their areas.

2. Ask the students what they noticed about the ways water and wind impacted the soil and sand. Use the following guiding questions for the discussion:

   - **Did anything surprise you about what happened to the sand and soil when you put wind or water on them?**
     (I didn't think just air would be strong enough to move soil. I thought water was weak, but it was actually pretty strong.)

   - **Do you think wind and water can change land? What is your evidence from your notebook?**
     (Yes, I think they can change land because I saw the wind moving pieces of sand or soil. I saw the water causing the sand or soil tower to crumble or slide.)

   - **Did every aspect of the towers change?**
     (Some of the cone shape stayed in place. Some came off the sides or top, but you could still see mostly how it used to look.)

Diverse learner support

ELL strategy
For all students, but especially ELLs, increase your wait time before calling on someone or moving on. Get comfortable with silence, as it gives students time to think and construct sentences (4).

3. Tell the students that what they just observed is called erosion. Erosion is the carrying away of sand and soil due to water and wind. Write this definition on the board.

Stability and change

Students make observations of aspects of the towers that change and aspects that stay the same.

Carrying out investigations

Students must work together effectively to follow instructions, communicate, and sketch and write observations.

Stability and change

Students cite evidence from their STEM notebooks about aspects of the towers that changed and aspects that stayed the same. They consider that erosion is an example of change, while stopping erosion is an example of stability.

Constructing explanations

Students have multiple opportunities to make claims that wind and water can change land.

Engaging in argument from evidence

Students make the claim that sand could be a good model for soil and link the claim to evidence they collected in their STEM notebooks.

4. Tell the students that erosion is a kind of change. To prevent erosion, you try to keep things the same. Tell students that erosion is something that they will be discussing over the course of this module.

5. Ask the students the following guiding questions to gauge their confidence level in using sand as a model for soil:

   - **Given the evidence you have collected (from anywhere in your STEM notebook), do you think sand would be a good model for soil?**
     (I think sand would be a good model for soil because they both have small things that make them up. I think it's a good model because they react mostly the same to the wind and water.)

   - **What differences did you notice between the soil and sand?**
     (We noticed the color was different.)

   - **Do you think those differences are so important that we couldn't use sand as a model for soil?**
     (I don't think so. I think color probably isn't important. It's more important how it behaves with wind and water.)

6. Tell the class that you know from previous experience that sand is easier to work with, dries faster, and is cheaper, while soil can get super moldy! Given that, and their evidence that sand behaves similarly to soil, we're going to use sand as a model for soil for the rest of the investigations.

7. Tell the students that scientists and engineers often can't use the real thing to do all their tests, so like us, they often use models as long as they have evidence that the models are good.

8. Ask the students if they have any questions or concerns about using sand as a model for soil.

9. Direct students to the final question on Notebook Sheet B.

Developing and using models

Students consider evidence that can help them decide on a good model for soil based on an understanding that models are not exactly like the real thing but similar in ways important to the questions you are trying to answer.

10. Tell the students that one of the first steps in engineering is gathering information on a problem. The better you understand a problem, the more likely you are to solve it. From there, engineers can begin to develop possible solutions. Ask students the following guiding questions to wrap up the lesson:

    - **Can you think of a time when wind or water was a problem?**
      (I have seen flooding. I've seen the beach wash away.)

    - **Would you say these events happened quickly or slowly?**
      (I think some of them could happen very quickly, like a flash flood. Some of them can take a long time, like when water slowly gets closer to a home on a riverbank.)

Defining problems

Students consider times when erosion can be harmful to people and break down why these events can pose practical problems for people and describe characteristics like how quickly or slowly they can happen.

Assessment

Formative Assessment

Use this table to provide timely, actionable feedback for individual students on their successes and areas for improvement, as well as to plan any necessary whole-class remediation. Revisit the Common Misconceptions table in the module overview to familiarize yourself with other possible difficulties.

