GRADE 2

Building Blocks OF SCIENCE™ | 3D

Earth Materials

Program Highlights and Lesson Sampler

Phenomenon-Based Investigations with Digital Support—in 30-Minute Lessons

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Earth Materials

Teacher's Guide

3rd Edition

Building Blocks OF SCIENCE™ | 3D

Kit Materials

Material	Quantity Needed From Kit	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Bucket of blue modeling dough	3						■
Bucket of green modeling dough	3						■
Bucket of orange modeling dough	3						■
Craft stick	72			■			
Fluted catch pan	12			■	■		
Gravel				■			■
Hand lens	24		■	■	■	■	
Jar with lid, 4 oz	12				■		
Land and Water Card Set	1	■	■	■		■	■
Literacy Reader: *Earth Materials* (below grade level)*	1	■	■	■	■	■	■
Literacy Reader: *Earth Materials* (on grade level)*	1	■	■	■	■	■	■
Pair of safety goggles	24			■		■	
Plastic cup with lid, 1 oz	36	■		■			■
Plastic cup with lid, 2.5 oz	68			■	■	■	■
Plastic tank	6			■		■	
Rock Study Kit	6		■	■			
Sand				■	■	■	■
Spoon	48			■	■		
Spray bottle	6			■			

* The below-grade literacy reader is distinguished from the on-grade literacy reader by a yellow dot near the bottom left corner of the back cover.

Needed But Not Supplied Materials

Material	Quantity Needed	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Assorted art materials for model-building (e.g., blue cellophane, construction paper, plastic knives, scissors, and glue)							■
Assorted rock field guides (optional)			■				
Blue crayon or colored pencil	24	■					
Brown crayon or colored pencil	24	■					
Chart paper or whiteboard		■	■	■	■	■	■
Glue stick	24	■					
Ice cube	18	■				■	
Index card	36			■			■
Large, heavy-duty, wide-rimmed disposable plate	24						■
Long-handled spoon	1						■
Marker		■	■	■	■	■	■
Masking tape					■		
Outdoor location for collecting soil samples	1				■		
Pair of safety goggles (for teacher)	1			■		■	
Pair of scissors	24	■		■			
Paper towels		■		■	■	■	
Permanent marker						■	
Plastic bottle with cap, 16 or 20 oz	6					■	
Plastic straw	48			■			
Projection system (optional)	1				■		
Relief map or relief globe	1	■				■	
Roll of plastic wrap	1					■	
Science notebook	24	■	■	■	■	■	■
Sheet of green construction paper	1			■			
Small shovel	1				■		
Stopwatch or timer	1	■					
Tape (optional)			■				
Water	2.25 gal	■		■	■	■	

NOTES

Unit Overview: *Earth Materials*

Earth's surface is constantly changing. In the six lessons of *Earth Materials*, students will investigate how natural materials such as water, minerals, rocks, and soil are key parts of Earth's surface and the materials that make landforms from canyons to mountains. Usually, changes to landforms happen over a long period of time; however, some agents of change, such as volcanoes and floods, can cause landforms to change more quickly. Students explore these concepts through investigation, discussion, and problem-solving. Students make observations and predictions, analyze and graph data, develop claims supported with evidence and reasoning, and use the engineering design process.

Students begin by drawing upon previous knowledge to document what they know about Earth's materials. Then they investigate water, learning about, where on Earth water can be found, the cycle through which it moves, and the ways it can shape the land. Students then explore several types of rocks and create a way to classify rocks by their properties. They compare the properties of sand, rocks, and gravel to conclude that sand is made when rocks are broken down over time. Students observe local soil to identify the different components.

Students investigate how wind and water can change Earth's surface and landforms over time. The class models how vegetation on sand dunes can slow wind erosion, and they work in teams to design a wind barrier and test the model's effect on slowing wind erosion. Students read about and discuss solutions to slow the effects of soil erosion. Additionally, students investigate how glaciers and rivers can shape and change land.

In the last lesson, students apply what they have learned throughout the unit to plan and build a model island that incorporates two landforms and a body of water. Students present their models to the class and discuss how erosion will impact the island and one of the landforms represented.

Credit: Filip Fuxa/Shutterstock.com

Next Generation Science Standards

The Building Blocks of Science unit *Earth Materials* integrates process skills as defined by the Next Generation Science Standards (NGSS).

Performance Expectations

- **2-ESS1-1:** Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
- **2-ESS2-1:** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- **2-ESS2-2:** Develop a model to represent the shapes and kinds of land and bodies of water in an area.
- **2-ESS2-3:** Obtain information to identify where water is found on Earth and that it can be solid or liquid.
- **2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- **K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Ideas

- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems
- **ESS2.B:** Plate Tectonics and Large-Scale System Interactions
- **ESS2.C:** The Roles of Water in Earth's Surface Processes
- **PS1.A:** Structures and Properties of Matter
- **ETS1.C:** Optimizing the Design Solution

Science and Engineering Practices

- Developing and Using Models
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

- Patterns
- Stability and Change

Important Terms Related to Science Instruction

Science and science instruction rely on specific terminology. Many scientific terms are likely to be new or unfamiliar to students. Below is a list of terms that are used throughout Building Blocks of Science units. Each is followed by a student-friendly definition to help students understand the meaning of the term in a scientific context. A brief description of how Building Blocks employs each of these scientific skills and tools is intended to help you help students model the behavior of scientists.

- **Analyze:** To examine. *Students are asked to examine (analyze) data they collect to help develop their understanding of core ideas and crosscutting concepts.*
- **Claim:** A statement. *To help students develop their understanding of concepts, they will make statements (claims) concerning various scenarios based on observations and data they have collected*.
- **Classify:** To arrange things in groups or categories. *As students investigate and collect data, they will arrange (classify) their data to look for patterns that may help to support claims that they make.*
- **Communicate:** To share information. *Students are continually asked to share experiences, questions, observations, data, and evidence (communicate) within their groups and with the class as a whole. Communication takes many forms, including discussions, the creation of models, designing solutions to problems, and formal presentations.*
- **Compare:** To note similarities and differences among things. *Like classifying, noting how things are alike and different (comparing) is another skill that students will use to analyze their data and look for patterns, cause and effect relationships, and other crosscutting concepts.*
- **Conclude:** To arrive at an opinion by reasoning. *The scientific practices of conducting investigations, collecting and analyzing evidence, and sharing and discussing information lead students to form opinions based on reasoning (to conclude). The conclusions that students develop during the unit will help you assess their understanding of the unit's core ideas.*
- **Evaluate:** To form an idea based on evidence. *Throughout each unit, students will look at (evaluate) the observations and data they collect and discuss their conclusions with classmates in order to form ideas about concepts based on evidence.*
- **Evidence:** Information to show whether something is true or valid. *Students will use the observations and data (evidence) they collect to support claims they make as being valid or true.*
- **Explain:** To describe in detail. *Throughout investigations, students will analyze the data they collect, make claims supported by evidence, and share their information with one another to make sense of (explain) core ideas and phenomena.*
- **Investigate:** To use a standard process to discover facts or information. *Students will carry out standard processes (investigate), sometimes developing those processes themselves, to discover facts or information related to scientific ideas.*
- **Model:** A representation of an object or idea. *Using a representation of an object or idea (a model) helps student scientists communicate and evaluate ideas regarding phenomena. Students will develop many types of models during a unit, including drawings, physical models, diagrams, graphs, and mathematical representations.*

- **Phenomena:** Occurrences or events that can be observed and cause one to wonder and ask questions. *Presenting occurrences or events (phenomena) related to the science concepts being studied engages students through real-world events and ensures common experiences for all students. Presenting phenomena also allows students to develop their own questions and take ownership of their learning.*

- **Predict:** To develop anticipated results of an event based on prior experience or knowledge. *Students are asked to anticipate (predict) the results of events based on experience and data from prior events.*

- **Reasoning:** Thinking about something in a logical way. *Students are asked to make claims, support them with evidence, and explain their claims in a logical fashion (with reasoning). Making claims supported with evidence and reasoning is scientific, or evidence-based, argumentation.*

- **Record:** To write down. *During investigations, students will keep track of their observations (record) by drawing or writing in their science notebooks or on student investigation sheets.*

- **Variable:** A factor that is able to be changed. *As students conduct investigations, they will consider which factors can be changed or manipulated (variables) to test something during the investigation.*

The 5E Instructional Model

Building Blocks of Science uses a constructivist approach to learning by encouraging students to build upon existing ideas using the 5Es. This instructional model cycles through five phases:

- **Engage:** Students draw upon prior knowledge to make connections to a new concept or topic.
- **Explore:** Students are provided with an activity related to a concept or topic and are encouraged to make claims and observations, collect evidence, and ask questions.
- **Explain:** Students use observations and discussion to construct an explanation for a concept or topic they are studying.
- **Elaborate:** Students must draw upon their experiences and apply their knowledge to a new situation in order to demonstrate understanding.
- **Evaluate:** Students assess their knowledge and review what they have learned.

In each Building Blocks of Science unit, students begin with an engaging pre-assessment activity, which allows the teacher to gauge levels of previous knowledge. The following lessons cycle through the explore, explain, and elaborate phases, and then in the final lesson, students are evaluated using project-based and summative assessments.

Incorporating Phenomena

Building Blocks of Science uses phenomena, or observable occurrences, to encourage students to develop questions that will lead to deeper understanding of the core ideas investigated in each unit and to support inquiry-based learning. Each unit includes both an anchoring phenomenon and lesson-specific investigative phenomena.

The unit's anchoring phenomenon, introduced to students in the first lesson, serves as the main focus of the unit. The anchoring phenomenon is introduced through a descriptive narrative in the Teacher's Guide and supported visually by a short online video. This visual teaser of the anchoring phenomenon piques students' interest and helps them to think more deeply and to develop questions. Viewing the video again at the end of the unit prompts students to make connections between the anchoring phenomenon and its applications beyond the scope of the unit's investigations.

An investigative phenomenon is presented to students at the beginning of each lesson to encourage them to develop additional questions. At the end of each lesson, the class revisits its questions and addresses them based on the evidence they collected during the lesson investigations, making connections to the lesson's investigative phenomenon.

As students begin to develop a deeper understanding of the unit's core ideas, they begin to make sense of the phenomena introduced throughout the unit. Students draw connections between what they have learned and how it applies to the world around them. In the last lesson, students engage in a performance task in which they are challenged to synthesize their knowledge to make connections to the unit's anchoring phenomenon. Students may be asked to build a model or design a solution to a problem. When communicating their designs and findings to their classmates, students explain their reasoning using evidence-based claims and answer questions during their presentation.

Each unit's literacy and digital components provide examples of connections between a concept and a phenomenon and ask students to make their own. Teachers are encouraged to support these connections by selecting related articles and videos or by engaging the class in discussion. Teacher Tips within the Teacher's Guide suggest other opportunities to identify related phenomena.

Anchoring phenomenon videos kick off each unit

The Engineering Cycle

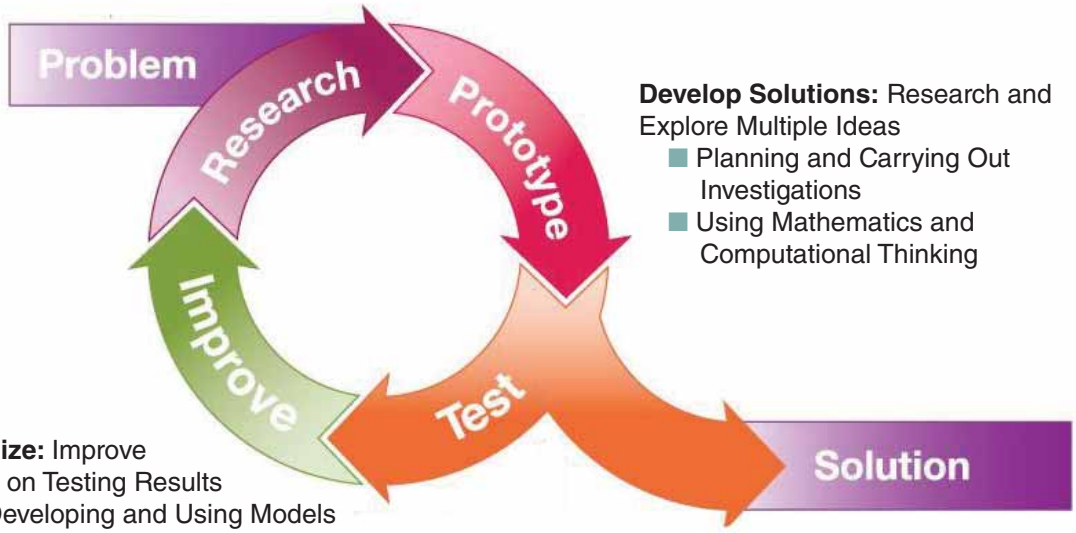
Building Blocks of Science incorporates an engineering design process to support the engineering, technology, and application of science (ETS) core idea outlined in the National Research Council's "A Framework for K–12 Science Education" (NRC, 2012, pp. 201–202). This ETS core idea has been brought into action through the NGSS ETS performance expectations, which allow students to practice systematic problem solving as they apply scientific knowledge they have acquired.

Through scientific engineering and design, students apply what they have learned to creatively solve real-world problems. This 21st-century skill encourages students to collaborate and exposes them to the idea that one problem can have multiple solutions.

An engineering design process can be thought of in three phases: defining a problem, developing solutions, and optimizing the design. Each phase can be correlated with NGSS Science and Engineering Practices as depicted in the graphic below.

Engineering Design Process

Define Problem: Identify Constraints and Criteria for Success
- Asking Questions and Defining Problems
- Obtaining and Evaluating Information



Develop Solutions: Research and Explore Multiple Ideas
- Planning and Carrying Out Investigations
- Using Mathematics and Computational Thinking

Optimize: Improve Based on Testing Results
- Developing and Using Models
- Analyzing and Interpreting Data

In each Building Blocks of Science unit, students employ this engineering cycle to assess their knowledge and build problem-solving skills. Depending on the activity, students may create a model, develop an experiment, or redesign an existing product. To increase student engagement, relate the engineering process to a task, a phenomenon, or a career.

