

Exploring Land and Water



Teacher Guide



hot springs



volcanoes

mountains and valleys carved by glaciers



Exploring Land and Water

Teacher Guide



Core Knowledge®

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Exploring Land and Water Teacher Guide

Core Knowledge Science™ 2

UNIT 3

Introduction

ABOUT THIS UNIT

The Big Idea

This unit focuses on the landforms and water features that change over time.

America's national parks are a treasure-trove of significant landforms with opportunities to explore the effects of wind and water on land. By touring six of the natural areas (Mount Rushmore National Memorial, Glacier National Park, Yellowstone National Park, Arches National Park, Yosemite National Park, and Cape Cod National Seashore), students explore different types of landforms, including mountains, hills, sand dunes, geysers, volcanoes, and arches, and how they are changed quickly and over long periods of time by wind and water. Students learn about different bodies of water, such as glaciers, streams, rivers, lakes, and oceans. Students investigate how wind and water affect rock erosion over years and years and see how quickly wind and water can change landforms through mudslides, flooding, and shifting sands.

A key concept underlying the unit is that landforms can undergo both quick changes and those that occur over long periods of time. These processes give students a foundation in Earth's geography and geology, which will be developed in later grades as they explore plate tectonics and learn more about Earth processes.

In this unit, observation of the phenomena allows students to explore different landforms and to gather evidence of how Earth events change landforms. The unit builds on student understandings about changing environments and weather patterns from the Kindergarten Performance Expectation K-ESS2-2, in which students explore how plants and animals change the environment. The unit also develops new understanding of Performance Expectation K-PS3-1, in which they learn about weather patterns and the effects of wind and water on land.

Students explore concepts that include the following:

- Hills, mountains, valleys, rock arches, plains, geysers, volcanoes, sand dunes, and beaches are types of landforms.
- Landforms can be created quickly or slowly.
- Quick changes to landforms include rockslides, landslides, mudslides, floods, earthquakes, and volcanic eruptions.
- Wind and water can erode rock, sand dunes, and beaches.

- There are different solutions to prevent water from changing the shape of rock and to prevent sand erosion.
- Glaciers are frozen forms of water.
- Flowing water moves earth materials.
- Maps are used to help locate things in nature.
- The land and water features of an area can be modeled.
- Water soaks into the ground.
- Geysers and volcanoes bring underground materials to Earth's surface.
- Sand landforms include dunes and beaches.
- Sand dunes and beaches are formed in different ways.

Scientists, including geologists and geographers, observe, analyze, and study Earth processes and changing landforms to describe patterns in the natural world in order to answer scientific questions. This series of lessons incorporates learning goals that support scientific principles and practices, such as analyzing and interpreting data, recognizing cause and effect, and planning and carrying out investigations.

Note to Teachers and Curriculum Planners

This unit introduces Grade 2 students to the causes and effects of changes to landforms. Students will tour six different national parks to explore distinctive landforms and how they are affected by wind and water: Mount Rushmore National Memorial's rock face; Glacier National Park's glaciers, lakes, and streams; Arches National Park's wind erosion; Yellowstone National Park's geysers and volcanoes; Yosemite National Park's rock, land, and mudslides; and Cape Cod National Seashore's sand dunes. The following are preliminary considerations for planning and instruction relative to this unit:

- While the unit engages Grade 2 students in investigating how landforms are created, students are not required to calculate the time scales over which these landforms develop or change. Students only need to know that some changes happen more quickly or slowly than others.

Students will investigate landforms and bodies of water in greater depth in Grade 5.

Note to Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, students benefit not just from reading about concepts and ideas, but from hands-on experiences. Following the release of the Next Generation Science Standards (NGSS), the Core Knowledge Foundation used this opportunity to update and enhance the science portion of the *Core Knowledge Sequence*.

While there have been some shifts in the grade levels at which certain topics are recommended, the fundamental principles of pedagogy inherent to the Core Knowledge approach, such as the importance of building a sequential, coherent, and cumulative knowledge base, have been retained.

Online Resources



To learn more about the changes and to access resources for this unit, please use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit embodies Core Knowledge’s vision of best practices in science instruction and knowledge-based schooling, such as the following:

- building students’ knowledge of core ideas in life, physical, and Earth sciences, as well as engineering design
- developing scientific practices that give students firsthand experience in scientific inquiry, engineering, and technology
- connecting scientific learning to concepts across various disciplines, such as mathematics and literacy

What are the relevant NGSS Performance Expectations for this unit?*

This unit, *Exploring Land and Water*, has been informed by the following Grade 2 Performance Expectations for the NGSS topic *Earth’s Place in the Universe*. Students who demonstrate understanding can do the following:

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.

Online Resources



For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

*NEXT GENERATION SCIENCE STANDARDS (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and their endorsement is not implied.

Sources:

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

National Research Council. 2012. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K–12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

What Students Should Already Know

The concept of progressions, articulated in the National Research Council's *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, is very much aligned to the Core Knowledge principle of building new knowledge on prior knowledge. According to the NRC, students build “progressively more sophisticated explanations of natural phenomena” over the course of many years of schooling. “Because learning progressions extend over multiple years, they can prompt educators to consider how topics are presented at each grade level so that they build on prior understanding and can support increasingly sophisticated learning.” In schools following NGSS recommendations, teachers can build on the “prior understandings” captured in the following summaries of NGSS Disciplinary Core Ideas:

ESS2.D: Weather and Climate

- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

ESS2.E: Biogeology

- Plants and animals can change their environment.

ESS3.C: Human Impacts on Earth Systems

- Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

ETS1.C: Optimizing the Design Solution

- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

What Students Need to Learn

For this unit, the Core Knowledge Science Sequence specifies the following content and skills. Specific learning objectives are provided in each lesson segment throughout the unit. NGSS References, including Performance Expectations, Disciplinary Core Ideas, and Crosscutting Concepts, are included at the start of each lesson segment as appropriate.

Lesson 1. Land, Water, and Changes: Examples from Mount Rushmore SEGMENTS 1–4

- Identify hills and mountains as landforms.
- Describe how water can change rock.
- Explain solutions to prevent water from changing the shape of rock.

Lesson 2. Land, Water, and Changes: Examples in Glacier National Park SEGMENTS 1–6

- Identify valleys as landforms.
- Identify glaciers as frozen forms of water.
- Describe how water flows and moves earth materials.
- Interpret maps.
- Model the land and water features of an area.

Lesson 3. Land, Water, and Changes: Examples in Yellowstone National Park SEGMENTS 1–4

- Describe plains, geysers, and volcanoes.
- Identify how water soaks into the ground.
- Describe how geysers and volcanoes work.
- Talk about how earthquakes can change the land.

Lesson 4. Land, Water, and Changes: Examples in Yosemite National Park

SEGMENTS 1–3

- Describe landslides.
- Identify how long it takes for landforms to be created.
- Describe how mass land movements can occur suddenly and make quick changes to the landscape.

Lesson 5. Land, Water, and Changes: Examples in Arches National Park

SEGMENTS 1–2

- Describe rock arches.
- Identify how long it takes for rock arches to form.
- Describe how rock arches can fall and collapse suddenly.

Lesson 6. Land, Water, and Changes: Examples at Cape Cod National Seashore

SEGMENTS 1–4

- Describe sand landforms, such as dunes and beaches.
- Explain how sand dunes and beaches are formed.
- Describe how erosion from wind and water can change dunes and beaches.
- Identify solutions to prevent sand erosion from wind and water.

What Teachers Need to Know

Supportive information on the content standards and the science they address is provided throughout the lessons at points of relevance:

Know the Standards: These sections, found later in this Teacher Guide, explain what to teach and why, with reference to NGSS and Core Knowledge expectations, as well as connections to relevant math and reading language arts standards.

Know the Science: These sections provide supporting, adult-level, background information or explanations related to specific science concepts, examples, or Disciplinary Core Ideas.

USING THE STUDENT BOOK

Student Book



The *Exploring Land and Water* Student Book includes eleven chapters, intended to be read aloud by the teacher as the students look at images on each page.

As you will note when you examine the Student Book, minimal text is included on each page. Instead, colorful photos and engaging illustrations dominate the Student Book pages. The design of the Student Book in this way is intentional because

students in Kindergarten through Grade 2 are just learning to read. At these grade levels, students are learning how to decode written words, so the complexity and amount of text that these young students can actually read is quite limited.

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

The intent of the Grades K–2 CKSci lessons is to build students’ understanding and knowledge of science concepts, as well as of associated practices and skills. It is for this very reason that in Grades K–2 CKSci, the core content of each lesson is reinforced to students using a teacher Read Aloud, accompanied by example images and diagrams. Cognitive science research has clearly documented the fact that students’ listening comprehension far surpasses their reading comprehension well into the late elementary and early middle school grades. Said another way, students are able to understand and grasp far more complex ideas and text that they hear read aloud than they would ever be able to read or comprehend when they read to themselves.

For a more thorough discussion of listening and reading comprehension and the underlying cognitive science research, teachers may want to refer to Appendix A of the Common Core State Standards for English Language Arts, noting in particular the Speaking and Listening section of the appendix.

Use this link to download the CKSci Online Resources for this unit, where the specific link to this appendix can be found:

www.coreknowledge.org/cksci-online-resources

USING THE TEACHER GUIDE

Pacing

To meet NGSS Performance Expectations we encourage teachers to complete all Grade 2 CKSci units during the school year. To be sure all NGSS standards and dimensions are addressed, each Core Lesson segment should be completed. Each lesson segment requires thirty to forty-five minutes of instruction time. The time it takes to complete a full lesson depends on class size and individual circumstances.

Within the Teacher Guide, each Core Lesson is composed of multiple numbered segments, generally four to six. Each segment concludes with a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this unit Introduction, you will find a blank Pacing Guide on pages 18–19, which you may use to plan how you might pace the lessons. We strongly recommend that you preview the unit in full before beginning and create your pacing guide before teaching the first lesson segment. As a general rule, we recommend that you spend a minimum of twenty-seven days and a maximum of forty-one days teaching the *Exploring Land and Water* unit so that you have time to teach the other units in the Grade 2 CKSci series.

The Core Lessons

- Lesson time: Most Core Lesson segments constitute one classroom session of thirty to forty-five minutes. However, some segments cover two or three days of instruction, and some single-day activities and performance tasks will require setting aside a longer block of time.
- Lesson order: The lesson segments are coherently sequenced to build from one to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

Unit Opener: Introduction to the Unit Phenomenon and Problem	Unit Opener: Exploring Land and Water (same day as Lesson 1.1)	Big Question: How can things that happen on Earth change the land?
Lesson 1: Land, Water, and Changes: Examples from Mount Rushmore (2-ESS1-1, 2-ESS2-1, 2-ESS2-3)	1.1 What Are Hills and Mountains? (same day as Unit Opener)	Lesson 1 Guiding Question: What can change rock? 1.1 What is unusual about Mount Rushmore?
	1.2 What Are Weathering and Erosion?	1.2 How can ice change rock?
	1.3 Weathering and Erosion Problems	1.3 Why would a carved stone monument need protection?
	1.4 What Keeps the Water Out?	1.4 How can people prevent ice from cracking rock?
Lesson 2: Land, Water, and Changes: Examples in Glacier National Park (2-ESS1-1, 2-ESS2-1, 2-ESS2-3)	2.1 What Are Glaciers and Valleys?	Lesson 2 Guiding Question: How can water change land? 2.1 What kinds of land and water occur in Glacier National Park?
	2.2 Let's Map It!	2.2 How do maps show different types of land and water?
	2.3 How Does Water Flow?	2.3 How does water move and collect on land?
	2.4 What Does Water Move?	2.4 How can water and ice move dirt, sand, and rocks?
	2.5 Where Can We Find Water?	2.5 How are glaciers, mountain streams, and lakes related?
	2.6 Modeling Land and Water Features	2.6 How can we model a place's land and water?