Assessed Task
Bringing It All Together: Step 2 (Discussion)

Concepts and Practices	*Indicators of Success*	*Indicators of Difficulty*
Wind and water can change the shape of the land.	☐ If student mentions prior ideas or misconceptions, he/she connects them to evidence from the investigation and how the evidence may change their ideas.	☐ Student mentions only evidence from prior knowledge or misconceptions and not evidence from the investigations, e.g., I just know that air can't affect soil and rocks; air is nothing; the Earth never really changes.

Assessment tools aligned to the three dimensions of NGSS

Concepts and Practices	Indicators of Success	Indicators of Difficulty
Constructing explanations	☐ Student makes a claim that directly answers the question, e.g., Yes, wind and water can change land. ☐ Student uses STEM notebook to find evidence from Lesson 2 to support the claim.	☐ Student makes a claim that does not answer or indirectly relates to the question, e.g., I think water can sometimes change sand. ☐ Student does not refer to STEM notebook and/or only cites opinions or prior experiences.
Stability and change	☐ Student notes that *some* aspects of the towers stay the same (roughly the same shape) while others change (grains or chunks blow or slide away).	☐ Student only notes changes or indicates that there is either change/no change without understanding that some aspects can change while others can stay the same.

Differentiated learning

Remediation

Ask students to redo the investigation, but this time they should write down all evidence of change in one color. Ask the students to provide written answers to the same guiding questions addressed in the Assessment Table, but this time they should include specific words they just wrote down in color.

Enrichment

Ask students to think about all the different variable combinations, soil and water, sand and wind, etc., and rank them for how much change they caused. Ask students to provide evidence for their rankings.

Extension(s)

Literacy integration

Integration of knowledge and ideas

Literacy: "Wind and Water Wonders"

Materials

For each students

- Smithsonian Science Stories Literacy Series: *Changing Earth*

Procedure

Have students read "Wind and Water Wonders." This could be done as a whole-class activity or on an individual student level. Challenge students to think about how the actual phenomena they are reading about compare to the model used in the lesson. The purpose of this reading is to develop a deeper understanding of the widely different rates at which these geologic changes occur. Some events can happen very quickly, while others occur over a time period much longer than one can observe. The other focus of this reading is to provide students with actual examples of the different ways wind and water can change the shape of the land. Use the following guiding questions to test for understanding and to reflect on their learnings from the first lesson:

- **Pick a structure. How do you think it was formed?**
  (I think this one was formed by water because it looks like the water in a river carved out that part.)

- **Do you think it formed quickly or slowly?**
  (I think it took a long time because rock is really hard and the water in the river is not moving very fast.)

Stability and change

Students will read and discuss real-world examples of how the wind and water can change land slowly and rapidly. Examples include canyons and sand dunes.

Teacher notes:

Smithsonian Science for the Classroom Creates Student Scientists and Engineers

Anyone with a question can be a scientist! *Smithsonian Science for the Classroom* gets students thinking, acting, reflecting, and communicating like scientists and engineers.

Scientists and engineers explore and investigate, read to gather information, record their data, and reflect on their ideas. *Smithsonian Science for the Classroom* provides students with:

- Hands-on investigations that integrate literacy through the *Smithsonian Science Stories* Literacy Series
- Literacy lessons dedicated to reading, writing, speaking, and listening to gather information to support claims
- STEM Notebooks built by students to keep records of their questions, predictions, claims linked to evidence, and conclusions. Lesson notebook sheets scaffold student thinking and provide opportunities for students to explain phenomena, communicate their design for solutions, and self-assess.

How Can We Stop Soil from Washing Away?

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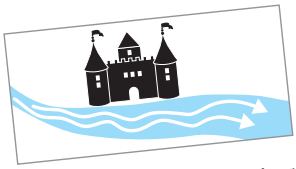
What I Already Know

Write or draw your answers on a blank page in your STEM notebook.