Sensemaking: Developing Claims Supported with Evidence and Reasoning

Scientific argumentation, or evidence-based argumentation, is defined as making scientific explanations (claims) using empirical data (evidence) to justify an argument (reasoning). Scientists use this type of argumentation to make sense of phenomena and refine their ideas, explanations, and experimental designs. In the classroom, students should be introduced to scientific argumentation to guide them in sensemaking, or building an understanding of phenomena based on evidence gained through observations, investigations, and data analysis. Through sensemaking, students refine and revise their understanding as new evidence is acquired and information is shared through class discussions.

Building Blocks of Science units offer multiple opportunities for students to make sense of scientific concepts by developing claims and supporting their claims with evidence and reasoning. At the start of an investigation, students are presented with a question related to a scientific concept. To make sense of a phenomenon or concept, students must draw upon their previous knowledge and experiences to develop a statement or conclusion that answers the question. To support that claim, students must provide relevant and specific data as evidence. This data may come from previous investigations, inference clues, texts, or class discussions. Students may even reference personal experience. Reasoning provides justification for why the selected evidence supports the claim. Relevant scientific principles should be incorporated into this reasoning. After the investigation, students should revisit their initial claims and determine if they are supported by newly gathered evidence. If the available evidence does not support students' initial claims, students should identify misunderstandings and present a claim that is supported.

To support students who struggle with scientific argumentation, ask them to use sentence frames such as "I think _____ because _____" to help with sensemaking. Explain that the first blank is the claim and the second blank is the evidence and reasoning.

Science Notebooks

Science notebooks are an integral part of the process of learning science because they provide a location for students to record their ideas, questions, predictions, observations, and data throughout the unit. The science notebook is used for notes, Tell Me More responses, diagrams, and outlines. Student investigation sheets can be glued, taped, or stapled into the science notebook as well.

Spiral notebooks are recommended and can be purchased inexpensively. If you choose to pre-assemble notebooks, consider including blank sheets of centimeter graph paper and plain paper for writing and drawing. It is recommended to create tabs for each lesson and to have students date each entry.

NOTE: Student investigation sheets use a specific numbering sequence to make it easier for students and teachers to identify them. The first number calls out the lesson, and the letter references the investigation. For example, Student Investigation Sheet 1A supports Investigation A of Lesson 1. If there are multiple student investigation sheets in one investigation, a second number will indicate the order of use (Student Investigation Sheet 2A.1, 2A.2, etc.).

Take-Home Science Activities

Take-Home Science activities are included in each unit and are called out within the related lesson. These activities reflect the science concepts and vocabulary that students are learning about and extend that learning to the home.

A reproducible letter explains how Take-Home Science activities work. Topic-specific activity sheets include directions for the parent, simple background information, and a space for the student to record observations or data. It is recommended that students share their findings and compare experiences as a class after completing the activity. Take-Home Science resources are found with the student investigation sheets at the end of the lesson in which they are assigned.

Assessment

Building Blocks of Science units provide assessment opportunities that correspond to specific lesson objectives, general science process skills, communication skills, and a student's ability to apply the concepts and ideas presented in the unit to new situations. The Teacher's Guide includes strategies for both formative and summative assessment. Each unit includes:

- **Pre-Unit Assessment and Post-Unit Assessment Opportunities:** The pre-unit assessment asks students to draw upon previous knowledge, allowing you to gauge their levels of understanding. The post-unit assessment touches upon the topics and concepts from the entire unit and evaluates students' learning. It is a beneficial practice to ask students to compare the pre-unit assessment and post-unit assessment activities to indicate growth.

- **Formative Assessment Strategies:** At the end of each lesson, specific strategies are listed for each investigation. These include ways to utilize Student Investigation Sheets and Tell Me More questions as assessment tools. In lower grades, an Assessment Observation Sheet lists things to look for as you work with small groups of students.

- **Literacy and Digital Components:** These resources can be assigned to differentiate assignments and to assess student progress as needed.

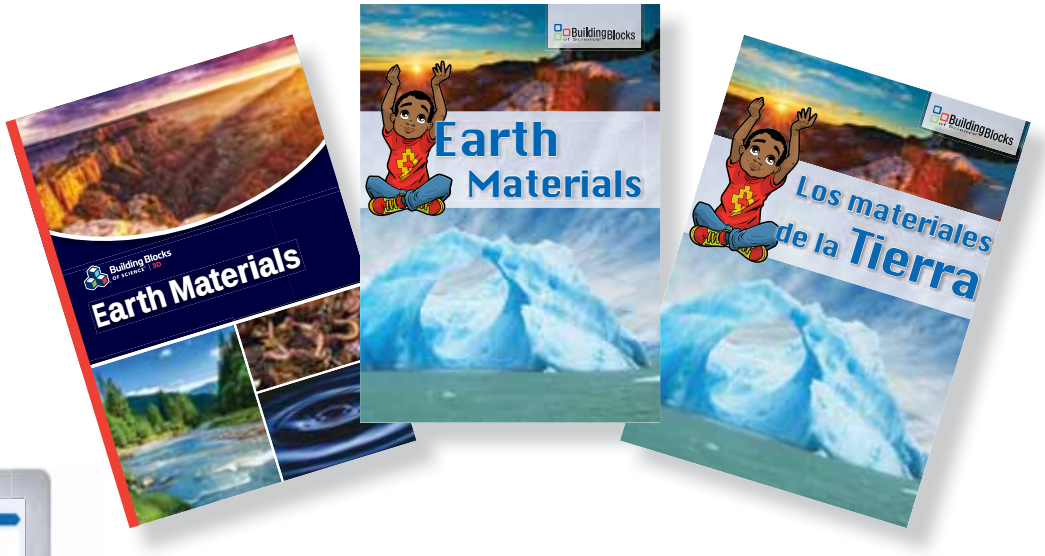
- **General Rubric:** Appendix A includes a rubric that provides an expected progression of skills and understanding of science content. You can use these guidelines to assess students throughout the course of the unit.

- **Summative Assessment:** This unit-specific, cumulative assessment allows students to demonstrate their understanding of content presented by responding to questions in a variety of formats. Each question is aligned to performance expectations and provides insight on students' understanding of the concepts addressed. An answer key is provided, as well as a chart that indicates the performance expectation addressed by each question and lessons to revisit if remediation is required.

Additionally, there is a second end-of-unit assessment accessible only online. This digital summative assessment is **scenario-based** and touches upon all the standards from the unit. It includes both close-ended and open-ended questions.

Building Blocks of Science 3D—The Total Package

Phenomenon-Based Investigations with Digital Support—in 30-Minute Lessons



Hands-on materials are always included—not an extra purchase

Navigating the Teacher's Guide

Phenomenon

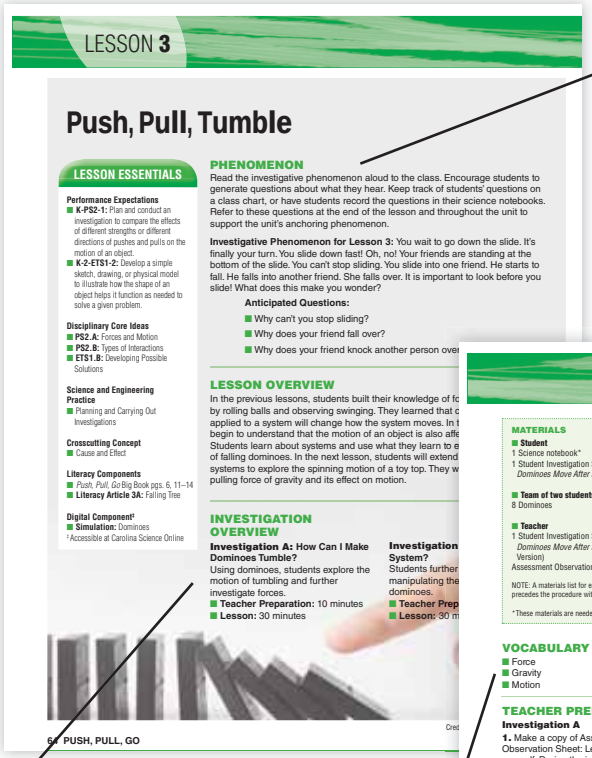
NGSS Standard and 5E Alignment

Investigation Overview with Time Considerations

Vocabulary

Tell Me More Formative Assessment Questions

Teacher Tips and Differentiation Strategies



LESSON 3

Push, Pull, Tumble

LESSON ESSENTIALS

Performance Expectations
- K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Ideas
- PS2.A: Forces and Motion
- PS2.B: Types of Interactions
- ETS1.B: Developing Possible Solutions

Science and Engineering Practice
- Planning and Carrying Out Investigations

Crosscutting Concept
- Cause and Effect

Literacy Components
- *Push, Pull, Go* Big Book pgs. 6, 11–14
- Literacy Article 3A: Falling Tree

Digital Component[2]
- Simulation: Dominoes

[2] Accessible at Carolina Science Online

PHENOMENON

Read the investigative phenomenon aloud to the class. Encourage students to generate questions about what they hear. Keep track of students' questions on a class chart, or have students record the questions in their science notebooks. Refer to these questions at the end of the lesson and throughout the unit to support the unit's anchoring phenomenon.

Investigative Phenomenon for Lesson 3: You wait to go down the slide. It's finally your turn. You slide down fast! Oh, no! Your friends are standing at the bottom of the slide. You can't stop sliding. You slide into one friend. He starts to fall. He falls into another friend. She falls over. It is important to look before you slide! What does this make you wonder?

Anticipated Questions:
- Why can't you stop sliding?
- Why does your friend fall over?
- Why does your friend knock another person over

LESSON OVERVIEW

In the previous lessons, students built their knowledge of fo
by rolling balls and observing swinging. They learned that c
applied to a system will change how the system moves. In t
begin to understand that the motion of an object is also affe
Students learn about systems and use what they learn to e
of falling dominoes. In the next lesson, students will extend
systems to explore the spinning motion of a toy top. They w
pulling force of gravity and its effect on motion.

INVESTIGATION OVERVIEW

Investigation A: How Can I Make Dominoes Tumble?
Using dominoes, students explore the motion of tumbling and further investigate forces.
- Teacher Preparation: 10 minutes
- Lesson: 30 minutes

Investigation
System?
Students further
manipulating the
dominoes.
- Teacher Prep
- Lesson: 30 m

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LESSON 3

MATERIALS
- Student
  1 Science notebook*
  1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?*
- Team of two students
  8 Dominoes
- Teacher
  1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* (Teacher's Version)
  Assessment Observation Sheet: Lesson 3

NOTE: A materials list for each investigation precedes the procedure within the lesson.

*These materials are needed but not supplied.

OBJECTIVES
- Demonstrate that a force is any push or pull.
- Investigate and demonstrate that force causes an object to start moving, stop moving, or change direction.
- Predict and explore what happens if a component of a system in motion is missing or not working properly.
- Build on the understanding that position and motion can be changed by pushing and pulling objects.
- Gather evidence that it takes a push or pull to change the motion of objects.
- Build an understanding that objects move in different patterns (e.g., straight line, zigzag, curved line).

VOCABULARY
- Force
- Gravity
- Motion

TEACHER PREPARATION

Investigation A

1. Make a copy of Assessment Observation Sheet: Lesson 3 for yourself. During the investigations in this lesson, use the questions and prompts on this sheet to formatively assess students as they work.

2. Find an online video that shows large, complex domino setups. It will be helpful if the video uses dominoes similar to the ones students will use in the investigation.

3. Have eight dominoes from the kit available for each team of two students.

Investigation B

1. Have one copy of Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* for each student.

2. Have eight dominoes from the kit available for each team of two students.

3. Have your Assessment Observation Sheet handy to continue formatively assessing students.

Figure 3.1:

LESSON 3

Investigation B

WHAT IS A SYSTEM?

MATERIALS
- Student
  1 Science notebook*
  1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?*
- Team of two students
  8 Dominoes
- Teacher
  1 Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* (Teacher's Version)
  Assessment Observation Sheet: Lesson 3

*These materials are needed but not supplied.

1. Review the term "system" with students by referencing the swing or the ramp and ball. Ask students to make connections to the dominoes. Ask:
- What are the parts of this system? *(Eight dominoes)*
- What force causes changes in this system? *(A push)*
- What changes occur? *(A force causes the dominoes to tumble over.)*
- Do you think the system still work if you take away one part of it? Make a prediction.

2. Instruct students to use their dominoes to test their predictions. Allow time for pairs to set up their dominoes and then test what will happen if one domino is removed from the middle of the system. Assist students who appear to be struggling. When all students have tested their predictions, ask:
- What happens to the motion in the system when pieces are removed? How do you know?
- What do you think would happen if you removed two dominoes? Make a prediction and try it.
- How does changing a system affect the way it moves?

3. Provide each student with a copy of Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* Allow time for students to draw what happens to the line of dominoes and to complete the sentence prompts. Answer any questions students have as they work.

? How can you change how fast something tumbles?

Tell Me More!

Disciplinary Core Ideas
- PS2.A: Forces and Motion
- PS2.B: Types of Interactions
- ETS1.B: Developing Possible Solutions

Science and Engineering Practice
- Planning and Carrying Out Investigations

Crosscutting Concept
- Cause and Effect

5Es
- Elaborate

Teaching Tip

Depending on the setup, some students' dominoes may continue to fall if they are very close together. If students appear to struggle with this concept, you may wish to lead a demonstration. Show what happens when you remove one of the middle dominoes, when you remove two dominoes that are side by side, and when you remove two dominoes from different locations.

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Extensions

Additional Features

- Lesson Overview Charts
- Guide to Instructional Scaffolding
- Teacher Preparation
- Background Information
- NGSS Standards by Lesson
- Literacy and Digital Components
- Summative Assessment

LESSON **3**

EXTENSIONS | ASSESSMENT STRATEGIES

Action Attraction
Challenge students to explore what might make the dominoes fall more slowly or more quickly. You might prompt students by asking:

- Does spacing make a difference in how a line of dominoes topples over?
- How might you test this question?
- Make a prediction and then try your ideas.