Lesson 3: Land, Water, and Changes: Examples in Yellowstone National Park (2-ESS1-1, 2-ESS2-1, 2-ESS2-3)	3.1 What Is Yellowstone National Park?	Lesson 3 Guiding Question: How can volcanoes change land? 3.1 How is Yellowstone National Park different from Glacier National Park?
	3.2 Geysers and Groundwater (two class sessions)	3.2 What happens to water that soaks into the ground?
	3.3 What Are Volcanoes?	3.3 What are volcanoes?
	3.4 Modeling Volcanoes and Earthquakes	3.4 How can we model volcanoes and earthquakes?
Lesson 4: Land, Water, and Changes: Examples in Yosemite National Park (2-ESS1-1, 2-ESS2-1)	4.1 What Is Yosemite National Park?	Lesson 4 Guiding Question: How can land move quickly? 4.1 How has land in Yosemite National Park changed slowly and quickly?
	4.2 What Is a Landslide?	4.2 What is a landslide?
	4.3 Preventing Landslides	4.3 How can people prevent landslides?
Lesson 5: Land, Water, and Changes: Examples in Arches National Park (2-ESS1-1)	5.1 What Is Arches National Park?	Lesson 5 Guiding Question: How do rock arches form and change? 5.1 How do rock formations in Arches National Park change slowly and quickly?
	5.2 How Can Sandstone Be Shaped?	5.2 How can wind and water shape sandstone?
Lesson 6: Land, Water, and Changes: Examples at Cape Cod National Seashore (2-ESS1-1, 2-ESS2-1)	6.1 What Is Cape Cod National Seashore?	Lesson 6 Guiding Question: How can wind and water affect sand and sand formations? 6.1 How does sand make up changing landforms along the ocean shoreline?
	6.2 Sand on the Move!	6.2 How can we model changing dunes and beaches?
	6.3 Sand Dunes and Beaches	6.3 How can wind and water affect sand dunes and beaches?
	6.4 Protecting Sand Dunes	6.4 How can people protect sand dunes from erosion?
Unit Capstone	Unit Capstone: Exploring Land and Water	Big Question: How can things that happen on Earth change the land?
Unit Supplement	Science in Action (two class sessions)	Who are some people who work in this type of science, and what do they do?

Activity Pages

Activity Pages



AP UO.1

AP 1.1.1

AP 1.2.1

AP 1.3.1

AP 1.4.1

AP 1.4.2

AP 2.1.1

AP 2.2.1

AP 2.3.1

AP 2.4.1

AP 2.5.1

AP 2.6.1

AP 2.6.2

AP 3.1.1

AP 3.2.1

AP 3.2.2

AP 3.3.1

AP 3.4.1

AP 3.4.2

AP 4.1.1

AP 4.2.1

AP 4.2.2

AP 4.3.1

AP 4.3.2

AP 5.1.1

AP 5.2.1

Black-line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 238–275. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced. The Activity Pages can be organized into a learning portfolio for each student to demonstrate their progress relative to NGSS expectations and as student work products.

Make sufficient copies for your students in advance of each lesson segment.

Unit Opener—Our Landscape (AP UO.1)

Lesson 1—The Rock (AP 1.1.1)

Lesson 1—How Does Freezing Water Affect Rocks? (AP 1.2.1)

Lesson 1—Problem and Solution: Water (AP 1.3.1)

Lesson 1—Did the Sealing Tests Work? (AP 1.4.1)

Lesson 1—Scrapbook—Lesson 1 (AP 1.4.2)

Lesson 2—Water and Land (AP 2.1.1)

Lesson 2—Map It! (AP 2.2.1)

Lesson 2—How Water Flows (AP 2.3.1)

Lesson 2—Moving Ice (AP 2.4.1)

Lesson 2—Solve a Riddle (AP 2.5.1)

Lesson 2—Land and Water Flags (AP 2.6.1)

Lesson 2—Scrapbook—Lesson 2 (AP 2.6.2)

Lesson 3—Yellowstone National Park (AP 3.1.1)

Lesson 3—Modeling Groundwater (AP 3.2.1)

Lesson 3—Geyser Go! (AP 3.2.2)

Lesson 3—About Volcanoes (AP 3.3.1)

Lesson 3—Look at an Earthquake (AP 3.4.1)

Lesson 3—Scrapbook—Lesson 3 (AP 3.4.2)

Lesson 4—Yosemite National Park (AP 4.1.1)

Lesson 4—Paper House Template (AP 4.2.1)

Lesson 4—Landslide Investigation (AP 4.2.2)

Lesson 4—Solution Scorecard (AP 4.3.1)

Lesson 4—Scrapbook—Lesson 4 (AP 4.3.2)

Lesson 5—Arches National Park (AP 5.1.1)

Lesson 5—Water Changes Rock (AP 5.2.1)

Activity Pages



AP 5.2.2

AP 5.2.3

AP 6.1.1

AP 6.2.1

AP 6.3.1

AP 6.4.1

AP 6.4.2

Lesson 5—Wind Changes Rock (AP 5.2.2)

Lesson 5—Scrapbook—Lesson 5 (AP 5.2.3)

Lesson 6—Cape Cod National Seashore (AP 6.1.1)

Lesson 6—Exploring Sand (AP 6.2.1)

Lesson 6—Draw a Solution (AP 6.3.1)

Lesson 6—Solution Scorecard (AP 6.4.1)

Lesson 6—Scrapbook—Lesson 6 (AP 6.4.2)

Online Resources for Science

Online Resources



For each CKSci unit, the Teacher Guide includes references to online resources (including external websites and downloadable documents) to enhance classroom instruction. Look for the icon on the left.

Use this link to download the CKSci Online Resources for this unit:

www.coreknowledge.org/cksci-online-resources

The Online Resources Guide also links to lists of additional recommended children's books that support the content of this unit.

Teaching Strategies

Start with the familiar.

Lead with an experience. Begin each lesson with a demonstration, activity, or question about a phenomenon to engage students and focus their attention on the topic. Start with the familiar. Every science topic introduced to students relates in some way to their known world and everyday experiences. The purpose of every lesson is to build a bridge between what is familiar to students and broader knowledge about the way the world works.

Ask driving questions.

The unit is governed by a Big Question, related to the unifying phenomenon. Each multipart lesson is built around a lesson Guiding Question. And then at the beginning of each Teacher Guide lesson segment, you will find a driving question and Core Lesson segment devoted to encouraging students to think about this question as they are introduced to new science content. Use this opportunity to engage students in conversation, to think about how their own real-world experiences relate to the topic, or to participate in a demonstration that relates to the driving question.

Encourage scientific thinking.

Approach the lessons with students not as learning about science, but as learning about the world with a scientific mind. Science learning models science practice.

Throughout the lessons, encourage students to ask questions about what they observe, do, and read. Record relevant questions in a prominent place in the classroom. Guide students back to these questions as opportunities to answer them emerge from readings, demonstrations, and activities.

Use continuous Core Vocabulary instruction.	<p>During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Through scaffolded questioning, encourage students to come up with definitions in their own words and to use the words in their own sentences.</p> <p>Core Vocabulary words for each lesson, as well as Language of Instruction, other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary and Language of Instruction definitions in the Glossary on pages 276–277.</p>
Emphasize observation and experience.	<p>Lessons employ various ways for students to learn, including watching, listening, reading, doing, discussing, and writing. To meet the NGSS Performance Expectations, which are multidimensional standards, students must not only gain factual knowledge associated with Disciplinary Core Ideas, but also use the content knowledge they acquire.</p>
Use science practices.	<p>Give students opportunities to discover new content knowledge through investigation and to use their new knowledge both in problem-solving exercises and as evidence to support reasoning. Students learn what science and engineering practices are by engaging in those same practices as they learn.</p>
Make frequent connections.	<p>Use a combination of demonstrations and reading materials, rich with examples, to help students recognize how the science concepts they are learning apply in their everyday lives. Prompt students to relate lesson content to their own experiences, to relate the new and unfamiliar to the familiar, and to connect ideas and examples across disciplines. Refer to the Crosscutting Concepts cited in the lessons, often included in the NGSS References listed at the start of each lesson.</p>
Monitor student progress.	<p>Use verbal questioning, student work, the Check for Understanding assessments at the end of each lesson to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.</p>

Instructional Design

The unit is composed with several integrated features that support three-dimensional learning for all students and development for teachers. Within each lesson, notations appear in the column to the left to indicate certain features in the instructional support.

Differentiation	<p>Adjustments to instruction appear in the text, indicated by SUPPORT, EXTEND, and CHALLENGE notations.</p> <p>SUPPORT—Reading, writing, listening, and/or speaking alternatives appear for students who are English language learners, have special needs, or read below the grade level. Extra support is suggested for students who struggle to meet targeted expectations.</p> <p>EXTEND—Extensions are suggested for students with high interest or who have already met the performance expectations.</p>
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CHALLENGE—Additional, relevant, and interesting exercises are suggested for students to explore that exercise math, reading, or science skill/comprehension that pushes beyond the grade level.

Teacher Development	Information in the instructional text, Know the Science boxes, and Know the Standards boxes is provided to support ongoing teacher development with regard to both content and the teaching process.
Monitor Progress	Opportunities for formative assessment appear throughout the instructional support. These instances are most consistently noted in a Check for Understanding that concludes each lesson segment.
Math Connection	Connections to math standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.
Language Arts Connection	Connections to reading and language arts standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.
Building Progressions	Prior expected student learning and how the prior learning will be built upon are explained throughout the instructional support and in Know the Standards boxes.



DCI
SEP
CCC
PE

Opportunities for students to develop and use specific elements of NGSS Disciplinary Core Ideas (DCI), Science and Engineering Practices (SEP), and Crosscutting Concepts (CCC) are highlighted throughout the instructional support text.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit. Use the following link to download any of the CKSci Online Resources Guides:

www.coreknowledge.org/cksci-online-resources

Icon Key:

DCI ESS1.C The history of planet Earth

DCI ESS2.A Earth materials and systems

DCI ESS2.B Plate tectonics and large-scale system interactions

DCI ESS2.C The roles of water in Earth's surface processes

DCI ETS1.C Optimizing the design solution

SEP 1 Asking questions (for science) and defining problems (for engineering)

SEP 2 Developing and using models

SEP 3 Planning and carrying out investigations

SEP 4 Analyzing and interpreting data

SEP 5 Using mathematics and computational thinking

SEP 6 Constructing explanations (for science) and designing solutions (for engineering)

SEP 7 Engaging in argument from evidence

SEP 8 Obtaining, evaluating, and communicating information

CCC 1 Patterns

CCC 2 Cause and effect

CCC 3 Scale, proportion, and quantity

CCC 4 Systems and system models

CCC 5 Energy and matter: flows, cycles, and conservation

CCC 6 Structure and function

CCC 7 Stability and change

3D Learning

Student performance in a given task related to making sense of a phenomenon or designing a solution requires integrated elements of the SEPs, CCCs, and DCIs. At certain points of instruction, the Teacher Guide identifies when all three dimensions are integrated for student learning and as support for the teacher.

Effective and Safe Classroom Activities

Online Resources



Conducting safe classroom demonstrations and activities is essential to successful elementary science education. The following resources provide Core Knowledge's recommendations for developing effective science classroom activities.

These resources, included at the back of the Teacher Guide on pages 278–282, consist of the following:

- Classroom Safety for Activities and Demonstrations
- Strategies for Acquiring Materials
- Advance Preparation for Activities and Demonstrations
- What to Do When Activities Don't Give Expected Results

These resources may also be accessed within the CKSci Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

MATERIALS AND EQUIPMENT

The unit, like all hands-on science, requires a large variety of materials to support various ways of learning (including doing, discussing, listening, watching, reading, and writing). Prepare in advance by collecting the materials and equipment needed for all the demonstrations and hands-on investigations.

- Roll paper, poster board, or a bulletin board should be dedicated at the beginning of the unit to serve as a question board to cumulatively document and return to student questions. The question board is referred to in the materials for lesson segments in which it is used but is not repeated in the materials listed here.
- Internet access and the means to project images/videos for whole-class viewing is also required in many lesson segments but is not repeated below.