1. How do you think this was formed?
2. How long do you think it took to form?



3. A castle is built on the side of a river. Over time the river has carried much of the soil away from the base of the castle. Can you think of one or two ways you could slow down or stop this process? Why would they work?

Explaining phenomena

Developing and using models

Wind and Water: Wind Test

Wind → Sand

1. What did you do? Draw it!	What changed? Draw it!

Wind → Soil

2. What did you do? Draw it!	What changed? Draw it!

Wind and Water: Water Test

Water → Sand

3. What did you do? Draw it!	What changed? Draw it!

Water → Soil

4. What did you do? Draw it!	What changed? Draw it!

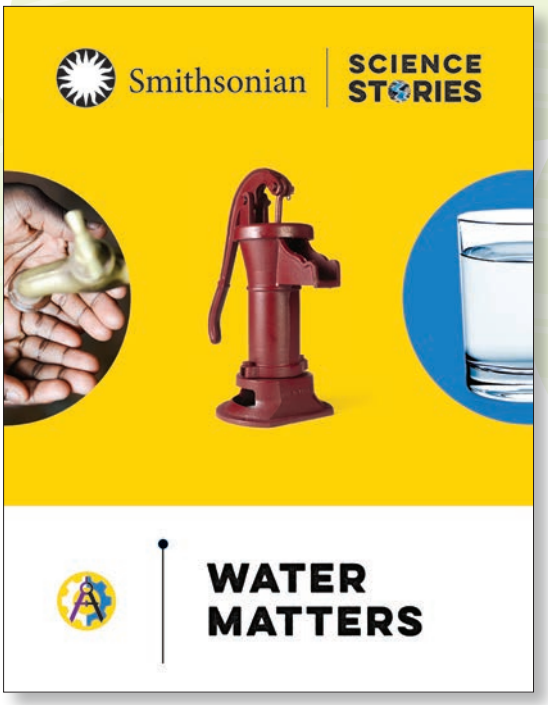
5. Can you think of a time when wind or water was a problem?

Module-Specific, On-Grade and Below-Grade Nonfiction Literacy Supports Every Module of the *Smithsonian Science for the Classroom* Program.

Grade 1 *How Can We Send a Message Using Sound?*

Grade 3 *How Can We Protect Animals When Their Habitat Changes?*

Grade 4 *How Can We Provide Energy to People's Homes?*



Grade 5 *How Can We Provide Freshwater to Those in Need?*

Smithsonian | SCIENCE STORIES

Connecting student literacy to science in the real world

CHANGING EARTH

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READING 1

WIND AND WATER WONDERS

Have you seen the world around you change quickly?

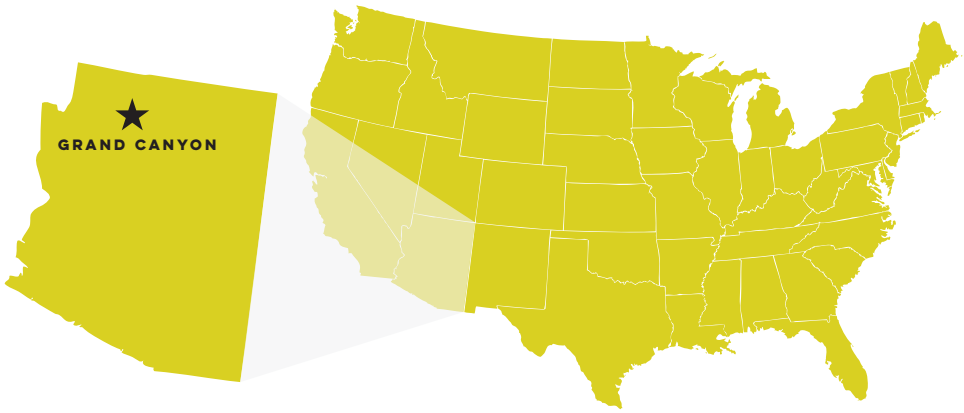
Maybe you have seen a stormy sky, and then the Sun came out.