Domino Rally Events
Do a quick Internet search for videos that show domino challenges that people have set up. Share these videos with students, and encourage them to work together in small groups with all 96 dominoes to see how many dominoes they can set up to tumble with one push.

Credit: Africa Studio/Shutterstock.com

Counting and Setting Up Sets
Challenge pairs of students in a learning center to set up a line of dominoes that not only will fall down with one push but also is set up in sets of two or five. Have students offset the line of dominoes so that before the line is sent tumbling, they can identify and count the sets of two, three, or five.

1. Investigation A

- Use students' responses to the Tell Me More question to assess their understanding of domino motion. If students do not seem to understand this concept, you may wish to provide supplemental examples of motion and force.

2. Investigation B

- Use Student Investigation Sheet 3B: *How Do Dominoes Move After a Push?* to determine how well students understand force and motion using dominoes. Look for use of appropriate vocabulary and drawings that demonstrate motion.
- Use students' responses to the Tell Me More question to evaluate their understanding of forces. Students should recognize that adding force will increase the speed at which an object tumbles.

3. Refer to the Assessment Observation Sheet where you recorded observations during this lesson to formatively assess your class, and adjust instruction as needed.

4. Refer to the General Rubric in Appendix A to assess individual progress as needed.

Assessment Strategies

Literacy Articles

Literacy Article 3A

Name: _____ Date: _____

Falling Tree

You saw a tree in the forest. It was tall. It was wide. It was huge!

It rained hard. The wind blew.

The tree tumbled over! The tree fell onto smaller trees.

They had thin trunks. The smaller trees tumbled, too. The smaller trees fell on bushes. The bushes tumbled.

The rain stops. The Sun comes out. Birds start to sing.

Credit: Patryc

Take-Home Science Activities

Student Investigation Sheet 3B: How Do Dominoes

Name: _____ Da

This is a line that moves.

Dominoes _____.

A push _____.

© Carolina Biological Supply Company Student Investigation Sheet 3B

Student Investigation Sheets

Take-Home Science

Dear Family,

Our class is beginning an inquiry science unit. Inquiry science is all about questions, active explorations, drawing, writing, and recording what you see and do to build an understanding of science. Young children are natural scientists. Scientists question everything. Once scientists answer one question, they move without blinking to the next question.

Take-Home Science is an exciting part of our program because it's one way we can better connect home and school. With everyone working together, we can reinforce the science concepts that your student is exploring in the classroom. Here's how Take-Home Science works.

Your student will bring home an investigation sheet that explains an activity related to the science unit the class is studying. The activity is designed so that everyone in the household—younger and older children alike—can work together to learn about science.

A section of the investigation sheet explains the science words and ideas that will be explored during the activity. These science words and ideas are not new to your student, because the activity follows a lesson in which those same concepts were explored.

The activities are simple and can be completed within 20 minutes using items normally found in the home. A section of the investigation sheet is for your student to complete and bring back to school. In class, your student will have the opportunity to share his or her experiences and results with other students.

The activities are intended to be quick, informal, and fun. Enjoy!

GO EXPLORING!

Credit: Cathy Keifer /Shutterstock

© Carolina Biological Supply Company Lesson 5 Take-Home Science Letter

Earth Materials

Unit Overview

Earth's surface is constantly changing. In the six lessons of *Earth Materials*, students will investigate how natural materials such as water, minerals, rocks, and soil are key parts of Earth's surface and the materials that make landforms from canyons to mountains. Usually, changes to landforms happen over a long period of time; however, some agents of change, such as volcanoes and floods, can cause landforms to change more quickly. Students explore these concepts through investigation, discussion, and problem-solving. Students make observations and predictions, analyze and graph data, develop claims supported with evidence and reasoning, and use the engineering design process.

Unit Anchoring Phenomenon

The surface of Earth is constantly changing. The results of these changes usually take a long time to become noticeable, but some agents of change, such as volcanoes and floods, cause land to change more quickly. The anchoring phenomenon in *Earth Materials* is how natural materials such as water, minerals, rocks, and soil are important parts of Earth's surface.

	LESSON 1	LESSON 2
INVESTIGATIVE PHENOMENA	You turn on the faucet, and water comes out. In the summer, you like to play in sprinklers and swim in pools. You play in puddles when it rains. But where does the water come from? What does this make you wonder?	You have seen pictures of mountains, creeks, and streams. They all have one thing in common: rocks. Big rocks, small rocks, rocks of different shapes and colors. What does this make you wonder?
OBJECTIVES	■ Begin building an age-appropriate understanding about the materials that compose Earth. ■ Identify the uses of water and recognize its various forms. ■ Describe how water and ice can change the shape of land through erosion. ■ Use a map to identify different types of water sources. ■ Use a model to identify the stages of the water cycle. ■ Determine and graph the percentage of water compared to land.	■ Make close observations using a hand lens. ■ Use a student-designed plan to sort rocks by their characteristics. ■ Classify rocks based on their characteristics. ■ Recognize that some objects are made of more than one material. ■ Use evidence and reasoning to support a claim about changes in landforms.
SCAFFOLDING Students should know:	↓ Earth is composed of materials, or resources, that together help support life. ↓ Water is the natural material that makes up most of Earth's surface. ↓ Water is found on Earth in different forms. ↓ Water moves through a predictable cycle.	↓ Rocks are natural materials that typically have more than one component. ↓ Heat, pressure, and time are the factors that can form rocks. ↓ Rocks can be broken down by weathering and moved to new locations by erosion. ↓ Rocks make up many of the landforms on Earth.

Concepts build from one lesson to the next

	LESSON 3	LESSON 4	LESSON 5
	Guess which of Earth's materials I am describing. You may have seen this material on the playground, maybe in art class, or perhaps when you were on vacation. If you live near a desert or a beach, you might see this material often. It is made of small grains and can feel gritty. What does this make you wonder?	It's the weekend! No school! The weather is nice, and you are playing outside. You notice that your friend's mom is planting flowers in her garden. You see her using a shovel to dig holes in the ground, and then place a flower in each one. What does this make you wonder?	It has been raining nonstop for three days. It's not fun waiting for the bus in the rain. You notice that there is a lot of water on the ground and that the water is starting to change how the ground looks. Where the ground used to be flat, there are now small holes that are filled with water. There are tiny streams running between them. You are learning about bodies of water and landforms in school. What does this make you wonder?
	■ Observe the properties of sand, and recognize that some objects are made of more than one material. ■ Describe how sand is formed over time. ■ Investigate the connection between water, wind, and the erosion of the materials that make up Earth's surface. ■ Explore and design solutions to reduce wind erosion on sand dunes.	■ Observe the properties of soil. ■ Recognize that soil contains nutrients for plant growth and is composed of different materials. ■ Analyze the components of soil obtained from the local area. ■ Investigate the connection between water, wind, and the erosion of natural materials on Earth. ■ Identify and discuss solutions to the problem of soil erosion on farmland.	■ Investigate the connection between water, ice, and the erosion of the materials that Earth is made of. ■ Recognize the characteristics of several landforms and how they change over time. ■ Use a model to investigate how glaciers and rivers can change the shape of the land over time. ■ Discuss how other naturally occurring processes on Earth, such as volcanoes and the movement of Earth's plates, can create and change landforms.
	↓ Sand is a natural material formed primarily from the weathering and erosion of rocks over time. ↓ Wind and water can change and shape landforms composed of sand, such as sand dunes. ↓ Vegetation can help reduce the effects of wind erosion on sand dunes. ↓ Engineers design solutions to reduce the effects of erosion on sand dunes.	↓ Soil is a natural material composed of small, loose particles of Earth's crust. ↓ Soil contains nutrients that are important for plant growth. ↓ Wind and water can affect how soil forms. ↓ Runoff can wash away the top layers of soil, which affects the availability of nutrients that are needed for plant growth.	↓ Landforms can change over time due to weathering and erosion. ↓ Glaciers and rivers can contribute to the formation of new landforms or change the shape of existing landforms. ↓ Islands and mountains can be formed by volcanoes and other Earth processes.

Earth Materials

Unit Anchoring Phenomenon

The surface of Earth is constantly changing. The results of these changes usually take a long time to become noticeable, but some agents of change, such as volcanoes and floods, cause land to change more quickly. The anchoring phenomenon in *Earth Materials* is how natural materials such as water, minerals, rocks, and soil are important parts of Earth's surface.

LESSON 6

INVESTIGATIVE PHENOMENA

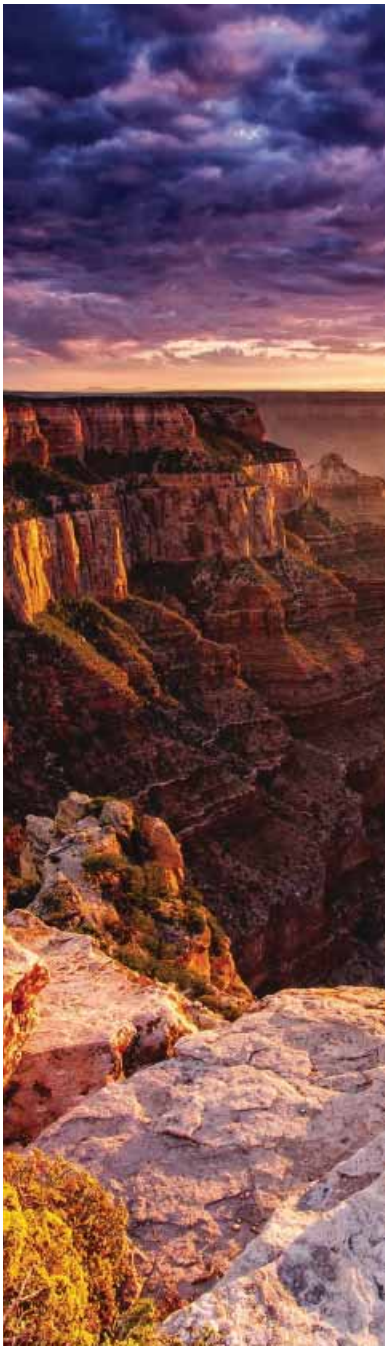
Off the south coast of Hawaii, a volcano is erupting underwater and forming new land. You have the ability to travel thousands of years into the future, and when you arrive, you see that there is a new island. What does this make you wonder?

OBJECTIVES

- Recognize the connection between wind, water, and ice and the erosion of the materials that make up Earth's surface.
- Identify that some changes to landforms occur slowly, over a long period of time, while others happen quickly.
- Create a model to explain the characteristics of landforms and the effect of erosion on those landforms.
- Present models and communicate information to classmates about the materials that make up Earth's surface.
- Evaluate learning throughout the unit, and compare that knowledge to initial ideas from the beginning of the unit.

SCAFFOLDING Students should know:

- Wind, water, and ice play a role in erosion of the materials that make up Earth's surface.
- Some landforms change slowly over a long time, while other changes happen more quickly.
- Even though islands are surrounded by water, the island itself can be composed of different types of landforms and other bodies of water.



NOTES

Lesson 4: Soil

NGSS correlations by lesson

Investigation Overview	Standards	Resources

Investigation Overview

Investigation A: What Makes Up Soil?
5Es: Explain
The class discusses the different materials that make up soil.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30 minutes

Tell Me More! Draw a picture of the types of living things you think you might find if you dig a few inches down in soil.

Investigation B: What Can We Learn by Studying Soil?
5Es: Explore, Explain
Students investigate soil from their local area and analyze the components that make up their sample.
- **Teacher Preparation:** 20 minutes
- **Lesson:** 60 minutes (90 minutes if you take students outside)

Tell Me More! A hotel is opening in an area that has lots of sand in the soil. They have asked you to help design the landscaping for the hotel. They want many types of plants and trees. What might you suggest they do so they can have the landscaping they want?

Investigation C: How Can Wind and Water Affect Soil?
5Es: Elaborate
Students discuss how erosion can affect soil, specifically on farmland.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30 minutes

Tell Me More! You learned about how farms can be affected by soil erosion. In what other ways do you think soil erosion could be a problem?

30-minute investigations fit into your busy day

Standards

Next Generation Science Standards Performance Expectations
- **2-ESS1-1:** Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
- **2-ESS2-1:** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- **K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Ideas
- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems
- **ETS1.C:** Optimizing the Design Solution

Science and Engineering Practice
- Constructing Explanations and Designing Solutions

Crosscutting Concept
- Stability and Change

Language Arts and Math Standards
Language Arts
- **L.2.4:** Vocabulary Acquisition and Use
- **L.2.6:** Vocabulary Acquisition and Use
- **RI.2.1:** Key Ideas and Details
- **RI.2.3:** Key Ideas and Details
- **RI.2.4:** Craft and Structure
- **RI.2.5:** Craft and Structure
- **RI.2.7:** Integration of Knowledge and Ideas
- **RI.2.9:** Integration of Knowledge and Ideas
- **SL.2.1:** Comprehension and Collaboration
- **SL.2.2:** Comprehension and Collaboration
- **SL.2.3:** Comprehension and Collaboration
- **W.2.8:** Research to Build and Present Knowledge

Integrated ELA and math

Math
- **2.MD.A.1:** Measure and estimate lengths in standard units.
- **2.MD.A.3:** Measure and estimate lengths in standard units.
- **2.MD.D.10:** Represent and interpret data.