Lesson 1 Land, Water, and Changes: Examples from Mount Rushmore

Lesson 1.1

- assortment of rocks such as granite and sandstone (2–3 rocks per group)
- crayons, markers, or pencils
- hand lenses (1 per group)

Lesson 1.2

- quick-setting gypsum plaster (2 inches or ½ cup per group, 5 pounds total)
- small milk carton bottoms or paper cups (cup or pint size, cut in half) (2 halves per group)
- small balloons (1 per group)
- water (½ cup per group)
- wooden craft sticks (1 per group)
- plastic cups (1 per group)
- markers (1 per group)
- freezer
- large syringe or turkey baster for filling balloons (optional)

Lesson 1.3

- bars of soap (2 for teacher demonstration)

Lesson 1.4

- water
- watering cans (or spray bottles) (1 per group)
- basins (1 per group)

Lesson 1.4, continued

- soft modeling clay (1 4-inch section per group)
- tarpaulin squares (waterproof cloth of canvas or plastic), 12" x 12" (1 per group)
- the cartons with cracked plaster from Lesson 1.2

Lesson 2 Land, Water, and Changes: Examples in Glacier National Park

Lesson 2.2

- colorful topographic maps (3–4)
- colored pencils (assorted colors per student)
- clipboards (1 per group)
- compass to identify north (teacher use)

Lesson 2.3

- medium-sized clear container or basin, 12" or longer at the base
- water (2 cups)
- measuring cup
- large rocks (2–3)
- blocks of ice (1–2)
- soil (1 cup)
- plank of wood
- heat lamp or hair dryer (optional)

Lesson 2.4

- large shallow container
- sand

Lesson 2.4, continued

- small rocks or pebbles
- miniature “glacier”
- small (16 ounces or less) water bottle
- scissors
- freezer
- blocks
- spray bottle of water
- paper towels

Lesson 2.5

- putty

Lesson 2.6

- flour (3 cups per group)
- salt (1 cup per group)
- water (1 cup per group)
- oil (3 tablespoons per group)
- green food coloring
- brown food coloring (or brown paint)
- blue food coloring
- large mixing bowl
- plastic resealable bags (2 per group)
- foam boards (1 per group)
- toothpicks (1 for each flag, multiplied by the number of groups)
- scissors (1 pair per group)
- glue (1 bottle per group)

Lesson 3 Land, Water, and Changes: Examples in Yellowstone National Park

Lesson 3.2

Day 1:

- coarse sand and gravel
- plastic animal figurines (assortment, 2–3 per group)
- black marker
- safety pin

Day 1, continued

- clear plastic cups (2 per group)
- turkey basters (1 per group)
- clear containers (1 per group)
- water (2 cups per group)
- blue food coloring
- water bottles (1 per group)

Day 2:

- water (1 cup)
- small pot or saucepan
- electric burner
- aluminum foil
- metal funnel (taller than the depth of the pot)

Lesson 3.4

- white glue ($\frac{2}{3}$ cup)
- baking soda ($\frac{1}{2}$ teaspoon)
- water ($\frac{1}{4}$ cup)
- shaving cream (2–3 cups)
- contact lens solution (1.5 tablespoons; solution must contain boric acid and sodium borate)
- orange food coloring
- water bottles (1 per group)
- mixing bowl
- fork or spatula
- air-dry clay or dough (1 cup per group)
- plate
- whipped cream (or shaving cream)
- graham crackers
- small bowl of water

Lesson 4 Land, Water, and Changes: Examples in Yosemite National Park

Lesson 4.2

- plastic/wooden chutes (1 per group)
- aluminum pans (1 per group)
- potting rocks (1 cup per group)

Lesson 4.2, continued

- soil (1 cup per group)
- duct tape
- paper cups (1 per group)
- water (1 cup per group)
- disposable spoons (1 per group)
- scissors (1 per group)
- plastic resealable bags (2 per group)
- clear tape (1 spool per group)

Lesson 5 Land, Water, and Changes: Examples in Arches National Park

Lesson 5.1

- river rocks (or other type of flat rock, like tiles that can be stacked) (4–6)
- timer

Lesson 5.2

Student use:

- eyedroppers (1 per group)
- trays (1 per group)
- parchment or wax paper
- water (1 cup per group)
- straws (1 per student)

Teacher preparation:

- sand
- cornstarch
- water
- bowl
- mixing spoon
- teaspoon
- measuring cups (1 cup, liquid and dry)
- plastic cups (1 per group)

Lesson 6 Land, Water, and Changes: Examples at Cape Cod National Seashore

Lesson 6.1

- globe
- lunch trays (1 per group)
- sand (1 cup per group)

Lesson 6.2

- straws (1 per student)
- shallow aluminum pans (1 per group)
- sand (2–3 cups per group)
- water (2 cups per group)
- rulers (1 per group)

Unit Capstone

- tape
- construction paper (assorted colors)
- marker

Science in Action

- paper (1 large sheet per group)
- pencils (1 per student)
- aluminum baking pans (deep) (1 per group)
- modeling clay (enough for all groups to make models)
- sand (2 cups per group)

EXPLORING LAND AND WATER PACING

_____’s Class

Note to Teacher: *Exploring Land and Water* is intended to be taught as the third unit of Grade 2 CKSci. As a general rule, we recommend that you spend a minimum of twenty-seven days and a maximum of forty-one days teaching the *Exploring Land and Water* unit so that you have time to teach the other units in the Grade 2 CKSci series.

Week 1

Day 1

Day 2

Day 3

Day 4

Day 5

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Week 2

Day 6

Day 7

Day 8

Day 9

Day 10

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Week 3

Day 11

Day 12

Day 13

Day 14

Day 15

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Week 4

Day 16

Day 17

Day 18

Day 19

Day 20

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Week 5

Day 21

Day 22

Day 23

Day 24

Day 25

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Week 6

Day 26

Day 27

Day 28

Day 29

Day 30

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Week 7

Day 31

Day 32

Day 33

Day 34

Day 35

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Week 8

Day 36

Day 37

Day 38

Day 39

Day 40

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Week 9

Day 41

Day 42

Day 43

Day 44

Day 45

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UNIT 3

Exploring Land and Water

OVERVIEW

Big Question: How can things that happen on Earth change the land?

Anchoring Phenomenon: Landforms in America’s natural areas reveal clues about changes in the land. The driving question we explore in this unit is, “How can things that happen on Earth change the land?” To answer this question over the course of the unit, students will determine that rock, sand, and soil make up landforms and that maps and other models can represent them. Students will also learn that water exists in different places, including oceans, rivers, lakes, and ponds, and that models and maps can represent how and where. Students will investigate how water can do things to change earth materials (rock, sand, soil) and discover that wind and water can change earth formations quickly or slowly. Students will explore how glaciers change landforms slowly while volcanoes, earthquakes, and landslides change landforms quickly. Subsequently, students consider and evaluate solutions designed to prevent wind or water from changing the shape of land.

Student Book storyline: Logan’s family lives in Massachusetts. For this summer’s vacation, they take a road trip in the United States, nearly coast to coast, driving to several of America’s national parks. On the trip, they visit six parks, where they encounter a variety of formations that invite investigation into earth-shaping processes.

Students will document Logan’s trip. On the trip, Logan sees some surprising and mysterious sights that students will have to learn about to help explain what he has seen.

Long-term project: Students will document Logan’s road trip with models, maps, and a trip log scrapbook. Models will include maps, three-dimensional dioramas depicting features, and functional models illustrating processes.

Key content takeaways from the unit standards bundle include the following:

- Rock, sand, and soil make up landforms, and maps can represent them.
- Water exists in different places, including oceans, rivers, lakes, ponds, and ice, and maps can represent how and where.
- Water can do things to change earth materials (rock, sand, soil).
- Wind and water can change earth formations quickly or slowly.
- Glaciers are water and change landforms slowly.
- Volcanic eruptions, earthquakes, and landslides change landforms quickly.
- Designed solutions can prevent wind or water from changing the shape of land.

These concepts are not presented in a linear fashion. Students will accumulate and combine information about all the sites mentioned and numerous other examples and interactivities to arrive at these conclusions.

Introductory Class Session Seeing New Sites

It's summer break in Massachusetts, and students prepare to follow their lead character, Logan, on a road trip around America to see some sites, including six national parks. Students will discuss landscapes to prepare them for the sites that Logan and his family will see.

Unit Opener Objective

- ✓ Discuss landscapes.

NGSS References

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 7 Stability and Change

Students explore and ask questions about how Earth has changed throughout its history.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Language of Instruction

The Language of Instruction consists of terms not considered a part of Core Vocabulary that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

observe

Instructional Activities

- teacher Read Aloud
- class discussion
- drawing

Materials and Equipment

- question board

Instructional Resources

Student Book



Ch. 1

Student Book, Chapter 1

"America's Amazing Landscape"

Activity Page



AP UO.1

Activity Page

Our Landscape (AP UO.1)

Advance Preparation

This unit opener is intended to be directly paired with Lesson 1.1, and the unit opener and lesson segment should be covered on the same day for a complete reading of Chapter 1 in the Student Book.

THE UNIT OPENER

1. Introduce the Anchoring Phenomenon.

NGSS Elements



SEP 1

- As students gather into class, ask them to talk about what comes to mind when they hear the word *landscape*. **Ask the following questions:** (See **Know the Science**.)
 - Do you think about deserts or grassy hills?
 - » Students might say mountains, hills, valleys.
 - What about lakes, rivers, and oceans? Are these part of a landscape, too?
 - » Accept all reasonable answers.

Activity Page



AP UO.1

- Explain that in this unit, you'll be visiting several different national parks in the United States and learning about Earth and its many different landscapes.
- Distribute Our Landscape (AP UO.1). Tell students to draw a picture of a landscape that they see on their way to or from school. Then, have students talk about what they drew with a partner.

2. Read together: "America's Amazing Landscape."

Student Book



Ch. 1

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

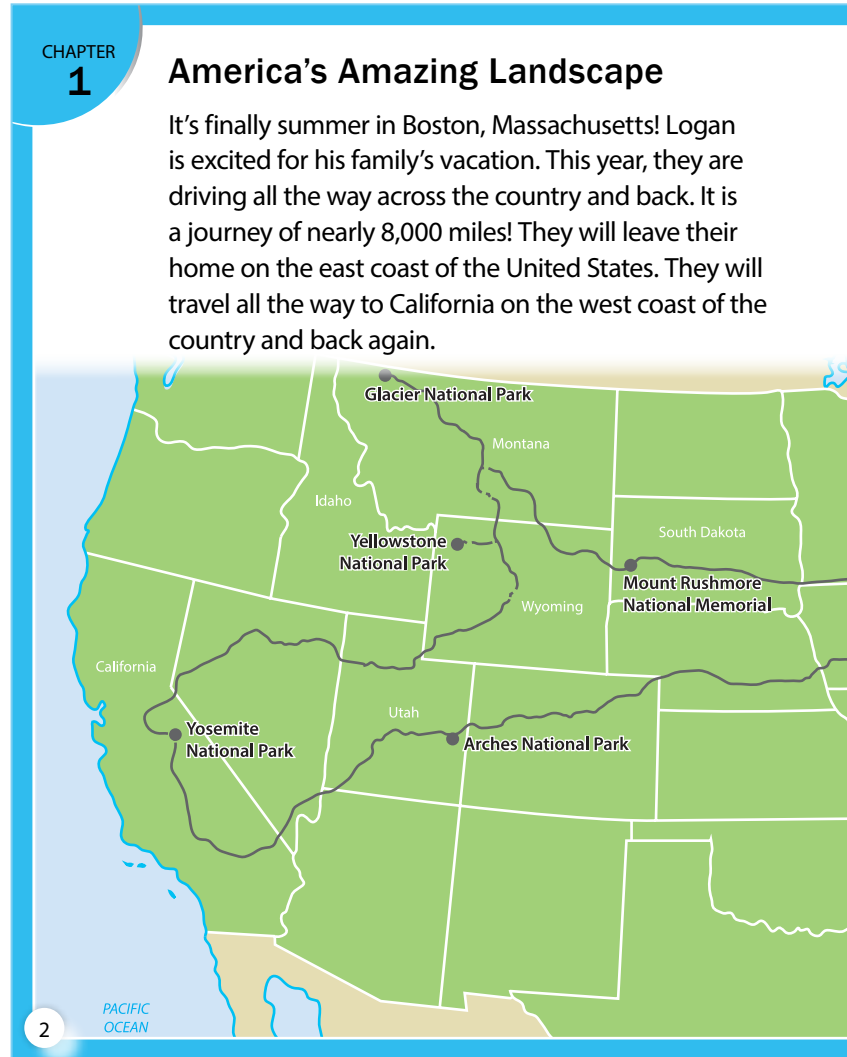
Know the Science

TEACHER DEVELOPMENT

Landscapes and Landforms: A landscape can be defined as all of the visible features of an area, including natural landforms and human-made structures. The difference between landscapes and landforms is that landforms are natural structures that are formed over short or long processes, such as mountains, whereas landscapes can include things like a city horizon or farmland. There are different types of landforms, such as mountains, plateaus, valleys, deserts, dunes, islands, rivers, oceans, loess, glaciers, peninsulas, and deltas.