Have you seen change happen slowly? It takes longer for the seasons to change.

Water and wind change Earth. The changes can happen fast or slow.

Can you think of any land near you that changed fast or slow?

The Grand Canyon is in the Southwest United States.



This river changed the shape of the land around it.

Water

Water covers most of Earth. You can see water in lakes and rivers.

You also see water when it rains. Did you know that water moves soil?

Movement of soil is called **erosion**. Erosion from water can change the shape of land.

Over time, amazing things can form, like **canyons**.

The Grand Canyon is famous. Do you know where it is?

WIND AND WATER WONDERS

Most of the land in this place looks very dry.

But a river runs through it, down at the bottom.

Why does the rest of the land look dry?

A **geologist** would answer that question.

A geologist is a scientist who studies Earth.

Geologists know there used to be more water in this place.

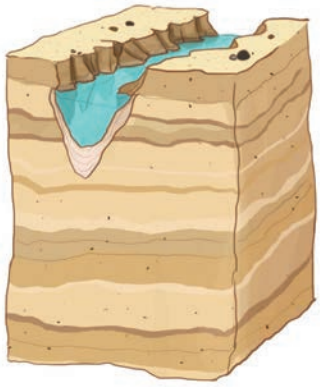
Sea animals with shells lived there. Back then the land was flat.

Then the land rose, and the sea dried up. Shells found in the rock walls prove that.

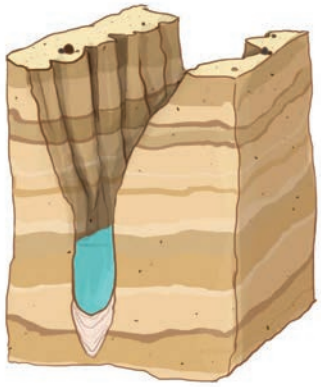
The land slowly changed to look this way.

Shells found in the rock layers mean water covered the area long ago.

WIND AND WATER WONDERS



Flowing water washes away soil and can leave a gap.



Over time, the land kept rising. It rose high enough to reach a river.

Have you seen a river? Does the water in a river look like it moves?

Water moves even when it looks still! As water moves, it drags bits and pieces of the land with it.

Over time, the river made a gap in the land. Water changed the shape of the land.

No one could see every step take place. That's how slow the change happened.

But you can clearly see the result. The gap will keep growing as long as the river is there.

But we won't be able to tell if it changed today. It will change over time.

FUN FACTS

The Grand Canyon is 446 kilometers (277 miles) long. That is about the size of Ohio from end to end.

The Grand Canyon is a little over 1,800 meters (1 mile) deep. That would be the height of 1,000 tall people!

People hike and ride mules through the Grand Canyon.

Explorers ride mules.

5

Water runoff creates dirty puddles in the street.

Rainwater moves leaves and sand to storm drains.

Have you seen water change land right in front of you?

You may not know it, but you probably have.

Have you seen dirty water? It doesn't start out dirty, but it can get dirty fast.

Water picks up loose dirt on the ground and moves it around.

Some of the dirt that was in your yard might end up in a yard down the street.

The water carries it there. It can travel far and fast down a hill.

Next time it rains, see if you find dirty puddles or dirt around storm drains.

You'll know water changed the land.

Wind

Have you ever tried to make a hill of sand?

Would **wind** make it easier or harder to do that?

Wind blows sand around all the time. You can see and feel it blow.

Pick up a handful of sand and drop it. The grains will scatter as they fall.

Loose sand softly falls.

Wind makes large dunes of sand creep forward.

FUN FACT

A sand dune will move 1 to 12 meters (5 to 40 feet) per year depending on its size. Small dunes move more than large ones.

Sand collects by rocks and small trees and forms hills or dunes.

You can see a small hill form quickly. Bigger hills take longer to form.