Resources

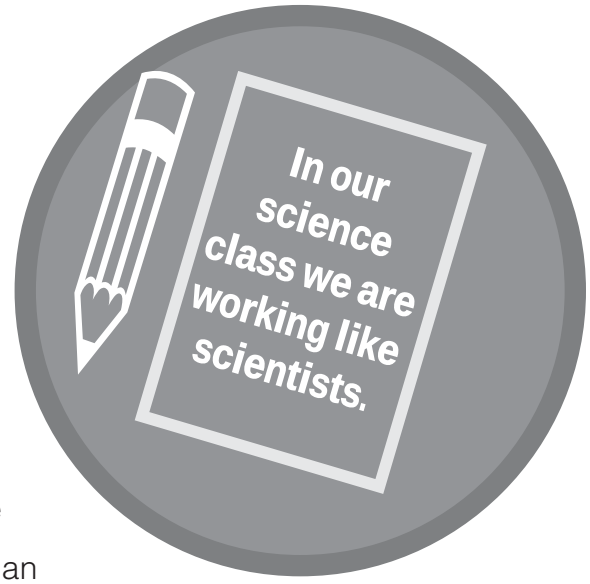
Student Investigation Sheets
- Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?*
- Literacy and Science 4C: *Reducing Soil Erosion*

Literacy Components
- *Earth Materials* Literacy Reader, pgs. 7, 12–13
- Literacy Article 4A: The Dirt on Soil

Digital Components
- Interactive Whiteboard: Our Ideas About Soil
- Interactive Whiteboard: Comparing Sand and Soil
- Simulation: Soil Erosion

Vocabulary
- Conserve
- Humus
- Runoff
- Soil
- Topsoil

Safety Contract



In science class, I will:

- ■ Listen to directions
- ■ Complete each step of the experiment
- ■ Look, feel, smell, and listen but never taste
- ■ Wait to begin until my teacher tells me
- ■ Wear safety goggles when my teacher tells me
- ■ Ask my teacher to approve any experiment I plan on my own or with classmates
- ■ Keep my hands away from my mouth and eyes as I work
- ■ Tie back long hair
- ■ Tuck in loose clothing
- ■ Keep my workstation neat
- ■ Put away materials after use
- ■ Follow all safety rules

I have read this contract and will follow these safety rules in science class.

Student's signature _____

Date _____

I have read this safety contract and understand what is expected of my child during science class.

Parent/Guardian's signature _____

Date _____

Note to Parent/Guardian:
Science materials and activities are chosen for safety and age appropriateness.

All lessons are anchored in phenomena

Soil

LESSON ESSENTIALS

Performance Expectations
- **2-ESS1-1:** Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
- **2-ESS2-1:** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- **K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Disciplinary Core Ideas
- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems
- **ETS1.C:** Optimizing the Design Solution

Science and Engineering Practice
- Constructing Explanations and Designing Solutions

Crosscutting Concepts
- Cause and Effect
- Stability and Change

Literacy Components
- *Earth Materials* Literacy Reader, pgs. 7, 12–13
- **Literacy Article 4A:** The Dirt on Soil

Digital Components‡
- **Interactive Whiteboard:** Our Ideas About Soil
- **Interactive Whiteboard:** Comparing Sand and Soil
- **Simulation**: Soil Erosion

‡ Accessible at Carolina Science Online

PHENOMENON

Read the investigative phenomenon aloud to the class. Encourage students to generate questions about what they hear. Keep track of students' questions on a class chart, or have students record the questions in their science notebooks. Refer to these questions at the end of the lesson and throughout the unit to support the unit's anchoring phenomenon.

Investigative Phenomenon for Lesson 4: It's the weekend! No school! The weather is nice, and you are playing outside. You notice that your friend's mom is planting flowers in her garden. You see her using a shovel to dig holes in the ground, and then place a flower in each one. What does this make you wonder?

Anticipated Questions:
- Where does soil come from?
- Is soil the same everywhere?
- What things can I find in the soil?

LESSON OVERVIEW

In Lesson 3, students investigated sand and looked at how water and wind can affect sand and landforms composed primarily of sands. Students also designed barriers to reduce the impact of wind erosion on their model sand dunes. In this lesson, students will investigate the properties of soil including the soil at their school. As a class, students will discuss solutions to reduce the effects of soil erosion. In the next lesson, students will explore how large landforms can be changed by erosion over time.

INVESTIGATION OVERVIEW

Investigation A: What Makes Up Soil?
The class discusses the different materials that make up soil.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30 minutes

Investigation B: What Can We Learn by Studying Soil?
Students investigate soil from their local area and analyze the components that make up their sample.
- **Teacher Preparation:** 20 minutes
- **Lesson:** 60 minutes (90 minutes if you take students outside)

Investigation C: How Can Wind and Water Affect Soil?
Students discuss how erosion can affect soil, specifically on farmland.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30 minutes

VOCABULARY

- Conserve
- Humus
- Runoff
- Soil
- Topsoil

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MATERIALS

■ Student

1 Science notebook*
1 Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?*
1 Literacy and Science 4C: *Reducing Soil Erosion*
1 Spoon

■ Team of two students

1 Fluted catch pan
2 Hand lenses
1 Jar (4 oz) with a local soil sample
1 Plastic cup (2.5 oz) of sand
1 Plastic cup (2.5 oz) of water
2 Spoons

■ Class

Outdoor location for collecting soil samples*
Paper towels*

■ Teacher

1 Teacher Sheet 4A: *Soil Profile*
1 Student Investigation Sheet 4B: *What Can We Learn by Studying Soil*? (Teacher's Version)
1 Literacy and Science 4C: R*educing Soil Erosion* (Teacher's Version)
25 Plastic cups with lids, 2.5 oz
12 Jars, 4 oz
1 Small shovel*
2 C Water*
Assessment Observation Sheet: Lesson 4
Chart paper or whiteboard*
Markers*
Masking tape*
Projection system* (optional)
Sand

NOTE: A materials list for each investigation precedes the procedure within the lesson.

*These materials are needed but not supplied.

OBJECTIVES

- Observe the properties of soil.
- Recognize that soil contains nutrients for plant growth and is composed of different materials.
- Analyze the components of soil obtained from the local area.
- Investigate the connection between water, wind, and the erosion of natural materials on Earth.
- Identify and discuss solutions to the problem of soil erosion on farmland.

TEACHER PREPARATION

Investigation A

1. Make a copy of Assessment Observation Sheet: Lesson 4 for yourself. During the investigations in this lesson, use the questions and prompts on this sheet to formatively assess students as they work.

2. Title a sheet of chart paper "Our Ideas About Soil." Alternatively, use Interactive Whiteboard: Our Ideas About Soil.

3. Prepare to share the diagram on Teacher Sheet 4A: *Soil Profile* with the class. You might project it using a document camera, or you might make a copy for each student.

4. If you haven't already done so, collect a sample of local soil in a 2.5-oz cup and secure the lid.

Investigation B

1. Make one copy of Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?* for each student.

2. Each pair of students will need 3–4 oz of soil. Decide whether you will take students outside to obtain their own soil samples or if you will collect enough soil for the class before the start of the investigation. If you choose to take students outside to obtain soil samples from the school grounds, select an area ahead of time where the class can dig. Since students will use spoons to obtain the samples, you may need a small shovel to loosen the soil.

3. Each pair of students will need one collection jar from the kit. Place a strip of masking tape on each jar for students to write their names on. If you collect soil for students, provide them with a jar of soil. If students will collect their own samples, provide empty jars when you reach the area for collection.

5. For each pair of students, fill one 2.5-oz cup halfway with sand and a second 2.5-oz cup halfway with water. Secure the lids on each cup.

6. Title a sheet of chart paper "Comparing Sand and Soil." Draw a Venn diagram on the chart paper. Label the left circle "Soil," the right circle "Sand," and the intersection "Both." Alternatively, use Interactive Whiteboard: Comparing Sand and Soil.

7. Each pair of students will need one fluted catch pan, a cup of water, a cup of sand, the collection jar with the local soil sample, two hand lenses, and two spoons. Decide how you will distribute these materials.

8. Have available a roll of paper towels to clean up any spills.

9. Have your Assessment Observation Sheet handy to continue formatively assessing students.

Investigation C

1. Make one copy of Literacy and Science 4C: *How Can Wind and Water Affect Soil?* for each student.

2. Title a sheet of chart paper "Soil Erosion." Create a two-column chart. Title the left column "Problem" and the right column "Solutions."

3. Have your Assessment Observation Sheet handy to continue formatively assessing students.

NOTES

Just-in-time background information

BACKGROUND INFORMATION

What Is Soil?

Soil consists of small, loose particles that make up the top layer of Earth's crust. Wind and water erosion change soil over time. Soil contains two main components—humus and rock particles—plus air and water. **Humus** (HUGH-muss) is a dark, organic material resulting from the decomposition of dead plant and animal material. It is rich in nutrients that are vital for plant growth. Rock particles, which also help compose soil, contain minerals that are needed by plants for healthy growth. Soil is home to many types of organisms, including worms, grubs, millipedes, and mites, all of which aid in the decomposition process. Microscopic creatures such as bacteria and fungi also break down dead plant and animal matter and turn it into nutrients that plants need.

Soil Layers

When people talk about soil, they generally refer to the uppermost layer as topsoil. However, soil has several layers, called horizons. Humus is the first layer. Topsoil is the next layer. **Topsoil** is rich in nutrients and is composed of minerals from decaying plants and animals. Many plant roots live in topsoil. If humus and topsoil are washed away by water erosion, plants will not grow easily there. Subsoil is below topsoil. Subsoil collects dissolved minerals and clay from the layers above it. The very bottom layer is bedrock, which can form what is known as the parent material for some soils. It is important to note that there is no uniform depth to soils around the world. Some areas may have exposed bedrock, while other areas may have soil that is many meters deep.

Soil Types and Textures

There are many different types of soil, each with its own color, composition, and texture. Soil types and properties vary from region to region. For example, soil with a lot of sand in it feels gritty and rough because the sand particles are large, coarse, and dry. Sandy soil does not have the organic matter or nutrients that most plants need to grow. Plants that can live in sand need to bury their roots deep to reach subsoil below the sand so they do not wash away. The more sand there is in soil, the more chance there is for erosion. Clay is a type of soil made up of rock particles that are so small they are hard to see. Clay is very heavy. It sticks together tightly when it is wet, and it is very hard when it is dry. Most plants cannot live in clay, although it does hold minerals that help plants grow. This makes clay a good component to mix with other types of soil. Silt is another type of soil. Silt has particles that are smaller than sand but larger than clay. Silt is fine and feels smooth and powdery. Soil with silt is good for growing plants because it has small, organic particles and minerals. Silt can be eroded easily, both by water and by wind. Loam is a soil composed of humus, sand, silt, and clay. Loam is a good soil for growing plants because it holds nutrients and allows water to circulate.

Soil and Erosion

Just as with sand and rock, erosion causes changes to soil. Soil erosion can happen slowly over a long period of time, but severe rainstorms and heavy rains can loosen weak soil quickly and wash it away through runoff. **Runoff** is a flow of water on land that can occur from melting ice, flooding, and even precipitation. When soil erodes, the humus and topsoil layers are affected. Important nutrients that are needed for growing plants are lost. Once these nutrients are gone, it is harder to grow plants in the soil.

Farmers and soil scientists who want to **conserve**, or save, soil have worked on solutions to lessen the effects of soil erosion. Planting trees at the edge of a field creates a barrier that slows the effects of wind erosion on the soil. Different farming methods, including contour planting, terrace farming, and crop rotation can also slow wind and water erosion. Contour planting is when rows for crops are plowed around the curve of a hilly field or around the shape of the land rather than straight up and down. Terrace farming has been used for centuries by farmers around the world. Terraces, or steps, are built up on a large hill, and plants are grown on each level of the terrace, preventing water from rushing straight down the hill quickly.

Disciplinary Core Ideas
- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems

Science and Engineering Practice
- Constructing Explanations and Designing Solutions

Crosscutting Concept
- Stability and Change

5Es
- Explain

Literacy Components
- *Earth Materials* Literacy Reader, pgs. 7, 12–13
- **Literacy Article 4A:** The Dirt on Soil

Digital Component
- **Interactive Whiteboard:** Our Ideas About Soil

3-dimensional learning

Investigation A

WHAT MAKES UP SOIL?

MATERIALS

- **Student**

1 Science notebook*

- **Teacher**

1 Teacher Sheet 4A: *Soil Profile*
1 Plastic cup (2.5 oz) of local soil*
1 Small shovel*
Assessment Observation Sheet: Lesson 4
Chart paper or whiteboard*
Markers*
Outdoor area to collect soil samples*
Projection system* (optional)

*These materials are needed but not supplied.

1. Review with students what they learned about sand in the previous lesson. Ask:

- What are some properties of sand? *(Students should mention color, size, shape, and texture.)*
- How does sand form? *(Students should identify that sand is formed from erosion and weathering, and that it takes a long time for sand to form.)*
- How does erosion affect sand and sand landforms such as deserts and sand dunes? *(Students should identify that wind and water can move sand, and that without vegetation, wind has a great effect on sand.)*

Teaching Tip

Leave the chart displayed throughout the investigation, and encourage students to add to it as they build their knowledge of soil.

2. Display the "Our Ideas About Soil" class chart. Allow time for students to discuss with a partner what they know about soil. Then invite students to share their ideas, and record their responses on the chart.

3. Show students the cup of soil that you prepared, and then have students pass the cup of soil around to make observations. Ask:

- What do you notice about the soil in the cup? *(Answers will vary depending on the soil composition of your area. Students may suggest that the soil has small pieces, or they might describe the color of the soil, texture.)*
- What do you know about the soil where we live? *(Students' knowledge about the soil in your area will vary. Listen for accurate descriptions of your local soil. Depending on where you live, the soil might be described as sandy or good for growing crops.)*

ELA connection SL.2.1, SL.2.3

4. Project Teacher Sheet 4A: *Soil Profile* or distribute a copy to each student. As you explain the components that make up soil, point them out on the class chart. Explain that depending on where it is from, soil can be composed of small particles of rock, sand, clay, humus, air, and water.

5. Point to the top layer on the diagram, and introduce the term "humus" (pronounced HUGH-muss). Explain that this top layer is the nutrient-rich part of the soil. Ask:

- What do you think makes this top layer good for growing plants? *(Answers will vary. Guide students to the understanding that as plants and animals decompose, they return to the soil many nutrients that are important to plants.)*

6. Point to the next layer on the diagram, and identify it as topsoil. Tell students that in some areas, topsoil may be the first layer. Explain that topsoil also contains a lot of nutrients, and it may include sand, silt, and clay.