Pages 2–3

Ask students to turn to pages 2 and 3 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “America’s Amazing Landscape,” and tell them to pay special attention to the map as you read.



Logan and his family will stop at six different national parks along the way. On their road trip they will see mountains. They will see places that are nearly flat for hundreds of miles. They will see deserts. They will see lakes and streams. They will even see snow in the summertime! What makes the land in one country so different from place to place? Maybe Logan will find out.



Ask students to look at the map on pages 2 and 3. Talk about what students see. Clarify that this is a map of the United States.

INFERENTIAL—What do you think the map shows?

- » The map of most of the United States shows where Logan’s family is going to travel.

LITERAL—What kinds of landscapes will Logan and his family see on their trip?

- » They will see mountains, flat areas, desert, lakes and streams, and snow.

3. Generate questions.

NGSS Elements



SEP 1

Ask students what they wonder about landscapes.

Start a question board for this unit. Write the Big Question at the top of the chart, and add student questions as you work through this unit on landforms. Work to generate answers with students based on things that are discussed and observed in each classroom session.

LESSON 1

Land, Water, and Changes: Examples from Mount Rushmore

OVERVIEW

Guiding Question: What can change rock?

Lesson 1 Segments	Segment Questions	Advance Preparation
1.1 What Are Hills and Mountains? Students read about Logan’s first stop at Mount Rushmore. Students learn that Mount Rushmore is a mountain, and they observe a variety of rocks to understand their traits.	What is unusual about Mount Rushmore?	Read Chapter 1 in the Student Book. Gather materials for the activity. See Materials and Equipment.
1.2 What Are Weathering and Erosion? Students participate in an investigation to see if water can change the shape of rock.	How can ice change rock?	Gather materials for student investigation. See Materials and Equipment.
1.3 Weathering and Erosion Problems Students read about how water can cause problems for Mount Rushmore and what workers can do to prevent cracks in the mountain.	Why would a carved stone monument need protection?	Read Chapter 2 in the Student Book.
1.4 What Keeps the Water Out? Students use their observations from their investigation to test different solutions for preventing or slowing water from changing rock.	How can people prevent ice from cracking rock?	Gather materials for class activity. See Materials and Equipment.

What’s the Story?

Summary: In Lesson 1 (Segments 1–4), students study landforms and how they change over time. Students explore how water can break rock when it freezes inside cracks (2-ESS2-3) and that water can change the way the land looks over time (2-ESS1-1). Students participate in an investigation where they freeze water inside of plaster and watch as it cracks the plaster, representing the concept of ice wedging. Later, students test some solutions to prevent water from changing the shape of rock (2-ESS2-1). The developing understanding of these phenomena in Lesson 1 prepares students for their work in Lesson 2, when they will build on their knowledge of water to study the way that glaciers (frozen forms of water) can change land over time.

Learning Progression: Lesson 1 builds toward the Grade 2 target of 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*; and 2-ESS2-3: *Obtain information to identify where water is found on Earth and that it can be solid or liquid*.

Guiding Phenomenon: The natural landscape changes its shape and appearance due to Earth events that occur quickly or slowly. Water can do things to change earth materials, like rock, sand, and soil. Designed solutions can prevent water from changing the shape of the land. These changes are explored in a tour of several of America’s national parks, beginning with South Dakota’s Mount Rushmore National Memorial.

Learning Objectives

By the end of Lesson 1, students will do the following:

- Identify hills and mountains as landforms.
- Describe how water can change rock.
- Explain solutions to prevent water from changing the shape of rock.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (partial)

Performance Expectation: 2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. (partial)

Performance Expectation: 2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid. (partial)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>6 Constructing Explanations and Designing Solutions</p> <p>Compare multiple solutions to a problem.</p>	<p>ESS1.C The History of Planet Earth</p> <p>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.</p>	<p>7 Stability and Change</p> <p>Things may change slowly or rapidly.</p> <p>1 Patterns</p> <p>Patterns in the natural world can be observed.</p>

<p>8 Obtaining, Evaluating, and Communicating Information</p> <p>Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.</p>	<p>ESS2.A: Earth Materials and Systems</p> <p>Wind and water can change the shape of the land.</p> <p>ESS2.C: The Roles of Water in Earth’s Surface Processes</p> <p>Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.</p> <p>ETS1.C: Optimizing the Design Solution</p> <p>Because there is always more than one possible solution to a problem, it is useful to compare and test designs.</p>	
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For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 1.1

What Are Hills and Mountains?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: What can change rock?

Today's Question: What is unusual about Mount Rushmore?

Tie to the Anchoring Phenomenon: Students learn about mountains as they join Logan on his family trip to Mount Rushmore.

AT A GLANCE

Learning Objective

- ✓ Identify hills and mountains as landforms.

Instructional Activities

- teacher Read Aloud
- class discussion
- student observation
- question generation

NGSS References

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 7 Stability and Change

Students observe rocks, start to build a vocabulary of properties of rocks, and ask questions about rocks. Students will start to learn about processes that can change Earth.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

hill

landform

mountain

national monument

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify landscape notice
observe

Instructional Resources

Student Book



Ch. 1

Student Book, Chapter 1
 “America’s Amazing Landscape”

Activity Page



AP 1.1.1

Activity Page
 The Rock (AP 1.1.1)

Materials and Equipment

- assortment of rocks such as granite and sandstone (2–3 rocks per group)
- crayons, markers, or pencils
- hand lenses (1 per group)
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Prepare a slideshow with pictures of urban, rural, and suburban landscapes, as well as different landforms, including mountains, plateaus, valleys, deserts, dunes, islands, plains, rivers, oceans, glaciers, peninsulas, and deltas.

THE CORE LESSON 1.1

1. Introduce students to Lesson 1.

NGSS Elements



SEP 1

- Ask a volunteer to state the Big Question that you’ll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**
- Tell students that, before they can answer the unit’s Big Question about the land, they first need to understand the different kinds of landforms. In Lesson 1, students will learn first about hills and mountains, as well as the processes of weathering and erosion, to apply their understanding to the Big Question. Write the Lesson 1 Guiding Question where students can see it:

What can change rock?



- Show a video to describe and explore different landforms. Explain that each lesson in this unit will focus on a different type of landform in a different national park in the United States along with Logan and his family. Along the way you'll learn about Earth's landforms.
- Discuss the different types of landforms in the local environment. Then have students describe the landforms that they have seen or visited.
 - » Accept all reasonable responses. Be sure to distinguish between natural landforms and human-made forms or plants.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

- Introduce Today's Question: **What is unusual about Mount Rushmore?** Explain that the first stop on the tour of national parks in this unit is Mount Rushmore National Memorial. Discuss what students know about Mount Rushmore.
 - » Some students may have visited, lived nearby, or seen pictures.
- **Ask what students know about mountains.** Then explain that by the end of this lesson, they will know a lot about mountains and Mount Rushmore.
 - » Most students will know about mountains. Many may have lived on or near or may have visited a mountain.

Tie to the Anchoring Phenomenon

As students work through Lesson 1, they will learn how some landforms are changed over time to look how they do today, when Logan and his family go to visit them.

2. Observe rock samples.

Activity Page



AP 1.1.1

NGSS Elements



SEP 1

- Have students form small groups of two or three.
- Distribute The Rock (AP 1.1.1), and go over it as a class. Tell students that they will be recording the observations they make about their rocks and then writing down a question they would like to ask about rocks.
- Distribute two or three samples of rocks and a hand lens to each group. Tell students to take a few minutes to look closely at the rocks. Students should feel the rock and make note of what they observe.

Ask students, How can you describe rocks?

- » Rocks are hard. They are bumpy. They are different colors. They have smooth sides. They feel rough.

- Tell students that you want to change how the rocks look. **Ask students the following:**
 - How can you change a rock? Can you cut a rock with scissors?
 - » no
 - Can you change the shape of a rock with an eraser?
 - » no
 - Can you squeeze a rock into a new shape with your hands?
 - » no
 - What do you see when you look at the rock with the hand lens?
 - » I can see small bits of rock and sand.
- Clarify for students that rock can be a very hard material and that there are certain ways to make changes to rocks quickly or over a long period of time. (See **Know the Science 1.**) Students will learn about these ways in this lesson.

Differentiation

SUPPORT—Some students may have a difficult time describing the rocks. Focus and narrow the discussion to just asking students whether the rocks are hard or soft.

CHALLENGE—Have students research natural ways that rocks change (erosion and weathering). Challenge some students to focus on wind and others to focus on water.

EXTEND—Have students identify landforms in the community that have been affected by weathering and/or erosion.

3. Continue to read together: “America’s Amazing Landscape.”

Student Book



Ch. 1

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Know the Science

TEACHER DEVELOPMENT

1. Types of Rock: Rocks are collections of one or more minerals, along with other materials, such as fossils and rock fragments. Many rocks are heavy and dense but others are not. There are different kinds of rocks, including igneous, metamorphic, and sedimentary rocks.

Ask students to turn to page 4 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “America’s Amazing Landscape,” and tell them to pay special attention to the pictures of Mount Rushmore as you read.

First Stop—Mount Rushmore

Logan’s family’s first stop is Mount Rushmore National Memorial in the state of South Dakota. Logan thinks that with a name like “Mount Rushmore,” they must be visiting a mountain. He learns that one side of this mountain is unusual, though.



NGSS Elements



DCI ESS1.C
CCC 7

Ask students to look at the picture on page 4. Talk about what they see. Clarify that they are looking at an actual mountain—a mountain with faces on it! (See **Know the Standards 1** and **2**.)

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.C The History of Planet Earth: The formation of mountains is a slow process, but sometimes they can be changed in a relatively short amount of time, such as by human activities.

2. CCC 7 Stability and Change: Natural processes, such as erosion and weathering, can take a long time to change landforms like mountains. Other processes, like human activities, can change landforms quickly. Landforms can also change quickly by natural events, like earthquakes, volcanic eruptions, and floods.

LITERAL—Where is Logan’s family’s first stop?

» Mount Rushmore

LITERAL—What kind of landform is Mount Rushmore?

» It is a mountain.

CORE VOCABULARY—Explain that a **mountain** is a tall, steep landform that is made of rock and rises high out of Earth’s surface. It usually takes a long time for mountains to form! A **hill** is a naturally raised area of land that is not as big as a mountain.

CORE VOCABULARY—Explain that a **national monument** is a place of historic or geographical importance, designated by the government. These places are open to the public for people to see. Mount Rushmore is an example of a national monument in America.

Page 5

Ask students to look at the picture on page 5. Talk about the picture. Explain that carving is a way that people can change rocks. People can carve into rock using very sharp and heavy tools.

Mount Rushmore is a monument. It is a giant sculpture that people carved into the mountain rock. The carving shows the faces of four United States presidents. They are George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln. The sculpture was completed in 1941. It took a team of many people about fourteen years to carve.



5

LITERAL—What faces were carved into Mount Rushmore?

- » the faces of George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln

LITERAL—How long did it take to sculpt Mount Rushmore?

- » fourteen years

Differentiation

SUPPORT—Discuss the differences between a **landform** and a **landscape**. A landform is a natural feature of Earth's surface, like the mountain in the story. Ask students to suggest possible landforms as you list them on the board (mountains, plateaus, valleys, deserts, dunes, islands, plains, rivers, oceans, glaciers, peninsulas, deltas). A landscape is all the natural and human-sculpted features of an area. The landscape of an area might include farm fields or tall buildings that are built on a landform, such as a valley.

Ask students to look at the picture on page 6. Talk about what students see.
(See **Know the Science 2.**)

When they arrive at the park, Logan's family walks down a long stone path. It is lined with flags on both sides. The faces of Mount Rushmore loom above them. Logan feels as tiny as an ant. The carved rock faces are huge!