Wind will keep blowing sand up and over the hill. What do you think will happen to the hill?

It doesn't blow away. The sand that makes it over the top moves the hill forward.

WIND AND WATER WONDERS

Wind also changes the shape of rocks.

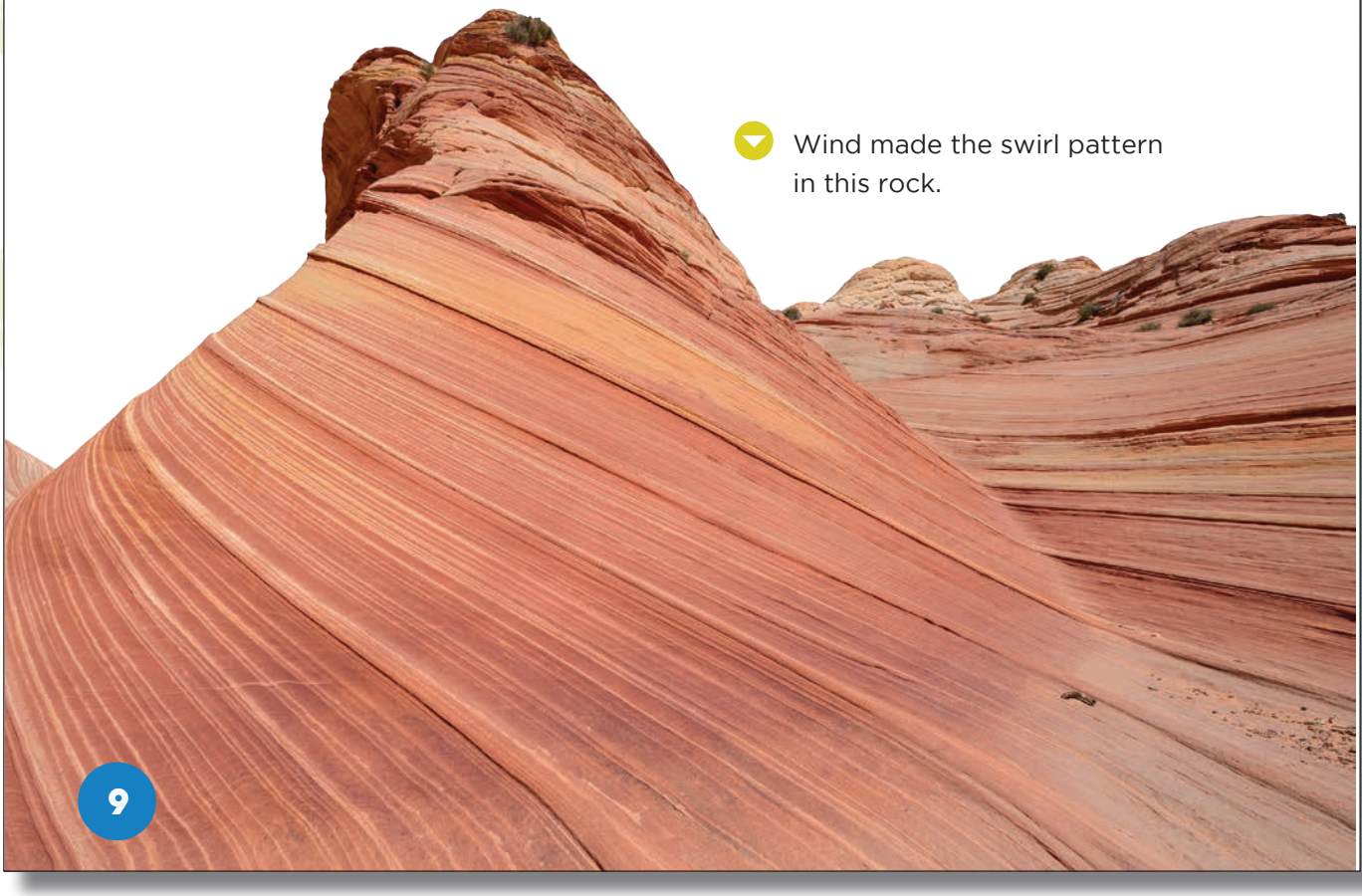
Wind picks up sand and throws it against rocks.