7. Point out the last two layers on the diagram. Explain that these layers do not contain many nutrients and are composed of sediment and the rock types that made up the upper layers of soil. Save the class chart for use in Investigation C.

Literacy intergration

Literacy Tip

Read Literacy Article 4A: The Dirt on Soil as a class, or ask students to read it in small groups. The article provides a deeper look into the importance of soil.

? Draw a picture of the types of living things you think you might find if you dig a few inches down in soil.

Tell Me More!

Formative assessment

NOTES

Disciplinary Core Ideas
- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems

Science and Engineering Practice
- Constructing Explanations and Designing Solutions

Crosscutting Concept
- Cause and Effect
- Stability and Change

5Es
- Explore
- Explain

Literacy Component
- *Earth Materials* Literacy Reader, pgs. 7, 12–13

Digital Component
- **Interactive Whiteboard:** Comparing Sand and Soil

Teaching Tip

If you take students outside, look for evidence of wind and water erosion on the school grounds. If you're not going outside, show students pictures that show evidence of wind and water erosion on the school grounds.

Investigation B

WHAT CAN WE LEARN BY STUDYING SOIL?

MATERIALS

Student
- 1 Science notebook*
- 1 Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?*
- 1 Spoon

Team of two students
- 1 Fluted catch pan
- 2 Hand lenses
- 1 Jar (4 oz) of local soil
- 1 Plastic cup (2.5 oz) of sand
- 1 Plastic cup (2.5 oz) of water
- 2 Spoons

Class
- Outdoor location for collecting soil samples*

Teacher
- 1 Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?* (Teacher's Version)
- 12 Jars (4 oz)
- 24 Plastic cups with lids, 2.5 oz
- 1 Small shovel*
- 2 C Water*
- Assessment Observation Sheet: Lesson 4
- Chart paper or whiteboard*
- Local soil*
- Markers*
- Masking tape*
- Sand

*These materials are needed but not supplied.

1. Divide the class into teams of two students. If you are taking students outside to collect soil samples, discuss outdoor safety procedures with the class, and emphasize that students must stay within the collection zone that you have established. Give each pair of students a collection jar and a spoon. Instruct students to write their names on the masking tape on the jar. Go outside to collect samples. Bring your shovel along to loosen the soil in the collection area if you did not do so in advance.

If you have already collected a soil sample for each pair of students, pass out one sample to each pair.

2. Distribute one copy of Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?* to each student. Ask students to predict what they will observe when they look closely at their soil sample. Direct students to record their predictions in Part A of the investigation sheet.

3. Distribute a fluted catch pan, two hand lenses, a cup of sand, a cup of water, and two spoons to each pair of students. Instruct students to remove the lid from their jar of soil and to carefully empty the contents of the jar into the pan. Allow ample time for students to explore the soil with their hand lenses, and encourage them to use their spoons to separate the different types of materials they find in their soil.

4. Instruct students to draw what they observe about their schoolyard soil sample in Part B, Step 1, of Student Investigation Sheet 4B. Encourage them to draw and label all the materials they can observe in their soil sample.

5. Instruct pairs to take the lid off the cup of sand and to place one spoonful of sand onto the lid. Most students will recall the properties of sand from the previous lesson, but allow ample time for students to observe the sand with their hand lenses.

6. After ample time for student pairs to explore, gather the class together for a discussion. Display the class chart you prepared titled "Comparing Soil and Sand." Use the following questions to guide the discussion, and record students' ideas in the correct section of the Venn diagram:

- What are the properties of the soil sample that you observed? *(Accept all reasonable responses. Encourage students to use appropriate vocabulary as they explain their answers.)*
- Did what you observe match your prediction? *(Answers will vary.)*
- Do you think this soil is good for growing plants? *(Answers will vary depending the composition of your local soil.)*
- What are the properties of the sand that you observed? *(Accept all reasonable responses.)*
- What are some properties that soil and sand have in common? *(Students may suggest that both soil and sand are made of particles and have a specific texture, that both are materials that make up Earth or the land, or that both were formed by weathering and erosion.)*
- Why do you think soil may be better than sand for growing plants? *(Answers will vary. Students may suggest the soil has nutrients or that it can hold plants upright better than sand can.)*

Teaching Tip

If you need to teach this investigation over multiple sessions, a good stopping point is after Step 6. Students can compare wet and dry soil in the next class session.

ELA connection
SL.2.1, SL.2.3

7. Instruct students to carefully take the lid off the cup of water and place a spoonful of their soil sample on the lid. Direct them to use the spoon to pour a very small amount of water onto the soil on the cup lid, just until the soil is moist. Allow time for students to observe the wet soil with their hand lenses and make comparisons between the wet soil and the dry soil. Students should work together to record their observations in the chart in Part B, Step 2, of the investigation sheet. Encourage students to use their senses of smell and touch to observe the differences between the wet and dry soil. As pairs explore their soil samples, use the following questions to encourage them to analyze their soil:

- Use your hand lens to examine the wet soil. Are the shapes of the bits of soil all the same? Are the colors different from the dry soil?
- Sniff the soil. How does the smell change when the soil is wet? Is there more odor than with dry soil?
- Pick up some soil and squeeze it in your hand. What happens?

Teaching Tip

Have paper towels handy so students can clean their hands after they explore the wet and dry soil. Immediately wipe up any spilled water.

8. Ask students to study the diagram in Part C of Student Investigation Sheet 4B. Direct students to use their sense of touch to explore their soil sample again. As pairs explore their soil samples, use the following questions to encourage them to analyze their soil:

- Does it feel rough and gritty like sand?
- Does it feel smooth and powdery like silt?
- Is it wet? Does it stick together like clay?
- Does it have a variety of textures and appear to have humus, like loam?
- Is there one kind of texture in your sample, or many textures?

Connect to phenomena

Identify Phenomena

You may want to contact your local agricultural extension office to get details on the composition of your local soil to share with students.

9. Have students answer the questions in Part C of the investigation sheet, and then use students' responses to facilitate a class discussion about the textures of the soil in your area.

10. Direct students to dump the moist soil from the cup lids into the trash and to put the lids back on the cups. Collect all the materials. Save the spoons, hand lenses, sand, and fluted catch pans for reuse. Save the cups of sand for reuse in Lesson 6. If at all possible, return the soil you collected to the schoolyard.

Tell Me More!

A hotel is opening in an area that has lots of sand in the soil. They have asked you to help design the landscaping for the hotel. They want many types of plants and trees. What might you suggest they do so they can have the landscaping they want?

NOTES

Investigation C

HOW CAN WIND AND WATER AFFECT SOIL?

MATERIALS

■ **Student**
1 Science notebook*
1 Literacy and Science 4C: *Reducing Soil Erosion*
1 spoon

■ **Teacher**
1 Literacy and Science 4C: *Reducing Soil Erosion* (Teacher's Version)
Assessment Observation Sheet: Lesson 4
Chart paper or whiteboard*
Markers*
Sand
*These materials are needed but not supplied.

1. Review with students what they learned in the previous investigation using the following questions:

- How does soil form? *(Soil forms when rocks break down over time through weathering and are moved by erosion to combine with humus, air, and water.)*
- Based on what you observed in the schoolyard, what kind of soil do we have in our area? *(Answers will vary depending on where you live.)*
- Do you think our local soil is good for growing plants? *(Answers will vary depending on where you live. If students find it difficult to answer this question, prompt them to make the connection between successful plant growth and nutrient-rich soil.)*

2. Write the term "runoff" on a piece of chart paper or on the board, and ask students what they think the word means. Allow a few students to share their ideas, and then explain that runoff is a flow of water on land that can occur from melting ice, flooding, or precipitation. Ask:

- If runoff affects the topsoil, what might happen? *(Accept all reasonable answers. Guide students to the understanding that runoff will remove the nutrients that plants need to grow.)*
- If there is no topsoil, what might happen? (*Students may suggest that plants cannot grow or that it would be harder to grow plants without topsoil.)*
- How do you think a lack of topsoil might affect our food supply? *(Answers will vary. Students may suggest that plants won't be available to feed livestock like cows and chickens or that farmers couldn't grow for crops for people.)*

Disciplinary Core Ideas
- **ESS1.C:** History of the Planet
- **ESS2.A:** Earth Materials and Systems
- **ETS1.C:** Optimizing the Design Solution

Science and Engineering Practice
- Constructing Explanations and Designing Solutionsa

Crosscutting Concepts
- Cause and Effect
- Stability and Change

5Es
- Elaborate

Literacy Component
- *Earth Materials* Literacy Reader, pgs. 7, 12–13

Digital Component
- **Simulation:** Soil Erosion

Digital simulations to enrich concepts

Digital Tip

Use the Soil Erosion simulation to support students' understanding of the effects of erosion on topsoil.

3. Explain that soil erosion occurs naturally but that large-scale farming practices, such as the use of large tractors to plow the ground can destroy the root systems that hold the soil together. This makes the soil weak, and runoff can more easily wash it away. Since new soil forms very slowly, erosion can cause soil to be unusable for growing crops.

Identify Phenomena

Display some images of fields of staple crops, such as corn or wheat. Encourage students to think about what food items these plants are used for. To enhance the discussion, display images of soil erosion on farms.

4. Distribute a copy of Literacy and Science 4C: *Reducing Soil Erosion* to each student. Read the text aloud to the class. Instruct students to work with a partner to fill out the chart in Part B.

5. After some time for pairs to record their ideas in the chart on the investigation sheet, post the class chart titled "Soil Erosion." Invite students to share the problems and solutions they brainstormed with their partners, and record their ideas on the class chart.

Tell Me More!

You learned about how farms can be affected by soil erosion. In what other ways do you think soil erosion could be a problem?

Phenomenon

Review students' questions about the investigative phenomenon from the beginning of this lesson. Guide students in applying the concepts explored in this lesson and connecting them to the anchoring phenomenon: how natural materials such as water, minerals, rocks, and soil are important parts of Earth's surface. By the end of the lesson, students should be able to explain that:

- Soil is formed over time by weathering and erosion.
- Soil is composed of different types of materials.
- Farmers and scientists have found ways to reduce the effects of wind and water erosion on farmland.

Connecting ideas about phenomena to evidence

Connecting investigations to Environmental Principles and Concepts

ENVIRONMENTAL CONNECTION

This lesson exposed students to critical environmental principles and concepts. Natural systems change in ways that people benefit from and can influence, and how we depend on natural systems. Investigation A asked students to think about soil and how it is important to us. In Investigation C, students discussed how soil erosion can affect farmland and different types of land planning that can be used to reduce soil erosion.

Credit: NPeter/Shutterstock.com

EXTENSIONS

Soil Settling Jar

Have students continue to explore their local soil by creating a soil settling jar. Fill a large, clear jar about one-third of the way with your local soil. Fill the jar the rest of the way with water, and secure the lid. Allow the jar to sit undisturbed for 24 hours. The various components of soil will settle, or sink, at different rates and form layers based on the density, size, shape, and composition of the particles. Depending on the soil sample you collect for the settling jar, you can expect the components of your local soil to settle out in different ways. Allow students to stir the contents of the jar periodically and observe what happens so they reach the understanding that each type of material follows a pattern as it sinks to the bottom of the container. Have students record their observations in words and drawings in their science notebooks.

Which Grows Better?

Plant three pots of the same kinds of seeds (radish, beans, and peas are quick growers). Plant one in sand, one in pebbles, and one in soil. As a class, make predictions about which material will allow the plant to grow the tallest. Set up the pots side by side with the same amount of light. Make sure to water the pots with the same amount of water. Have students periodically estimate the height of the plants and measure them. Encourage students to make a graph showing the different heights of the plants as they grow.

Math connection 2.MD.A.1, 2.MD.A.3, 2.MD.D.10

Collecting Soil Creatures

Visit the schoolyard to explore things that live in and on the soil. Before exploring, read *Life in a Bucket of Soil* by Alvin and Virginia Silverstein aloud to the class. Point out the illustrations and visuals to students. After reading the book, ask students to predict what they will find in their buckets of soil.

Provide plenty of buckets and shovels for collecting. Once you get back to the classroom, place the buckets with soil on tables covered with newspaper. Allow plenty of time for the class to explore the soil they collected. They are likely to find earthworms and other creatures. If so, have them create a habitat in the classroom. Be sure to provide water. Let students make observations for several days, and then return all living things to where you found them.

Credit: Sarah Marchant/Shutterstock.com

ASSESSMENT STRATEGIES

1. Investigation A

- Use the class discussion to gauge students' understanding of how soil is formed and the different layers that make up soil.
- Use students' responses to the Tell Me More question to assess whether they understand that the top layer of soil is important for many living things.

2. Investigation B

- Review Student Investigation Sheet 4B: *What Can We Learn by Studying Soil?* to assess students' knowledge of the different components of their sample of soil. Make sure that students can identify differences between wet and dry soil samples and that they understand soil needs nutrients to be beneficial plant growth.
- Use students' responses to the Tell Me More question to see if they understand that sandy soil would need to be mixed with another type of soil that has nutrients if plants are to grow successfully. Students may suggest putting the plants and trees in pots.

3. Investigation C

- Use the class discussion and students' responses to the questions on Literacy and Science 4C: *Reducing Soil Erosion* to determine how well they understand how soil erosion can affect farmland and the solutions that can reduce the effects of soil erosion.
- Use students' responses to the Tell Me More question to gauge their understanding of other ways soil erosion can be a problem.

4. Refer to the Assessment Observation Sheet where you recorded observations during this lesson to formatively assess your class, and adjust instruction as needed.

5. Refer to the General Rubric in Appendix A to assess individual progress as needed.

PLANNING AHEAD

Preparing for Lesson 5

In Part A, each group of four students will need an ice cube. Have a few extra ice cubes on hand as well. Store the ice cubes in a small cooler until you need them. In Part B, each group of four students will need one 16- or 20-oz plastic bottle with a cap.

NOTES

Formative assessment

Name: _____ Date: _____

ELA connection RI.2.1, RI.2.3, RI.2.4

The Dirt on Soil

Soil is made of many layers. One part of soil is humus. It is made of dead plants and animals. It is also home to many kinds of living things. Earthworms, bacteria, and molds live in humus. Underneath humus is topsoil. Most plants grow in topsoil.