INFERENTIAL—Why do you think those presidents were carved into the side of a mountain?

- » to honor important presidents and promote American democracy; to create a monument that people will visit

Know the Science

TEACHER DEVELOPMENT

2. Mount Rushmore: The carving of South Dakota's Mount Rushmore began in 1927 and was completed in 1941. Each head reaches a height of 60 feet (18 meters). To carve the four presidential heads, dynamite and pneumatic hammers were used to get through a large amount of rock quickly. Some 400 workers removed around 450,000 tons of rock, which still remains at the base of the mountain. The carving itself was done with drills and chisels.

INFERENTIAL—Did it take a long time or short time to carve the faces in the mountain rock?

- » Although fourteen years seems like a long time, it was actually a very short time for the changes in the rock to be made.

Differentiation

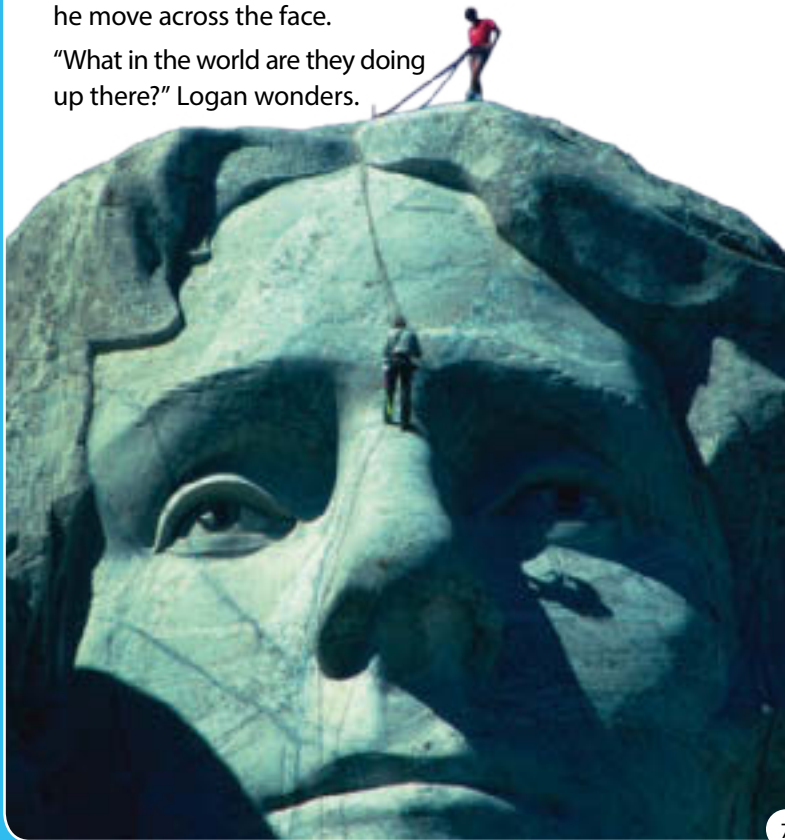
SUPPORT—Explain that the walkway with the flags is known as the Avenue of Flags and that the flags represent the different states and districts in America. The flags are arranged in alphabetical order.

Page 7

Ask students to look at the picture on page 7. Explain that binoculars are tools that people can use to see things that are far away more closely.

As Logan gets closer he notices two specks on a president's faces that seem to be moving. When he looks through binoculars, he sees that they are people! One person is hanging from ropes. The ropes hold the person in place while he move across the face.

"What in the world are they doing up there?" Logan wonders.



INFERENTIAL—What do you think this person is doing on Thomas Jefferson's face?

- » It looks like the person is working on it.

INFERENTIAL—What changes might the worker be making?

- » The worker might be filling in cracks so parts do not break off.

SUPPORT—Explain that sometimes people have to go up to the faces of Mount Rushmore to help maintain them, or to keep the rock from changing due to natural processes. Let students know that they will learn more about the natural processes that can change rocks later in this lesson.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look for student responses on Activity Page UO.1 to ensure understanding of landscapes. Students will show whether or not they grasp the concept of a landscape based on what they have chosen to draw on the Activity Page.

If students do not have proper understanding of a landscape and cannot distinguish between landscapes and landforms, ask students individually or collectively to tell you what a landscape is and what kinds of landscapes they can see in their community. Alternatively, you can query students by taking a poll, showing pictures of urban, suburban, and natural landscapes and asking such questions as the following:

- Who thinks a residential area with houses, streets, sidewalks, and lawns is a landscape?
 - » Yes, the houses, yards, and streets may be built on a landform (such as a valley, plain, hill, or mountain), but this is a residential landscape.
- Who thinks a desert is a landscape?
 - » Yes, there are desert landscapes, but a desert is also a landform.
- Who thinks a forest is a landscape?
 - » Yes, a forest of trees is a landscape, but it is not a landform. The trees could be growing on a mountain or plains landform.
- Who thinks the ocean/beach is a landscape?
 - » Yes, there are ocean/beach landscapes, but they are also landforms.

Students' show of hands will give you a gauge of student comprehension.

- Have students summarize what they learned so far about Mount Rushmore.
 - » It is in South Dakota and has four United States presidents carved into it. Those changes to the rock happened quickly.

Review student drawings in Activity Page 1.1.1 to determine student understanding of the following concepts:

- Landscapes are the visible features of an area.
- Hills and mountains are landforms, which are natural features of land.

Draw student attention to the question board. Review any questions that already have been answered, and ask students to think of other questions they have about

landforms, landscapes, hills, rocks, and mountains as you add them to the question board.

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In this first lesson, students follow Logan and his family to their first stop: Mount Rushmore. Students should be familiar with rocks and the fact that rocks are hard. Students will be able to build from this knowledge as they learn about the natural factors that can change rock.

LESSON 1.2

What Are Weathering and Erosion?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: What can change rock?

Today's Question: How can ice change rock?

Tie to the Anchoring Phenomenon: Logan and his family visit Mount Rushmore on their first stop around the country. Logan sees a person working on the face of Thomas Jefferson. Students will learn that weathering and erosion can change the shape of landforms, like mountains.

AT A GLANCE

Learning Objectives

- ✓ Define *weathering* and *erosion*.
- ✓ Identify sources of water on Earth.

Instructional Activities

- student investigation
- class discussion

NGSS References

Disciplinary Core Idea: ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 2 Cause and Effect

Students carry out an investigation into the process of how water and ice can weather rocks. Students start establishing an understanding of cause-and-effect processes in science.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

wear away

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change erosion shape weathering

Instructional Resources

Activity Page



AP 1.2.1

Activity Page

How Does Freezing Water Affect Rocks? (AP 1.2.1)

Materials and Equipment

- quick-setting gypsum plaster (2 inches or $\frac{1}{2}$ cup per group, 5 pounds total)
- small milk carton bottoms or paper cups (cup or pint size, cut in half) (2 halves per group)
- small balloons (1 per group)
- water ($\frac{1}{2}$ cup per group)
- wooden craft sticks (1 per group)
- plastic cups (1 per group)
- markers (1 per group)
- freezer
- large syringe or turkey baster for filling balloons (optional)
- question board

Advance Preparation

- In this investigation, students will simulate how frozen water can break rocks. They will fill a small balloon with water in one container and then cover it with quick-setting plaster to simulate a rock. When the container is frozen, the water in the balloon should expand and crack the plaster.
- Gypsum plaster is a natural material that is quick-setting, lightweight plaster used for patching walls and can be found at any hardware store. It can simulate a rock. This investigation requires the use of a freezer to freeze the cartons with a plaster mixture for several hours. Start the investigation in the morning, and return to it in the afternoon or on the following day to allow enough time for the materials to freeze.
- Pour about $\frac{1}{2}$ cup of quick-setting gypsum plaster into plastic cups that you can pass out to each group. Pour the water into a separate cup that you can pass out to each group.
- Cut the milk cartons in half. Each group will receive two bottom halves.
- This investigation works best if students have access to a sink or a drinking fountain so they can easily pour water into the balloon. If a sink or drinking fountain is not available, prepare to help students carefully pour the water into their balloons.
- Prepare an area where you can save the cartons with the cracks in them to be used again in Lesson 1.4.

THE CORE LESSON 1.2

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.C

How can ice change rock?

Ask students where they can find water on Earth.

» Water can be found in oceans, lakes, rivers, ponds, pools, or swamps.

Ask students, Who thinks water is strong enough to crack a rock? Elicit a discussion around this idea. Tell students that they will find out the answer in today's investigation. (See **Know the Science 1.**)

At this grade level, students are not expected to understand the the mechanics and intricacies of weathering and erosion, which are covered in depth at later grades. Instead, students will be familiarized with the idea that rock can be worn away.

Recall that *weathering* and *erosion* are Language of Instruction terms that you should use in context to familiarize students with them, but the terms are not Core Vocabulary that students should expected to use themselves

2. Facilitate the investigation, part 1.

NGSS Elements



DCI ESS2.C

SEP 3

CCC 2

- Place students in small groups of mixed ability. Give each group the following materials:
 - quick-setting gypsum plaster, ½ cup
 - water
 - plastic cup
 - wooden craft stick
 - small balloon
 - milk carton or paper cup (2 halves)
 - marker
 - large syringe or turkey baster for filling balloons (optional)

Know the Science

TEACHER DEVELOPMENT

1. Why Water Expands: There are only a few substances that expand when they freeze; water is one of them. When water freezes, it expands by nine percent in volume. This is caused by the structural changes in water that occur when it goes from a liquid to a solid state. When water freezes, the hydrogen bonds connecting the water molecules to one another become more permanent. These bonds force a stable, hexagonal arrangement of water molecules to form. This results in an increase in the intermolecular space and also explains why ice is less dense than water.



- Distribute How Does Freezing Water Affect Rocks? (AP 1.2.1) to each student. Explain that students will work in their groups to investigate whether water can crack rock when it is frozen. Gypsum will model a rock. Students will use Activity Page 1.2.1 to record their observations. (See **Know the Standards 1.**)
- Guide students through the investigation by calling out the steps, one at a time, and having students follow along:
 - Tell students to write their names on both milk cartons using the marker.
 - Have students fill a balloon with about half as much water as would fill the half carton. Then tell them to tie the balloon so the water cannot leak out. If necessary, help students tie the balloons. (And prepare for messes. Students may accidentally spill the water out of their balloons while attempting to tie them.)
 - Tell one student to place the balloon on the bottom of one of the milk cartons. The student should hold the balloon so that the knot is facing up.
 - Prompt another student to mix the quick-setting gypsum plaster using water, the plastic cup, and a wooden craft stick. Once this is mixed, tell students to pour about one inch (not more) of the plaster into each milk carton. The student who is holding the balloon by the knot must continue to hold it until the plaster hardens enough so that the balloon is held in place.
- Have students record what their investigation looks like so far in the first drawing box on Activity Page 1.2.1. Prompt students to draw what the milk cartons, plaster, and balloon look like before they are frozen.

Differentiation

SUPPORT—Some students may have a difficult time following the verbal instructions for the investigation. Alternatively, conduct this investigation as a whole class, inviting volunteers to come up and assist with the setup, or write out the steps for students to read and refer to as they complete the activity.

CHALLENGE—Challenge students to come up with a hypothesis or prediction about what they think the water will do to the plaster after it is frozen.

EXTEND—Have students form pairs and talk about how weathering and erosion could be a problem for people in their community.

- Go around the room to collect the milk cartons from each team, and set them in the freezer. Tell students that they will return to this investigation later in the day or in the next class.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth's Surface Processes: In this investigation, students work with water in its liquid form and freeze it to study how water in its frozen form can alter the shape of rock.

3. Facilitate the investigation, part 2.

NGSS Elements



DCI ESS2.C

CCC 2

SEP 3

- Take the milk cartons out of the freezer and pass them back out to their respective groups.
- Tell students to observe the plaster in each of the milk cartons and talk about what they notice. (See **Know the Standards 2** and **3**.) Then prompt students to draw what they observe on Activity Page 1.2.1 in the second drawing box.