A rock can wear away from the sand rubbing it.

Wind makes swirl patterns in sandstone.

These are more examples of slow change.

Can you find more ways wind and water have changed land near you?



Wind made the swirl pattern in this rock.

READING

2

A MOUNTAIN BLOWS ITS TOP

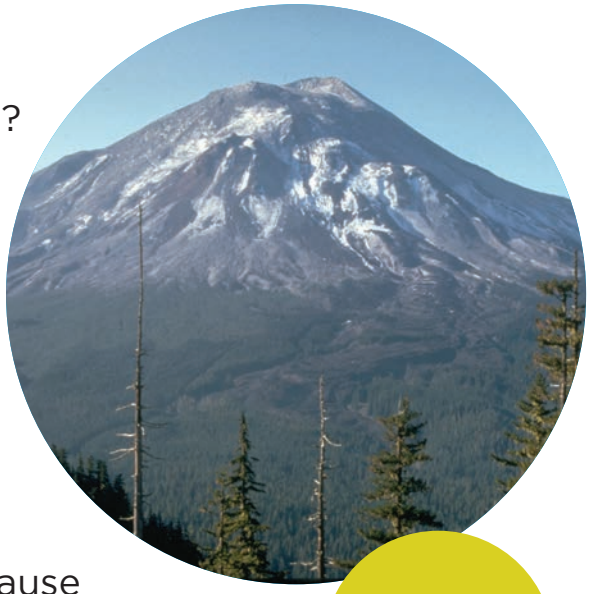
Have you ever seen tall **mountains**? They are all over the world.

But they are not all alike. Have you seen them change?

You don't see them grow taller or shrink every day. But one mountain changed quickly.

This is Mt. St. Helens. Long ago, people called it the Smoking Mountain.

Smoke would come out because it's a **volcano**! But people were not afraid.



This is Mt. St Helens before 1980.

It was mostly quiet for years and stunning to look at.

It looked like a tall peak. It had a cone shape. The sides all looked similar.

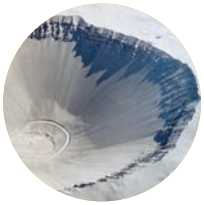
They were steep with snow and ice on them.

ENGLISH GLOSSARY

ash
Small pieces of rocks and minerals blown out of a volcano

canal
A man-made strip of water that allows boats to get to larger bodies of water

canyon
A deep valley with steep rock sides formed by water cutting into earth



crater
The bowl-shaped area on top of a volcano

earthquake
Vibrations in Earth caused by the release of energy, usually from movement along a fault

engineer
Someone who uses science to solve a problem

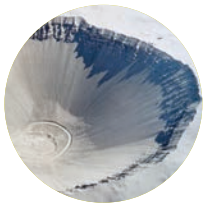
51

GLOSARIO

ceniza
Pequeños trozos de rocas y minerales expulsados por un volcán

canal
Una franja artificial de agua que permite a los barcos alcanzar cuerpos de agua más grandes

cañón
Un valle profundo con paredes de rocas escarpadas formado por el agua cortando la tierra a través del tiempo



cráter
El área en forma de tazón en la cima de un volcán

terremoto
Vibraciones en la Tierra causados por la liberación de energía, que por lo general son originados por movimientos a lo largo de una falla