Sometimes gardeners add a layer of cow manure to the soil in their garden at the start of a growing season. Manure is animal waste. It has materials in it that plants need to grow. These materials are called nutrients. Plants need help to get nutrients from the soil. Tiny living things called bacteria help the plants. They break down waste and turn it into nutrients that plants can use. Plants change the nutrients in soil into new materials. Some of these materials are sugar. Some of them are fiber. Some of them are starch. These are things you eat.

We need bacteria and the other things that live in soil. Without them, the soil would run out of nutrients. Plants would not grow. There would be no food to eat.

Questions:

1. What lives in humus?

2. In which layer of soil do plants grow?

3. Why are bacteria in soil important?

Credit: kazoka/Shutterstock.com

Name: _____ Date: _____

ELA connection
W.2.8

A. Predict

When I look at my soil sample, I predict that I will see _____

_____

_____.

B. Observe and Record

1. Look closely at your sample of soil from the schoolyard. Use your hand lens to help you. Use your sense of touch to feel the textures.

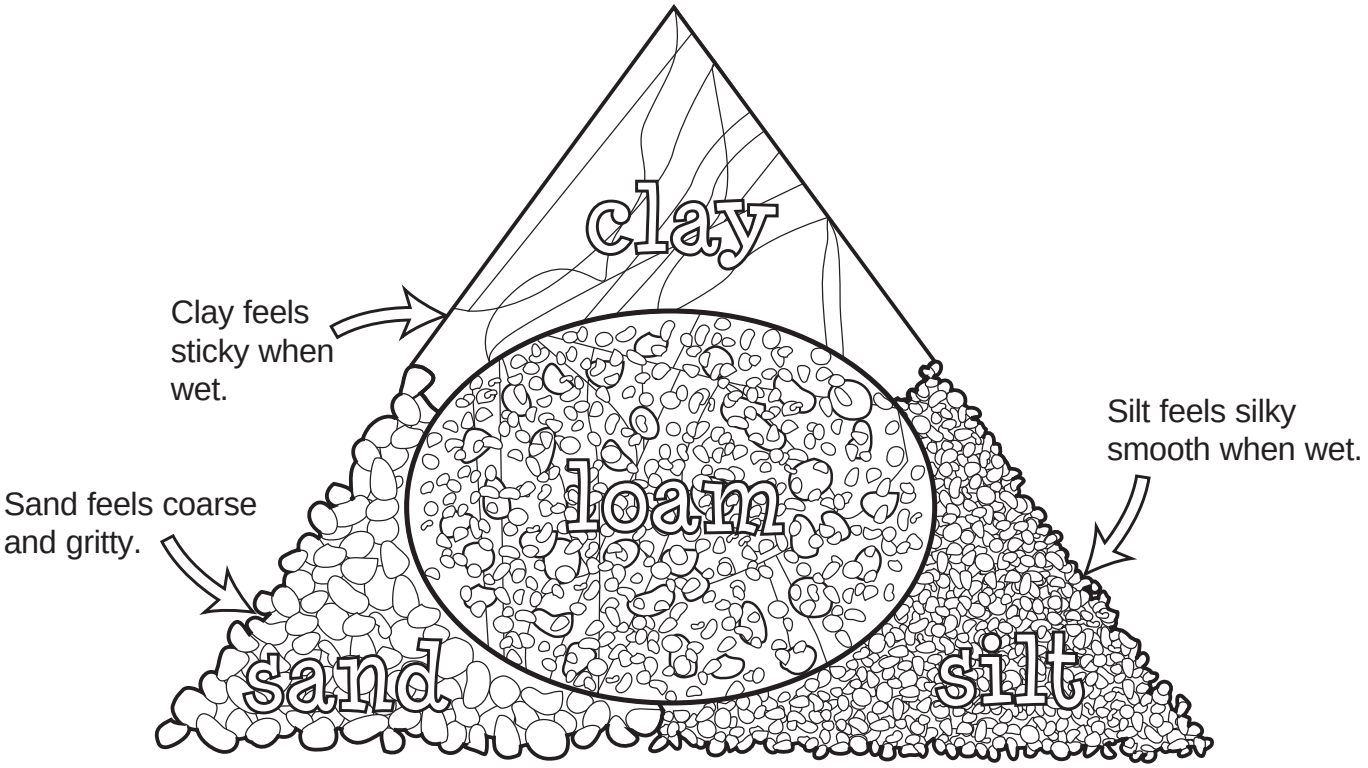
2. Draw what your schoolyard soil looks like. Draw as many textures as you can see.

3. Compare your wet and dry soil samples. Use your hand lens, your sense of touch, and your sense of smell. Draw what observe.

Wet	Dry

C. Analyze

1. Study the diagram below.



Loam is a combination of sand, silt and clay.

Credit: U.S. Department of Agriculture

2. Based on the soil diagram and what you observed, what materials are in your schoolyard soil sample?

I think that my schoolyard soil sample has the following materials: _____

I think this because

Literacy and Science 4C: Reducing Soil Erosion

ELA connection RI.2.4, RI.2.7, RI.2.8

Name: _____ Date: _____

A. Read

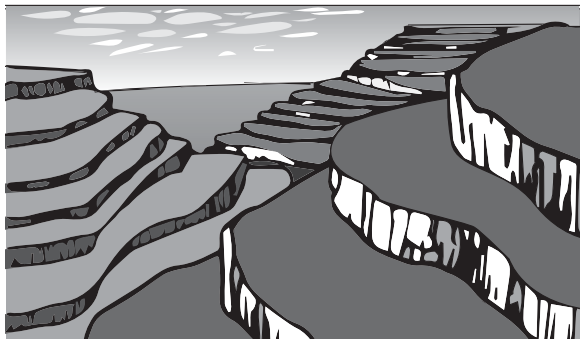
Read about how farmers are finding solutions to soil erosion. Then fill in the T-chart on the next page.

Contour Planting

The best way to control erosion is to make sure the soil is covered by vegetation. But when farmers grow crops, they clear the land and plant the crops in rows. Still, farmers have found a way to slow water erosion in their fields. Contour planting is when the crops are planted in rows that follow the shape of the land rather than rows that are straight up and down. Contour planting protects the crops from being washed away by water.

Terrace Farming

Water erosion can destroy topsoil so plants cannot grow. One solution farmers have to solve the problem of water erosion is to plant crops on a terrace. Terrace farming has been used by farmers around the world for centuries. Terraces, or steps, are built into the side of a large hill, and crops are planted on each level of the terrace. This slows the flow of water and prevents the water from rushing quickly down the hill and washing away the soil.



Wind Breaks

Wind erosion can cause freshly plowed soil to blow away. Farmers have found solutions to lessen the effects of soil erosion caused by wind. One solution is to grow trees along the edges of freshly plowed fields. The row of trees acts as a barrier, protecting the land from fast-blowing winds and slowing the effects of wind on the soil.

B. Compare

Problem	Solution

Assessment Observation Sheet

Lesson 4—Soil

Consider the following observations and talking points during student exploration activities, quiet conversations, and class discussions.

A. Can students describe that soil is made from rocks over long periods of time? Encourage students to use terms like "weathering" and "erosion" to describe soil.

B. Do students recognize which layers of soil contain the nutrients that are important for plant growth?

C. Do students make comparisons of the properties of their soil and sand? Can they make comparisons between wet and dry soil?

D. Talk informally about soil erosion on farmland. Can students describe solutions that prevent or slow erosion?

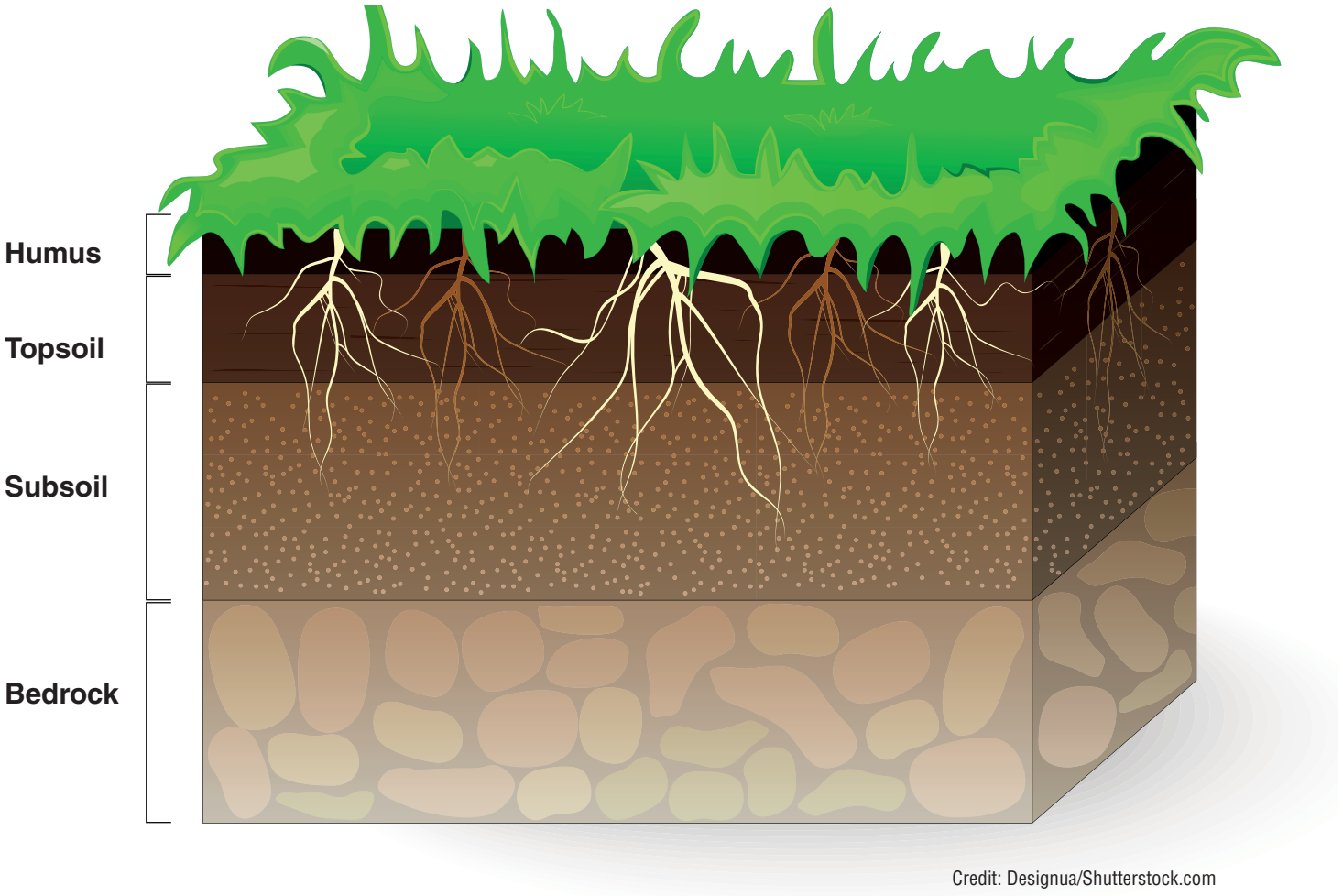
E. Additional considerations:

NOTES

Formative assessment—How are they progressing?

Teacher Sheet 4A

Soil Profile



Credit: Designua/Shutterstock.com

The Dirt on Soil

Soil is made of many layers. One part of soil is humus. It is made of dead plants and animals. It is also home to many kinds of living things. Earthworms, bacteria, and molds live in humus. Underneath humus is topsoil. Most plants grow in topsoil.

Sometimes gardeners add a layer of cow manure to the soil in their garden at the start of a growing season. Manure is animal waste. It has materials in it that plants need to grow. These materials are called nutrients. Plants need help to get nutrients from the soil. Tiny living things called bacteria help the plants. They break down waste and turn it into nutrients that plants can use. Plants change the nutrients in soil into new materials. Some of these materials are sugar. Some of them are fiber. Some of them are starch. These are things you eat.

We need bacteria and the other things that live in soil. Without them, the soil would run out of nutrients. Plants would not grow. There would be no food to eat.

Questions:

1. What lives in humus? *(Earthworms, bacteria, and molds live in humus.)*

2. In which layer of soil do plants grow? *(Plants grow in topsoil.)*

3. Why are bacteria in soil important? *(Bacteria break down wastes. This adds nutrients to soil. Without nutrients, plants cannot grow.)*

Credit: kazoka/Shutterstock.com

What Can We Learn by Studying Soil?

A. Predict

When I look at my soil sample, I predict that I will see _____. *(Students' predictions will vary.)*

B. Observe and Record

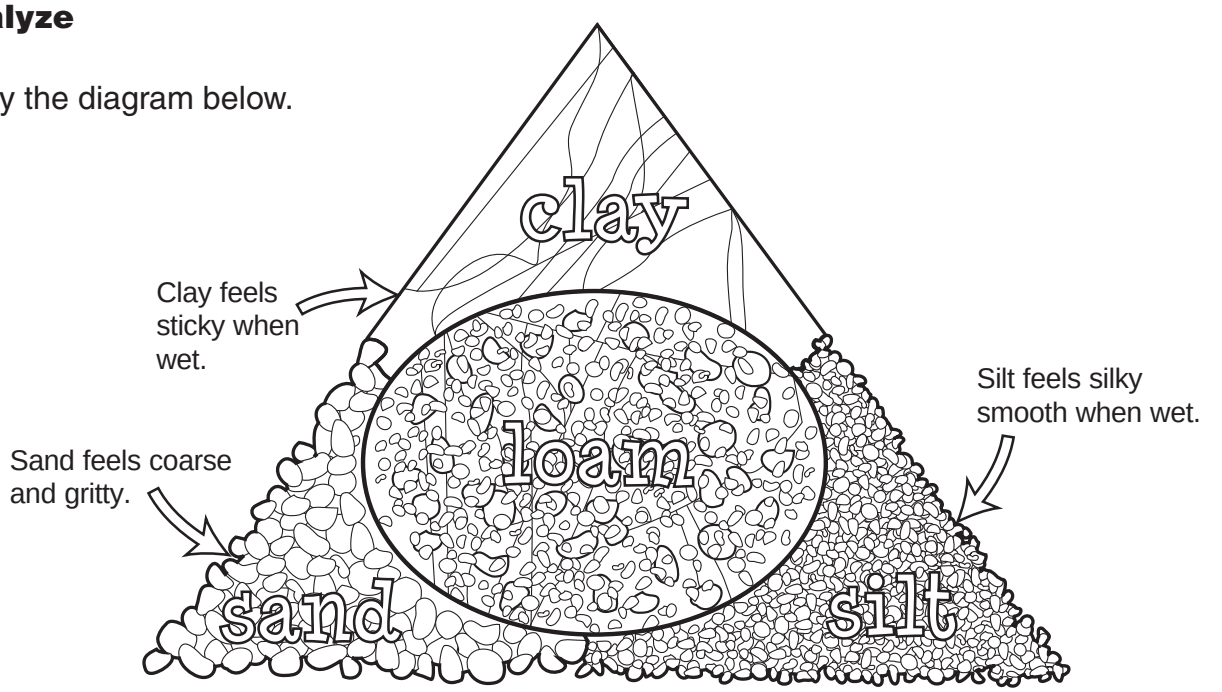
1. Look closely at your sample of soil from the schoolyard. Use your hand lens to help you. Use your sense of touch to feel the textures.