4. Summarize and discuss.

NGSS Elements



DCI ESS2.C

CCC 2

SEP 3

- Leaving the students in their groups, bring the class back together, and discuss what students noticed in the investigation.
- **Ask students to describe the difference between the carton with the balloon and the one without the balloon after freezing.**
 - » The plaster most likely cracked as the balloon with water expanded when frozen. In the sample without the balloon, the plaster was probably not cracked.
- Then start a discussion about how water is able to change the shape of rock by wearing it away. (See **Know the Science 2**.)

Know the Standards

TEACHER DEVELOPMENT

2. SEP 3 Planning and Carrying Out Investigations: In this investigation, students learn about the effects of ice on rock.

3. CCC 2 Cause and Effect: Students understand that the freezing of the water causes the plaster (rock) to break.

Know the Science

TEACHER DEVELOPMENT

2. Forms of Weathering: Weathering occurs when wind, water, or ice changes rocks or landforms at Earth's surface. Ice wedging is one form of weathering, but abrasion by sediment grains carried in wind, water, or glacial ice also occurs. Erosion is the transportation of sediments created by weathering—usually due to the action of water, wind, or glacial ice. Mass wasting is a specific type of erosion that is caused by gravity. It occurs when soil or rocks are carried away, not by water, wind, or ice, but by falling or sliding downward. Another way that water weathers rock is in its liquid form. When water flows over rock continuously for many years, it can eventually wear away the minerals by abrasion due to the sediment grains typically carried in the moving water. These sediment grains grind away rock just like the sediment grains glued to sandpaper wear away wood. The Grand Canyon in Arizona is an example of a rock landform that was carved away by water. Erosion, on the other hand, is what happens when rocks and sediments are picked up and carried someplace else by water, wind, or ice. A river, for instance, can carry sediment downstream—eroding it from the outside banks of meanders (high-energy areas of stream) and depositing it on the inside banks of meanders (low-energy areas of stream) farther along the stream's course. These earth materials can also simply roll downhill under the influence of gravity.

- Explain that water expands, or increases in size, when it freezes. Ask how that can affect rocks as in the experiment.
 - » If water gets in a crack in a rock and freezes, it will get bigger and make the crack larger.
- Collect the cartons that have the cracks in them. Let students know that they will revisit these in another investigation.

5. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings on Activity Page 1.2.1 to see that students understand that the rock was not cracked before the water froze.

Use the following questions to gauge student understanding of the investigation:

Ask students, What did the plaster represent?

» It represents the rock.

Ask students What did the ice that froze inside the balloon do to the plaster?

» The ice cracked the plaster.

Ask students, What effect would freezing water have on rocks and things made of rocks, like sidewalks and roads?

» The ice can break the rocks apart, so they need to be repaired.

Review student drawings on Activity Page 1.2.1, and listen for their responses to your questions to determine student understanding of the following concepts:

- Water can change the way rock looks.
- Weathering and erosion are two processes that can change the shape of rocks.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw students' attention to the question board. Add any additional questions students have about weathering and erosion caused by water.

Tie to the Anchoring Phenomenon

In observing how water is able to affect the structure and shape of rock by wearing away the rock, students can help Logan learn about why it is important for people to maintain Mount Rushmore.

LESSON 1.3

Weathering and Erosion Problems

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: What can change rock?

Today's Question: Why would a carved stone monument need protection?

Tie to the Anchoring Phenomenon: On Logan's trip to Mount Rushmore, he sees a person working on Thomas Jefferson's face. He later learns that the person is helping to preserve the appearance of the stone and prevent it from weathering. In this segment, students will learn about the importance of protecting rock landforms.

AT A GLANCE

Learning Objectives

- ✓ Explain how weathering and erosion by water are problems for people.
- ✓ Explore design solutions to water weathering and erosion problems.

Instructional Activities

- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ESS1.C The History of Planet Earth

Science and Engineering Practices: 1 Asking Questions; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 2 Cause and Effect; 7 Stability and Change

Students learn about the effects of water and wind on rock as well as ways humans try to reduce the damage. Students then construct explanations and design solutions to reduce weathering caused by erosion.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

preserve water

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change erosion shape weathering

Instructional Resources

Student Book



Ch. 2

Student Book, Chapter 2
"Protecting Stone Monuments
from Changes"

Activity Page



AP 1.3.1

Activity Page
Problem and Solution: Water
(AP 1.3.1)

Materials and Equipment

- bars of soap (2 for teacher demonstration)
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Leave one bar of soap in its original form. Prepare the second bar of soap by placing it in water or using it to wash your hands, until it gets noticeably smaller.
- Prepare a slideshow with pictures of the Grand Canyon, sand tufa of Arizona, and Wave Rock of Perth.

Online Resources



See the Online Resources Guide for a link to the recommended pictures:

www.coreknowledge.org/cksci-online-resources

THE CORE LESSON 1.3

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS1.C
DCI ESS2.C
DCI ESS2.A
CCC 7

Why would a carved stone monument need protection?

- Start the slideshow. Stop for each picture and discuss how weathering and erosion by water played a role in forming the unique shapes that students see for the Grand Canyon, sand tufa of Arizona, and Wave Rock of Perth. Ask students to describe what they notice about each picture, and give them time to ask questions. Clarify that it possibly took millions of years for water to change the landforms students are looking at. (See **Know the Science.**)

Online Resources



See the Online Resources Guide for a link to the recommended images:

www.coreknowledge.org/cksci-online-resources

2. Read together: “Protecting Stone Monuments from Changes.”

Student Book



Ch. 2

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Know the Science

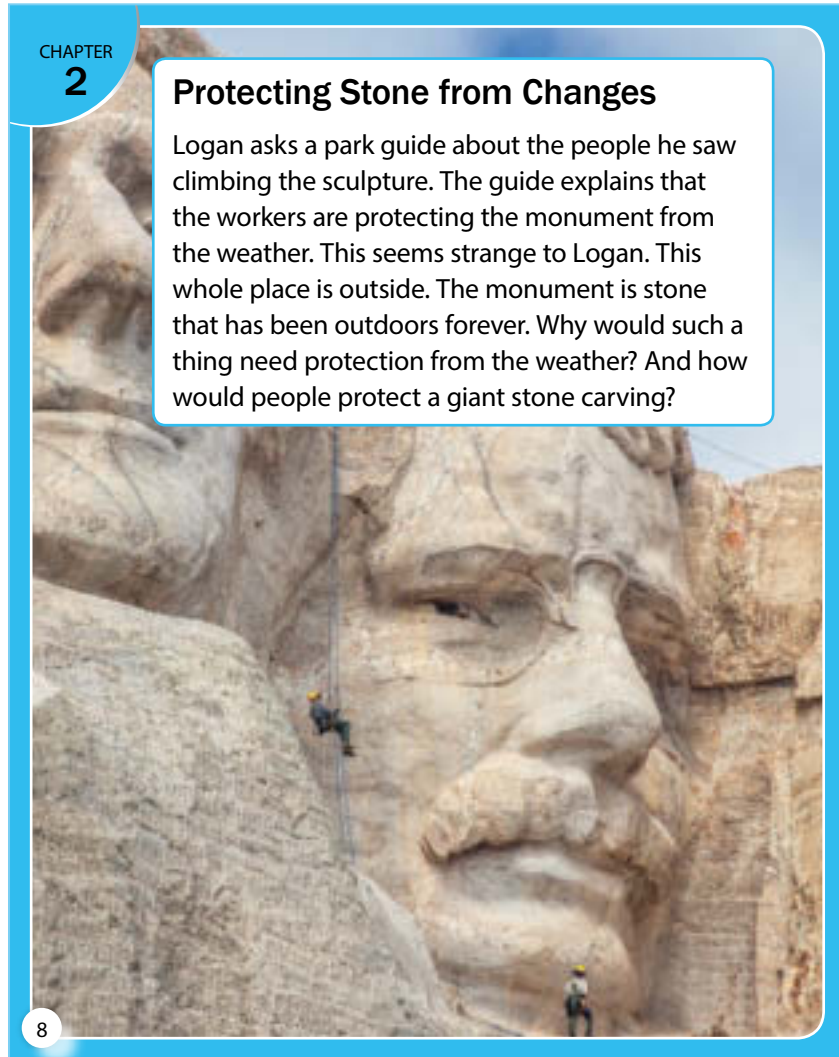
TEACHER DEVELOPMENT

Sand Tufa, Grand Canyon, and Wave Rock of Perth: Sand tufa are rock formations that resemble cauliflower stalks. They stand in a place that used to be a lake but has dried up. The lake was initially an alkaline lake, but when it became dry, a freshwater spring penetrated the land from below, forming tufa, or the calcium carbonate deposits.

The Grand Canyon is a national park in northern Arizona. Water carved the rock into a canyon over millions of years.

Wave Rock of Perth is located in Australia. This landform is said to resemble a large wave and was carved into its unique shape by groundwater.

Ask students to turn to page 8 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Protecting Stone Monuments from Changes,” and tell them to pay special attention to how the rocks look as you read.





Ask students to look at the picture on page 8. Explain that even though the stone monument is outside and stone can be very hard, weather—like wind and water—can still damage it. That’s why it is important to maintain the stone. (See **Know the Standards 1, 2, and 3.**)

CORE VOCABULARY—Explain that **preserve** means to keep something the way it should be. Offer examples so students become more familiar with the meaning of this word.

EVALUATIVE—Do you think cracks in the stone of the monument are bad? Why or why not?

» Yes, cracks are bad because it can make parts of the monument break.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.A Earth Materials and Systems: Students find out that water can change rock. In this case, people do not want Mount Rushmore to change. Workers take special measures to preserve the stone monument.

2. CCC 2 Cause and Effect: Students understand a simple cause-and-effect relationship between water and rock.

3. Language Arts Connection: Students satisfy a connection to the ELA standard CCSS.ELA-Literacy.RI.2.3 by making a connection between the natural process of ice wedging and the ways that humans can try to prevent it.

Ask students to look at the pictures on page 9. Explain that this page talks about how ice can crack rock, just like students explored in the investigation in the previous class.

Logan learns that the people who work to preserve the monument check the stone for cracks. The faces at Mount Rushmore are carved into a kind of rock called granite. Water can seep into cracks in the rock. During cold weather, the water freezes into ice. As ice becomes solid, it expands, or gets a little bigger. Ice inside cracks in rock pushes the granite apart little by little. The cracks can get bigger. Over time, small cracks could cause large chunks of rock to break off and fall. This happens to carved stones and to natural rock, too.



Water gets into a crack.



Ice gets bigger and pushes the crack wider.



The rock can break.

9

LITERAL—How does water ruin rock?

» It seeps into cracks, freezes, expands, and then pushes the rock apart.

Differentiation

SUPPORT—Explain that if this keeps happening to the rock, then the crack in the rock will get bigger and bigger and can eventually break the rock apart. This is what workers are trying to prevent at Mount Rushmore. This is why they preserve the monument by checking for cracks.

Ask students to look at the picture on page 10. Explain that this page talks about how workers preserve Mount Rushmore.

To preserve Mount Rushmore, workers fill cracks so water cannot get into them. This protects the sculpture. They fill the cracks with a material called silicone. Silicone is like a thick glue. It is hard and rubbery when it dries. Silicone is waterproof. It keeps water out of the cracks.



10

LITERAL—What do workers do to the cracks in Mount Rushmore?

» They fill them with silicone.

LITERAL—Why do they use silicone?

» It is waterproof and flexible, not hard like rock.

LITERAL—How does silicone work?

» The silicone keeps water out of the cracks and allows for the rock to move a little.

INFERENTIAL—Why is it important to keep water out of the cracks?

» so that the water does not stay in the cracks, freeze, and break the rocks

Ask students to look at the two pictures on page 11. Explain that this page talks about wind and how it can change rock. The page gives the example of the Great Sphinx in Egypt. Clarify that this is not a place where Logan is visiting on his trip. (See **Know the Standards 4** and **5**.)

During his trip, Logan reads more about how stone can be damaged. He learns that stone monuments can also be changed by wind. The Great Sphinx is another giant rock carving. It is a very old monument in Egypt. There is little rain and no ice to break the rock apart there. But it is hot, windy, and sandy. Wind blows tiny grains of sand against the monument. It grinds away at the stone. Over many years, the stone has worn away.



Workers try to protect the Sphinx from changes caused by wind. The Sphinx is much older than Mount Rushmore. Wind has been blowing sand against it for a very long time.