ingeniero
Alguien que utiliza la ciencia para resolver un problema

Smithsonian | SCIENCE *for the classroom*

Life Science	Earth and Space Systems Science	Physical Science	Engineering Design
Grade 1			
How Do Animal Parents Keep Their Babies Safe? *1-LS1-1 • 1-LS1-2 • 1-LS3-1 • K-2-ETS1-1* **Supporting:** Engineering Design	**Is a Day Always the Same Length?** *1-ESS1-1 • 1-ESS1-2 • 1-PS4-2* **Supporting:** Physical Science	**How Can We See Things in the Dark?** *1-PS4-2 • 1-PS4-3 • 1-LS1-1 • K-2-ETS1-1* **Supporting:** Life Science and Engineering Design	**How Can We Send a Message Using Sound?** *K-2-ETS1-1 • K-2-ETS1-2 • K-2-ETS1-3 • 1-PS4-1 • 1-PS4-4* **Supporting:** Physical Science
Grade 2			
How Do Plants and Animals Need Each Other? *2-LS2-1 • 2-LS4-1 • 2-LS2-2 • K-2-ETS1-1* **Supporting:** Engineering Design	**What Can Maps Tell Us About Water on Earth?** *2-ESS2-2 • 2-ESS2-3 • 2-PS1-1* **Supporting:** Physical Science	**How Do Heating and Cooling Change Things?** *2-PS1-1 • 2-PS1-2 • 2-PS1-3 • 2-PS1-4 • K-2-ETS1-1* **Supporting:** Engineering Design	**How Can We Stop Soil From Washing Away?** *K-2-ETS1-1 • K-2-ETS1-2 • K-2-ETS1-3 • 2-ESS2-1 • 2-ESS1-1* **Supporting:** Earth and Space Science
Grade 3			
What Explains Similarities and Differences Between Organisms? *3-LS1-1 • 3-LS3-1 • 3-LS3-2 • 3-LS4-2 • 3-ESS2-2* **Supporting:** Earth and Space Science	**How Do Weather and Climate Affect Our Lives?** *3-ESS2-1 • 3-ESS2-2 • 3-ESS3-1 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Can We Predict Patterns of Motion?** *3-PS2-1 • 3-PS2-2 • 3-PS2-3 • 3-PS2-4 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Can We Protect Animals When Their Habitat Changes?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 3-LS4-1 • 3-LS2-1 • 3-LS4-3 • 3-LS4-4* **Supporting:** Life Science
Grade 4			
How Can Animals Communicate with Light and Sound? *4-LS1-1 • 4-LS1-2 • 4-PS4-1 • 4-PS4-2 • 4-PS4-3 • 3-5-ETS1-1* **Supporting:** Physical Science and Engineering Design	**How Is the Ring of Fire Evidence of a Changing Earth?** *4-ESS1-1 • 4-ESS2-1 • 4-ESS2-2 • 4-ESS3-2 • 3-5-ETS1-1* **Supporting:** Engineering Design	**How Does Motion Energy Change in a Collision?** *4-PS3-1 • 4-PS3-3 • 4-LS1-1 • 3-5-ETS1-1* **Supporting:** Life Science and Engineering Design	**How Can We Provide Energy to People's Homes?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 4-PS3-4 • 4-PS3-2 • 4-ESS3-1* **Supporting:** Physical Science and Earth and Space Science
Grade 5			
How Can We Predict Change in Ecosystems? *5-LS1-1 • 5-LS2-1 • 5-PS3-1* **Supporting:** Physical Science	**How Can We Use the Sky to Navigate?** *5-ESS1-1 • 5-ESS1-2 • 5-PS2-1 • 3-5-ETS1-1* **Supporting:** Physical Science and Engineering Design	**How Can We Identify Materials Based on Their Properties?** *5-PS1-1 • 5-PS1-2 • 5-PS1-3 • 5-PS1-4 • 5-LS2-1* **Supporting:** Life Science	**How Can We Provide Freshwater to Those in Need?** *3-5-ETS1-1 • 3-5-ETS1-2 • 3-5-ETS1-3 • 5-ESS2-1 • 5-ESS2-2 • 5-ESS3-1* **Supporting:** Earth and Space Science

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