2. Draw what your schoolyard soil looks like. Draw as many textures as you can see. *(Students' drawings will vary.)*

3. Compare your wet and dry soil samples. Use your hand lens, your sense of touch, and your sense of smell. Draw what observe. *(Students' drawings will vary.)*

C. Analyze

1. Study the diagram below.



Loam is a combination of sand, silt and clay.

2. Based on the soil diagram and what you observed, what materials do you think are in your schoolyard soil sample?

I think that my schoolyard soil sample has the following materials:

I think this because_____ *(Specific components of the soil samples will vary, but students should use information from the diagram in their responses. Students should accurately describe their soil samples and use information from the diagram to support their identification of the sample's individual components.)*

Reducing Soil Erosion

A. Read

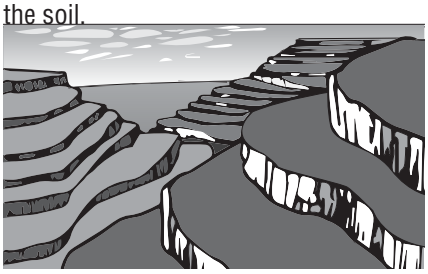
Read about how farmers are finding solutions to soil erosion. Then fill in the T-chart on the next page.

Contour Planting

The best way to control erosion is to make sure the soil is covered by vegetation. But when farmers grow crops, they clear the land and plant the crops in rows. Still, farmers have found a way to slow water erosion in their fields. Contour planting is when the crops are planted in rows that follow the shape of the land rather than rows that are straight up and down. Contour planting protects the crops from being washed away by water.

Terrace Farming

Water erosion can destroy topsoil so plants cannot grow. One solution farmers have to solve the problem of water erosion is to plant crops on a terrace. Terrace farming has been used by farmers around the world for centuries. Terraces, or steps, are built into the side of a large hill, and crops are planted on each level of the terrace. This slows the flow of water and prevents the water from rushing quickly down the hill and washing away the soil.



Wind Breaks

Wind erosion can cause freshly plowed soil to blow away. Farmers have found solutions to lessen the effects of soil erosion caused by wind. One solution is to grow trees along the edges of freshly plowed fields. The row of trees acts as a barrier, protecting the land from fast-blowing winds and slowing the effects of wind on the soil.

B. Compare

(Students should suggest solutions from the topics covered in the text in Part A. Students may give additional solutions such as barriers, walls, or not clearing land for farming.)

Summative Assessment

What have they learned?

Name: _____ Date: _____

1. Rain is an example of:

   a. Condensation

   b. Precipitation

   c. Evaporation

2. Terry is making a model that compares the amount of water on Earth to the amount of land on Earth. Describe what his model should show. _____

_____

_____

3. Where on Earth can you find water in solid form? Circle all that apply.

   a. Flowing rivers

   b. Glaciers

   c. Warm oceans

   d. Icebergs

Building Blocks of Science Student Literacy

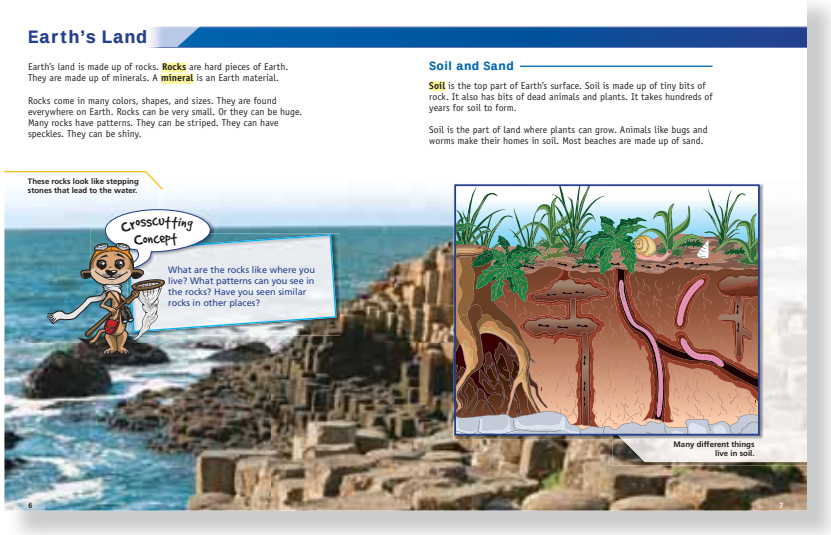
Build students' literacy skills with literacy components found within lessons and Literacy Readers.

Building Blocks of Science Literacy Components can be used to:

- Introduce a new lesson
- Support an investigation
- Incorporate science connections into your language arts sessions
- Differentiate instruction
- Review previously learned concepts

Literacy Readers—on-level and below-level readers in **English and Spanish** and available in **print or digital format**—provide informational text that:

- Incorporates English language arts and literacy standards
- Uses supporting text with graphs, vocabulary, charts, data, illustrations, and photographs to address **science concepts** related to lessons
- Provides opportunities to practice skills such as analysis and reasoning, and communication of ideas through **crosscutting concept** questions
- Challenges students to exercise and apply knowledge to a **science and engineering practice** activity
- Features a career that provides real-world insight into related science content



What else to look for?

Literacy Articles—These encourage students to elaborate upon unit topics, discuss real-world applications and phenomena, and ask students to connect this to concepts in the unit. Corresponding questions ask students to access high-level thinking and draw upon previous knowledge. (See page 34 of this sampler for an example.)

Science in the News Article Report—Students analyze a content-relevant reading or current event article, developing literacy skills as students identify important information, apply vocabulary, and draw connections to science content.

Building Blocks of Science®

Earth Materials

Student literacy–available in digital and print

Weathering

Wind, water, and ice change the shape of rocks. They slowly break down rock. They wear the rock away. The breaking apart of rocks is called **weathering**.

ELA connection L.2.4

Water in rivers flows over rocks day after day. The water wears away the rocks. It makes the rocks smooth.

Wind picks up sand. It blows the sand into rocks. The wind wears down the rocks by rubbing them with sand.

Ice can change rocks, too. Water gets into cracks in rocks and then freezes to form ice. The ice pushes the crack wider, and the rocks break apart.

Weathering from wind shaped this rock.

Erosion

Erosion is caused by water, wind, and ice breaking and moving rocks and soil. Flowing water breaks off pieces of rock and moves them. It moves bits of dirt and sand, too. Rivers move rocks and sand to the ocean.

Wind also causes erosion. Wind picks up small rocks and dirt. The wind blows them to another place.

Glaciers move rocks and soil, too. As the ice moves, it carries rocks and soil with it.

Erosion can happen quickly or slowly. Water from a heavy rainfall can carve a gully in a field in minutes. Glaciers erode the land over hundreds of years.

Erosion and weathering are similar. Both change the shape of the land by breaking off pieces of rock due to wind, water, or ice. In erosion, the broken rocks are carried away to another place. In weathering, the broken rocks continue to be broken into smaller pieces.

Water has eroded this beach.

Careers

Science in the world

Geologist

Geologists study Earth. They study rocks and minerals. They gather facts about landforms. Geologists learn about the forces that shape Earth.

Would I like this career?	You might like this career if • you like to study nature. • you like to be outdoors.
What would I do?	• You would study how rocks are formed. • You would study landforms.
How can I prepare for this career?	• Study science and math. • Develop skills in gathering facts.

Profesiones

Spanish literacy—available in digital and print

Geólogo

Los geólogos estudian la Tierra. Estudian rocas y minerales. Recopilan datos sobre los accidentes geográficos. Los geólogos estudian las fuerzas que forman la Tierra.

¿Me gustaría esta profesión?	Te gustaría esta profesión si • te gusta estudiar la naturaleza. • te gusta pasar tiempo al aire libre.
¿Qué tendría que hacer?	• Estudiarías cómo se forman las rocas. • Estudiarías los accidentes geográficos.
¿Cómo puedo prepararme para esta profesión?	• Estudia ciencias y matemáticas. • Aprende a recopilar datos.

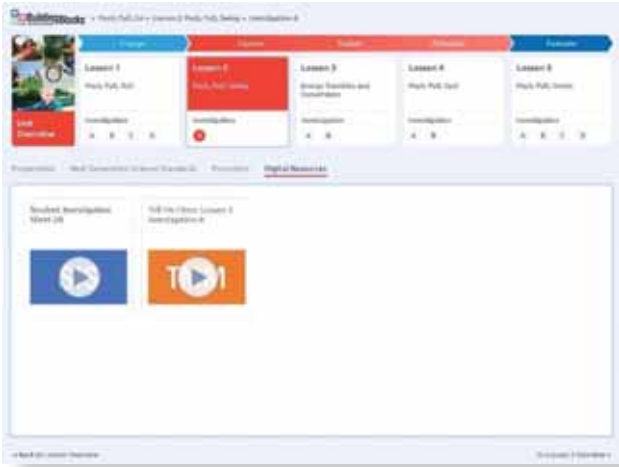
The Right Blend of Hands-On Investigation and Technology

Along with hands-on learning, Building Blocks of Science provides digital resources to enhance the classroom experience, offering an additional method of delivering content and support for teachers.

Support for Teachers

Everything you need to teach the lesson

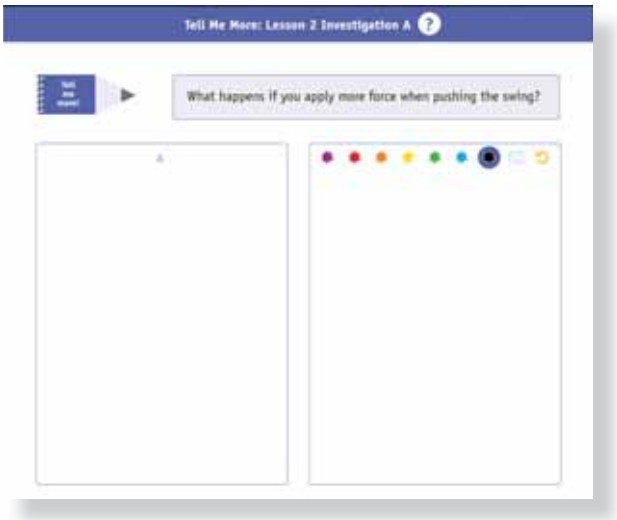
- Identification of where a lesson falls within the **5E Learning Cycle**
- **Preparation**—Includes investigation overview, materials list, and step-by-step teacher preparation instructions
- **NGSS Standards**—Includes the PEs, DCIs, SEPs, and CCCs that will be addressed within the investigation
- **Lesson Procedure**—step-by-step instruction for each investigation within a lesson
- **Digital Resources**—all the digital resources available in one place, by lesson and by individual investigations within each lesson