11

NGSS Elements

DCI ESS2.A
CCC 7

LITERAL—How can wind change a stone monument?

» It blows sand against the monument, and that grinds away at the stone.

Know the Standards

TEACHER DEVELOPMENT

4. DCI ESS2.A Earth Materials and Systems: Students read that wind is another factor that can change human-made objects, like the Great Sphinx.

5. CCC 7 Stability and Change: It takes water and wind many years to make these kinds of changes to stone monuments, like Mount Rushmore and the Great Sphinx.

INFERENTIAL—Based on what you have read about wind and water, do you think it takes a long time or a short time for wind and water to make these changes to stone monuments?

» It takes a long time for wind and water to make these changes.

SUPPORT—Explain that **weathering** is the breaking down of rocks, soil, and minerals as well as other surfaces like building bricks and wood by wind, rain, and weather. **Erosion** occurs when water or wind washes or blows away rocks or soil. Discuss examples of both and how both change landforms and landscapes, including ice and mass wasting.

3. Support concepts with an activity.

Activity Page



AP 1.3.1

NGSS Elements



DCI ESS2.A

SEP 6

CCC 2

CCC 7

Differentiation

- Remind students that they just read about a problem for stone monuments. Now, students will get a chance to identify solutions. (See **Know the Standards 6, 7, and 8.**)
- Have students form small groups of mixed ability, and distribute Problem and Solution: Water (AP 1.3.1). Review Activity Page 1.3.1 together as a class, and tell students that they will work as a group to describe the problem and come up with two solutions. They will use the words from the word banks to fill in the sentence frames on Activity Page 1.3.1.
- Circulate around the room as groups work on their problem statements and design solutions. Offer assistance as needed.

SUPPORT—Students whose primary language is not English may have a difficult time filling out sentence frames. Alternatively, conduct this activity as a whole class so that these students can listen to the sentences being read aloud and can still participate.

CHALLENGE—Challenge students to come up with a way to measure whether or not stone has been changed by water over time.

EXTEND—Have students form pairs and talk about how preventing weathering from water is important to society and the natural world.

Know the Standards

TEACHER DEVELOPMENT

6. DCI ESS2.A Earth Materials and Systems: Students apply what they learned about in Chapter 2 of the Student Book and investigated in the previous class segment to describe how water can change the shape of the land.

7. SEP 6 Constructing Explanations and Designing Solutions: Students identify two possible solutions that can help prevent the weathering and erosion of rock by water. In the next class segment, students will have the opportunity to investigate these solutions and determine how effective they can be.

8. CCC 7 Stability and Change: Students are participating in an activity that requires them to identify the fact that it takes water a long time to weather rock.

4. Check for understanding.

Monitor Progress

Formative Assessment

Have students summarize what they learned about preserving stone monuments.

Students will show whether or not they understand the problem and solutions based on the words they choose from the word banks to complete the sentence frames. Review student responses on Activity Page 1.3.1 to determine student understanding of the following concepts:

- Water can change the shape of rock.
- There are ways to prevent or slow water from changing rock.

See the Activity Page Answer Key for correct answers and sample student responses.

Visit the question board to add any questions students may have about weathering and erosion of rock monuments.

Tie to the Anchoring Phenomenon

In reading about how water is able to change the shape of the land and structures like Mount Rushmore and the Great Sphinx, students can help Logan learn about why it is important to come up with solutions to prevent weathering and erosion.

LESSON 1.4

What Keeps the Water Out?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: What can change rock?

Today's Question: How can people prevent ice from cracking rock?

Tie to the Anchoring Phenomenon: Logan learns about what workers can do to preserve Mount Rushmore. In today's class, students will investigate a solution to prevent or slow the weathering and erosion of rock by water.

AT A GLANCE

Learning Objective

- ✓ Evaluate solutions against desired features (criteria).

Instructional Activities

- student investigation
- class discussion

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ETS1.C Optimizing the Design Solution

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 2 Cause and Effect; 7 Stability and Change

Students investigate solutions to rock weathering by testing methods to reduce water accumulation in cracks in rock. Students identify the causes and effects of weathering on landscapes.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

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preserve problem solution

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criteria erosion evaluate weathering

Instructional Resources

Activity Pages



AP 1.4.1
AP 1.4.2

Activity Pages

Did the Sealing Tests Work?
(AP 1.4.1)
Scrapbook—Lesson 1
(AP 1.4.2)

Materials and Equipment

- water
- watering cans (or spray bottles) (1 per group)
- basins (1 per group)
- soft modeling clay (1 4-inch section per group)
- tarpaulin squares (waterproof cloth of canvas or plastic), 12" x 12" (1 per group)
- the cartons with cracked plaster from Lesson 1.2
- question board

Advance Preparation

- Have the cartons with the cracked plaster from Lesson 1.2 ready to pass out to the same groups of students.
- Cut squares of the tarpaulin that are large enough to cover the milk cartons.
- Fill the watering cans or spray bottles with water.

THE CORE LESSON 1.4

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.A
SEP 6

How can people prevent ice from cracking rock?

- Remind students that they previously read about how ice can crack rock. They also did an investigation where they saw this happen with the balloons inside the milk cartons filled with plaster.
- Make a list of the types of cracks in rocks that would be a problem for people.
 - » for example, cracks in sidewalks, building foundations, rocky cliffs on trails or on the sides of highways
- Tell students that today they are going to test the solutions they learned about in the previous class session by covering the plaster with tarpaulin and sprinkling water over it to see if it keeps the plaster dry.
- Students will also fill in the cracks using clay as a model for the silicone that the workers would normally use to fill the cracks. Students will then sprinkle water over it to see if clay will keep the water out.

2. Facilitate the investigation.

- Have students form the same groups from Lesson 1.2. Give each group the following materials, and distribute their group (cracked) cartons from the investigation in Lesson 1.2:

- water
- clay
- basin
- tarpaulin square
- watering can

NGSS Elements



DCI ESS2.A
DCI ETS1.C
SEP 6
CCC 2

- Before students get started, identify the criteria (desired features) of the solution as a class, and record the criteria on the board.

Ask students how they will know that the solution worked.

- » The clay prevents water from getting into the cracks; the plaster does not get any new or bigger cracks; the plaster does not get wet; the tarpaulin keeps the water off the plaster.



- Guide students through the investigation by calling out the steps, one at a time, and having students follow along: (See **Know the Standards 1** and **2**.)
 - Prompt groups to place the carton into a basin. Have two students hold the tarpaulin, tightly, over the milk carton. Ensure that the tarp covers the entire carton. Have another student in the group gently pour water over the tarp. **Ask students what happens. Ask,** Does the plaster in the carton get wet?
 - » The plaster does not get wet. The tarpaulin collects the water. The tarpaulin makes the water fall off the edges of it but not onto the plaster.
 - Next, tell students to leave the cartons in the basins and remove the tarps. Prompt students to fill the cracks in their plaster with clay. When the clay dries, have someone in the group gently pour water onto the plaster. **Ask students what they notice.**
 - » The clay keeps the water out of the cracks.

Differentiation

SUPPORT—Some students may have a difficult time following the verbal instructions for the investigation. Alternatively, conduct this investigation as a whole class, inviting volunteers to come up and assist with the setup, or write out the steps for students to read and refer to as they complete the activity.

CHALLENGE—Challenge students to come up with a way that they could measure the size of a crack in a sidewalk over time. Students should be able to express that they would need to take initial measurements of the crack and repeat those measurements periodically to compare the data to see if, in fact, the crack is getting bigger.

EXTEND—Have students form pairs and talk about the importance of testing and comparing solutions.

3. Check for understanding.

Monitor Progress

Formative Assessment



3D Learning: Students review the outcomes of their tests that were intended to solve the problem related to water changing the shape of rock over a long period of time.

- Check student work to ensure students understand that water can change the shape of rock and that there are different ways to prevent or slow these changes. Do not assess students based on artistic abilities. Students may draw pictures of ice in the cracks of rock, the faces of Mount Rushmore, or a giant mountain to represent what Logan saw at his first stop.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.A Earth Materials and Systems: Students use their knowledge that water can change rock to test solutions for preventing this natural occurrence.

2. DCI ETS1.C Optimizing the Design Solution: Students test two solutions to see how to effectively prevent water from changing the shape of rock.

Activity Pages



AP 1.4.1

AP 1.4.2

NGSS Elements



PE 2-ESS2-1

CCC Connections
to Engineering,
Technology, and
Applications of
Science

CCC Connections
to Nature of
Science

- Distribute Did the Sealing Tests Work? (AP 1.4.1) and Scrapbook—Lesson 1 (AP 1.4.2), and review them together as a class. Explain that for Activity Page 1.4.1, students will evaluate the solutions based on the outcomes of the tests. Tell students that *evaluate* means to think hard and make a judgment about something. (See **Know the Standards 3** and **4**.)
- Give students a few minutes to answer the questions on Activity Page 1.4.1. Then discuss those answers as a class.
- Prompt students to fill out Scrapbook—Lesson 1 (AP 1.4.2). Explain that students will keep these scrapbook pages in a folder and use them for the capstone at the end of Unit 3. For the picture, tell students that they can draw anything that represents what Logan saw at Mount Rushmore.

Review student responses on Did the Sealing Tests Work? (AP 1.4.1) and Scrapbook—Lesson 1 (AP 1.4.2) to determine student understanding of the following concepts:

- Water can crack rock and change the way the land looks through weathering and erosion.
- Water can make these changes over a long period of time.
- There are different ways to prevent or slow water from changing the shape of rocks.

See the Activity Page Answer Key for correct answers and sample student responses.

Review the question board with students. Identify those questions that have been answered about weathering, water, and rocks. Add any new questions students now have.

Tie to the Anchoring Phenomenon

In testing how the different solutions prevent water from getting to the rocks, students can identify with what Logan learns on his trip around the country about the ever-changing landscapes in nature.

Know the Standards

TEACHER DEVELOPMENT

3. PE 2-ESS2-1: The activities in this segment contribute in part to the Performance Expectation by having students test two different solutions that are designed to slow or prevent water from changing the shape of rock. Students will complete this Performance Expectation in full during the capstone, where they will compare multiple solutions that are designed to slow or prevent wind and water from changing the shape of the land.

4. CCC Connections to Engineering, Technology, and Applications of Science; CCC Connections to Nature of Science: Something as simple as caulking the cracks in rock can serve as a type of technology that helps preserve parts of the natural world. Scientists study the natural and material worlds in order to identify ways that humans can keep nature intact.

LESSON 2

Land, Water, and Changes: Examples in Glacier National Park

OVERVIEW

Guiding Question: How can water change land?

Lesson 2 Segments	Segment Questions	Advance Preparation
2.1 What Are Glaciers and Valleys? Students read about Logan's second stop, Glacier National Park. They learn that glaciers can be seen in the summertime!	What kinds of land and water occur in Glacier National Park?	Read Chapter 3 in the Student Book.
2.2 Let's Map It! Students learn about topographical maps and how they are used. Then students interpret some and make their own.	How do maps show different types of land and water?	Gather materials for student activity. See Materials and Equipment.
2.3 How Does Water Flow? Students observe how water flows downhill and collects in depressions in the land.	How does water move and collect on land?	Gather materials for demonstration. See Materials and Equipment.
2.4 What Does Water Move? Students investigate how sliding ice can push earth materials and change landscapes.	How can water and ice move dirt, sand, and rocks?	Gather materials for student investigation. See Materials and Equipment.
2.5 Where Can We Find Water? Students learn about other sources of water besides glaciers, such as streams, rivers, and lakes.	How are glaciers, mountain streams, and lakes related?	Read Chapter 4 in the Student Book.
2.6 Modeling Land and Water Features Students use what they learned in this lesson to make models of land and water features that represent the landscape at Glacier National Park.	How can we model a place's land and water?	Gather materials for modeling activity. See Materials and Equipment.

What's the Story?

Summary: In Lesson 2 (Segments 1–6), students explore what glaciers are and how they change the shape of the land (2-ESS1-1 and 2-ESS2-3). Students also learn that maps and models can be used to represent land and water features in an area (2-ESS2-2). Students participate in investigations where they observe how water runs downhill and how glaciers move and cause erosion. Later, students make models of land and water features based on what they learned throughout the lesson (2-ESS2-2). The developing understanding of these phenomena in Lesson 2 prepares students for their work in Lesson 3, when they will build on their knowledge of water and land to study plains, groundwater, geysers, volcanoes, and earthquakes.