Digital resources by lesson

Everything you need to teach ALL your students

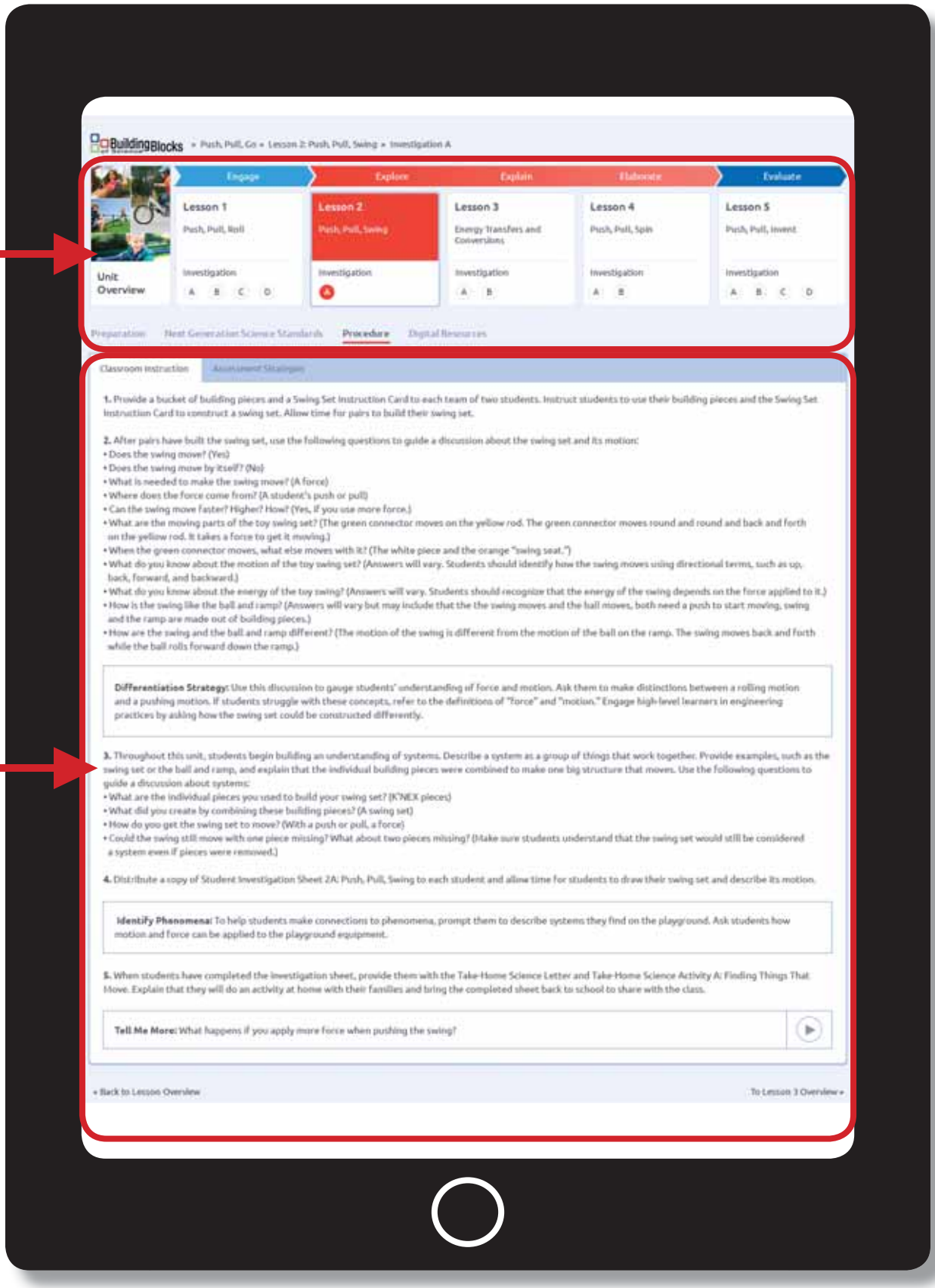
- Step-by-step instruction including guiding questions and anticipated responses
- Differentiation strategies at point of use within each investigation
- **Identify Phenomena** provides teachers with prompts to help students make connections to phenomena addressed within an investigation
- Assessment Strategies including **Tell Me More** formative assessment to help gauge student understanding



Tell Me More, a formative assessment strategy

For a closer look, visit:

www.carolina.com/bbs3dreview


BuildingBlocks
Push, Pull, Go » Lesson 2: Push, Pull, Swing » Investigation A
Engage
Explore
Explain
Elaborate
Evaluate
Lesson 1
Push, Pull, Roll
Lesson 2
Push, Pull, Swing
Lesson 3
Energy Transfers and Conversions
Lesson 4
Push, Pull, Spin
Lesson 5
Push, Pull, Invent
Unit Overview
Investigation
Preparation
Next Generation Science Standards
Procedure
Digital Resources
Classroom Instruction
1. Provide a bucket of building pieces and a Swing Set Instruction Card to each team of two students. Instruct students to use their building pieces and the Swing Set Instruction Card to construct a swing set. Allow time for pairs to build their swing set.
2. After pairs have built the swing set, use the following questions to guide a discussion about the swing set and its motion:
• Does the swing move? (Yes)
• Does the swing move by itself? (No)
• What is needed to make the swing move? (A force)
• Where does the force come from? (A student's push or pull)
• Can the swing move faster? Higher? How? (Yes, if you use more force.)
• What are the moving parts of the toy swing set? (The green connector moves on the yellow rod. The green connector moves round and round and back and forth on the yellow rod. It takes a force to get it moving.)
• When the green connector moves, what else moves with it? (The white piece and the orange "swing seat.")
• What do you know about the motion of the toy swing set? (Answers will vary. Students should identify how the swing moves using directional terms, such as up, back, forward, and backward.)
• What do you know about the energy of the toy swing? (Answers will vary. Students should recognize that the energy of the swing depends on the force applied to it.)
• How is the swing like the ball and ramp? (Answers will vary but may include that the the swing moves and the ball moves, both need a push to start moving, swing and the ramp are made out of building pieces.)
• How are the swing and the ball and ramp different? (The motion of the swing is different from the motion of the ball on the ramp. The swing moves back and forth while the ball rolls forward down the ramp.)
Differentiation Strategy: Use this discussion to gauge students' understanding of force and motion. Ask them to make distinctions between a rolling motion and a pushing motion. If students struggle with these concepts, refer to the definitions of "force" and "motion." Engage high-level learners in engineering practices by asking how the swing set could be constructed differently.
3. Throughout this unit, students begin building an understanding of systems. Describe a system as a group of things that work together. Provide examples, such as the swing set or the ball and ramp, and explain that the individual building pieces were combined to make one big structure that moves. Use the following questions to guide a discussion about systems:
• What are the individual pieces you used to build your swing set? (K'NEX pieces)
• What did you create by combining these building pieces? (A swing set)
• How do you get the swing set to move? (With a push or pull, a force)
• Could the swing still move with one piece missing? What about two pieces missing? (Make sure students understand that the swing set would still be considered a system even if pieces were removed.)
4. Distribute a copy of Student Investigation Sheet 2A: Push, Pull, Swing to each student and allow time for students to draw their swing set and describe its motion.
Identify Phenomena: To help students make connections to phenomena, prompt them to describe systems they find on the playground. Ask students how motion and force can be applied to the playground equipment.
5. When students have completed the investigation sheet, provide them with the Take-Home Science Letter and Take-Home Science Activity A: Finding Things That Move. Explain that they will do an activity at home with their families and bring the completed sheet back to school to share with the class.
Tell Me More: What happens if you apply more force when pushing the swing?
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To Lesson 3 Overview »

Digital Components to Support Instruction and Assessment

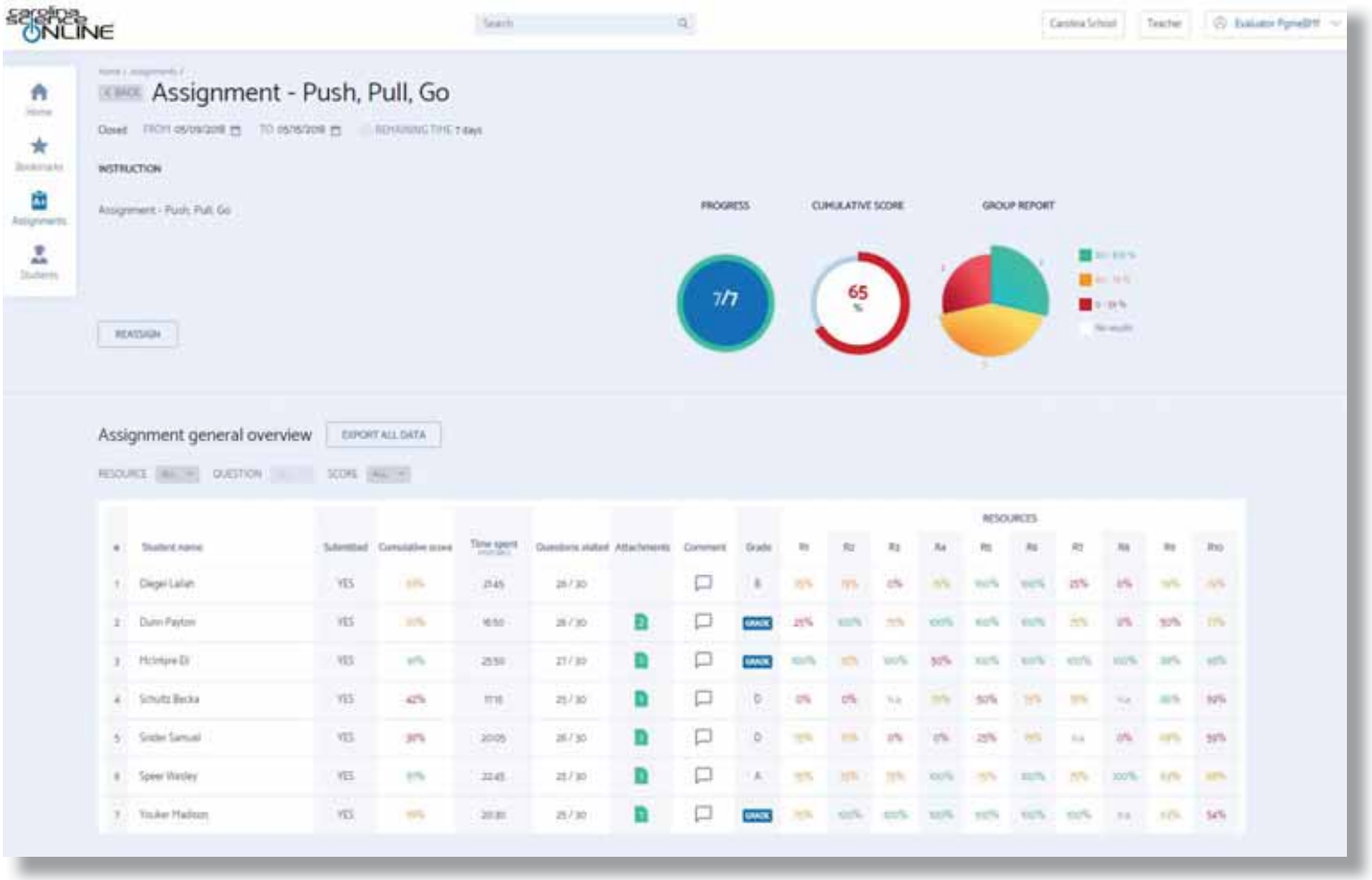
For the Teacher–Customizable Digital Planning at Your Fingertips

Building Blocks of Science 3D goes beyond just providing you access to your content. You can also:

- Use the assignment management system to create and grade custom assignments for classes and individual students to help differentiate instruction
- Create customizable bookmarks that include your student and instruction resources as well as URL links, PDF files, PowerPoint® presentations, and video files

The Assignment management system dashboard allows you to:

- Track the progress of your classes and individual students
- See student assignment results for the class at a glance and by individual student in detail
- Automatically grade close-ended questions (e.g., multiple choice, matching, fill-in-the-blank)
- Adjust student grades based on individual student performance and open-ended responses
- Assign remediation to student groups that need additional support or enrichment to groups that need a challenge



Digital components for students enhance and deepen student understanding, differentiate learning, and provide multiple modalities for delivering information.

"Digital Tips" take the guesswork out of integrating the following digital resources with hands-on investigations:

Simulations: Flexible enough to be used to introduce, support, or review a topic or concepts. Simulations are manipulative and provide a visual for differentiation.

Interactive Whiteboard Activities: With typing and drawing capabilities, IWB activities bring investigation-aligned classroom charts to life and are perfect for individual student review.

Student Investigation Sheets:
Students record their observations and data digitally when completing investigations.

Interactive Literacy Readers:
These enhanced versions of the printed student readers include check-for-understanding questions and animations to support the concepts covered in the text, enforce literacy skills, and provide additional practice.

Building Blocks OF SCIENCE™ | 3D

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Learning Framework

Kindergarten	**Push, Pull, Go** *K-PS2-1; K-PS2-2; K-2-ETS1-1;K-2-ETS1-2*	**Living Things and Their Needs** *K-LS1-1; K-ESS2-2;K-ESS3-1;K-ESS3-3; K-2-ETS1-2*	**Weather and Sky** *K-PS3-1;K-PS3-2;K-ESS2-1; K-ESS3-2; K-2-ETS1-1; K-2-ETS1-2*
1st Grade	**Light and Sound Waves** *1-PS4-1; 1-PS4-2; 1-PS4-3; 1-PS4-4; K-2-ETS1-1; K-2-ETS1-2*	**Exploring Organisms** *1-LS1-1; 1-LS1-2; 1-LS3-1; K-2-ETS1-2*	**Sky Watchers** *1-ESS1-1; 1-ESS1-2*
2nd Grade	**Matter** *2-PS1-1; 2-PS1-2; 2-PS1-3; 2-PS1-4; K-2-ETS1-1; K-2-ETS1-2*	**Ecosystem Diversity** *2-LS2-1; 2-LS2-2; 2-LS4-1; K-2-ETS1-2; K-2-ETS1-3*	**Earth Materials** *2-PS1-1; 2-ESS1-1; 2-ESS2-1; 2-ESS2-2; 2-ESS2-3; K-2-ETS1-1; K-2-ETS1-2*
3rd Grade	**Forces and Interactions** *3-PS2-1; 3-PS2-2; 3-PS2-3; 3-PS2-4; 3-5-ETS1-1; 3-5 ETS1-2*	**Life in Ecosystems** *3-LS1-1; 3-LS2-1; 3-LS3-1; 3-LS3-2; 3-LS4-1; 3-LS4-2; 3-LS4-3; 3-LS4-4; 3-5-ETS1-2*	**Weather and Climate Patterns** *3-ESS2-1; 3-ESS2-2;3-ESS3-1; 3-5-ETS1-2*
4th Grade	**Energy Works** *4-PS3-1; 4-PS3-2; 4-PS3-3; 4-PS3-4; 4-PS4-1; 4-PS4-3; 4-ESS3-1; 3-5 ETS1-2; 3-5-ETS1-3*	**Plant and Animal Structures** *4-LS1-1; 4-LS1-2; 4-PS4-2; 3-5-ETS1-2*	**Changing Earth** *4-ESS1-1; 4-ESS2-1; 4-ESS2-2; 4-ESS3-2; 3-5-ETS1-2*
5th Grade	**Structure and Properties of Matter** *5-PS1-1; 5-PS1-2; 5-PS1-3; 5-PS1-4; 3-5-ETS1-2*	**Matter and Energy in Ecosystems** *5-PS3-1; 5-LS1-1; 5-LS2-1; 5-ESS2-1; 5-ESS3-1; 3-5-ETS1-3*	**Earth and Space Systems** *5-PS2-1; 5-ESS1-1; 5-ESS1-2; 5-ESS2-1; 5-ESS2-2; 5-ESS3-1; 3-5-ETS1-2*

Phenomenon-based investigations with digital support in 30-minute lessons!

For more information, visit www.carolina.com/bbs