Learning Progression: Lesson 2 builds toward the Grade 2 target of 2-ESS2-2: *Develop a model to represent the shapes and kinds of land and bodies of water in an area.* Lesson 2 also builds toward the Grade 2 targets of 2-ESS1-1: *Use information from several sources to provide evidence that Earth events can occur quickly or slowly;* and 2-ESS2-3: *Obtain information to identify where water is found on Earth and that it can be solid or liquid.*

Guiding Phenomenon: The natural landscape changes shape and appearance due to Earth events that occur quickly or slowly. Glaciers are frozen forms of water, and they can erode sediment to change the way the land looks. These changes are explored in a tour of America's national parks, including Glacier National Park.

Learning Objectives

By the end of Lesson 2, students will do the following:

- Identify valleys as landforms.
- Identify glaciers as frozen forms of water.
- Describe how flowing water moves earth materials.
- Interpret maps.
- Model the land and water features of an area.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (partial)

Performance Expectation: 2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area. (partial)

Performance Expectation: 2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid. (partial)

<p>Science and Engineering Practices</p> <p>6 Constructing Explanations and Designing Solutions</p> <p>Make observations from several sources to construct an evidence-based account for natural phenomena.</p> <p>2 Developing and Using Models</p> <p>Develop a model to represent patterns in the natural world.</p> <p>8 Obtaining, Evaluating, and Communicating Information</p> <p>Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.</p>	<p>Disciplinary Core Ideas</p> <p>ESS1.C The History of Planet Earth</p> <p>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.</p> <p>ESS2.B Plate Tectonics and Large-Scale System Interactions</p> <p>Maps show where things are located. One can map the shapes and kinds of land and water in any area.</p> <p>ESS2.C The Roles of Water in Earth's Surface Processes</p> <p>Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.</p>	<p>Crosscutting Concepts</p> <p>7 Stability and Change</p> <p>Things may change slowly or rapidly.</p> <p>1 Patterns</p> <p>Patterns in the natural world can be observed.</p>
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For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 2.1

What Are Glaciers and Valleys?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: What kinds of land and water occur in Glacier National Park?

Tie to the Anchoring Phenomenon: Students learn about glaciers and valleys as they join Logan on his family trip to Glacier National Park.

AT A GLANCE

Learning Objectives

- ✓ Identify valleys as landforms.
- ✓ Identify glaciers as bodies of solid water, ice.

Instructional Activities

- teacher Read Aloud
- class discussion
- student observation
- question generation

NGSS References

Disciplinary Core Ideas: ESS2.B Plate Tectonics and Large-Scale System Interactions; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 1 Asking Questions

Students learn about different landforms formed by the interaction of water with landforms. Students also identify land and water features and ask questions about landform formation.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

glacier

landform

map

valley

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 3

Student Book, Chapter 3
"Next Stop—Glacier National Park"

Activity Page



AP 2.1.1

Activity Page
Water and Land (AP 2.1.1)

Materials and Equipment

- question board

THE CORE LESSON 2.1

1. Introduce students to Lesson 2.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**

- Tell students that, before they can answer the unit's Big Question about the land, they first need to understand the different kinds of landforms. In Lesson 2, students will learn about valleys and glaciers to apply their understanding to the Big Question. Write the Lesson 2 Guiding Question where students can see it:

How can water change land?

- Introduce Today's Question: **What kinds of land and water occur in Glacier National Park?** Remind students that in this unit they will be taking a tour of some of the national parks in the United States along with Logan and his family as they learn about Earth's landforms and history. Discuss what students know about Glacier National Park.
 - » Some students may have visited, lived nearby, or seen pictures.

- **Ask what students know about glaciers.** Then explain that by the end of this lesson, students will know a lot about glaciers and Glacier National Park.
 - » Some students may have heard the word, while others may have no knowledge.

Tie to the Anchoring Phenomenon

As students work through Lesson 2, they will learn how some landforms are changed over time to look how they do today, when Logan and his family go to visit them.

2. Read together: “Next Stop—Glacier National Park.”

Student Book



Ch. 3

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Ask students to turn to page 12 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Next Stop—Glacier National Park,” and tell them to pay special attention to the pictures of the different landforms as you read. (See Know the Standards 1.)

CHAPTER
3

Next Stop—Glacier National Park

Logan and his family continue their road trip. Their next stop is Glacier National Park in the state of Montana. Logan has learned that a glacier is made of ice. He supposes that must mean it will be cold and snowy there.

When they arrive, Logan is surprised to see a colorful summer landscape. The grass is green. Wildflowers are in bloom. The only snow he sees is near the tops of the tall mountains in the distance.




NGSS Elements



DCI ESS2.C

Ask students to look at the photograph on page 12. Talk about what they see. Where is the snow?

LITERAL—Where is Logan’s family’s second stop?

» Glacier National Park, in Montana in the United States

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth’s Surface Processes: Water is found on Earth in frozen form, as snow, ice caps, and glaciers. Students see pictures of snow and glaciers in Chapter 3 of the Student Book.

CORE VOCABULARY—Explain that a **glacier** is a mass of ice. It is a type of **landform** made entirely of water (frozen). Remind students that they learned in Lesson 1 that mountains and hills are landforms. (See **Know the Science**.)

INFERENTIAL—Why does Logan think it will be cold at Glacier National Park?

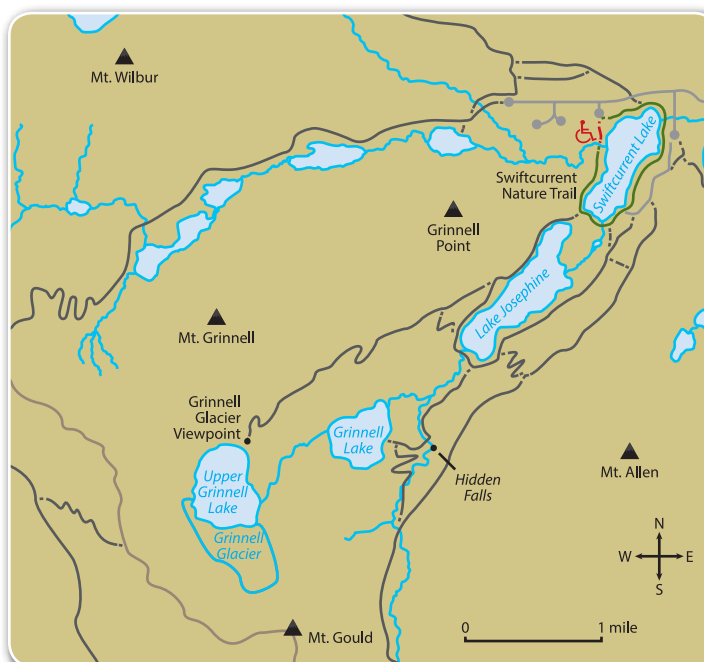
» He thinks it will be cold because glaciers are made of ice and ice is cold.

Page 13

Ask students to look at the map on page 13. Talk about the map students see on the page. **Ask students to raise their hands if they have used a map before.** Invite students to share what they used the map to find.

Logan's family decides to hike. They want to see a glacier up close. They also want to see some of the beautiful lakes and streams here. How will they find them?

They will use a map. The map shows where the mountains are. The map shows where the glaciers are. The map shows lakes and streams, too. The map also shows trails Logan will walk on to find these things.



13

Know the Science

TEACHER DEVELOPMENT

Glacier Movement: Glaciers are moving masses of ice that form from the compaction of snow over a long period of time. Glaciers move very slowly but contribute significantly to changing landscapes. If you move at a glacial pace, you are moving very slowly, like a glacier.



CORE VOCABULARY—Explain that a **map** is a representation of an area. It shows where things are located. There are many different kinds of maps. Some maps show physical features, like landforms (mountains, lakes, and valleys). Other maps show streets and roads. Some maps can tell you how deep oceans are or how tall mountains are. (See **Know the Standards 2** and **3**.)

LITERAL—What kinds of things can you tell from this particular map?

- » where the mountains are, where the glaciers are, where the lakes and streams are, and where the trails are

INFERENTIAL—How will the map help Logan and his family?

- » The map will help Logan and his family find things at the park.

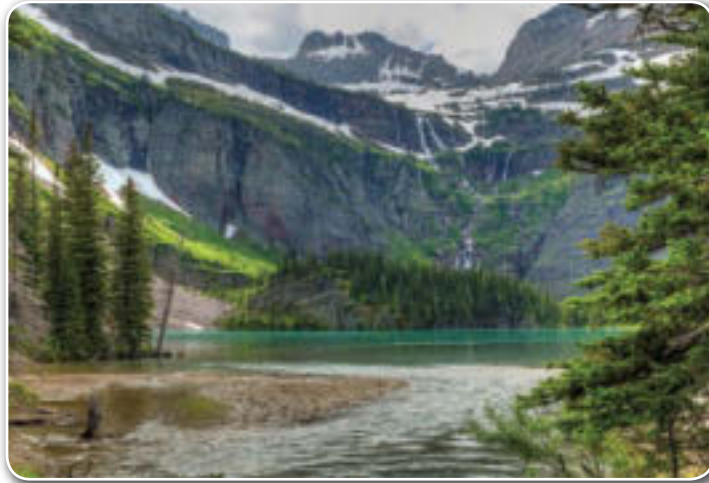
Know the Standards

TEACHER DEVELOPMENT

2. DCI ESS2.B Plate Tectonics and Large-Scale System Interactions: Students learn what a map is and how a map can be used to find key land features that Logan and his family want to see.

3. DCI ESS2.C The Role of Water in Earth's Surface Processes: Students identify that streams and lakes are bodies where water is found on Earth.

Logan's family finds their trail and starts walking. The trail first leads to a large lake. The lake is a bright turquoise blue. When Logan touches the water, it is very cold. It is so clear that he can see the bottom. The sides of the lake are steep and rocky.



Their hike continues along a stream that runs next to the trail. The water in the stream is deep. It is moving quickly! It flows downhill over and around rocks and small boulders.



14

Differentiation

NGSS Elements



DCI ESS2.C

SUPPORT—Explain that the top picture shows a lake. The bottom, smaller picture shows a stream. **Ask students what the lake and the stream have in common and how they are different.**

- » They are both bodies of water. The lake stays in one place. The stream is moving.

LITERAL—What words could Logan use to describe the lake?

- » *bright turquoise blue, large, cold, clear, steep and rocky sides*

LITERAL—What words could Logan use to describe the stream?

- » *next to the trail, deep water, moving quickly, flows downhill, has rocks and boulders around it*

Ask students to look at the picture on page 15. Explain that a lookout is a place where you can see a wide or far landscape. (See **Know the Standards 4.**)

The trail ends at a lookout. Logan and his family can see for miles! There are tall mountains. There are also deep valleys that are shaped like the letter U. Suddenly, Logan sees a large mass of snow and ice. He's found the glacier!



15

LITERAL—What landforms does Logan see at the lookout?

» Logan can see tall mountains, deep valleys, and the glacier.

CORE VOCABULARY—Explain that a **valley** is a low area of land. It usually sits between hills or mountains. You often find rivers or streams running through valleys.

NGSS Elements



DCI ESS2.C

Know the Standards

TEACHER DEVELOPMENT

4. DCI ESS2.C The Role of Water in Earth's Surface Processes: Students learn that valleys are often places where flowing rivers or streams can be found.

3. Turn and talk.

Activity Page



AP 2.1.1

NGSS Elements



DCI ESS2.C

Differentiation

- Have students form pairs. Distribute Water and Land (AP 2.1.1) to each student. Tell students to talk to each other about the kinds of land and water features that Logan saw at Glacier National Park. Then have them use Activity Page 2.1.1 to write down those features in the two columns.

SUPPORT—Some students may have a difficult time remembering the names of the land and water features from Chapter 3. Alternatively, allow these students to draw pictures of what Logan and his family saw, instead of listing their names.

CHALLENGE—Challenge students to identify each kind of water feature that Logan sees in Chapter 3 as water in its liquid or solid state.

EXTEND—Have students form small groups and talk about why they think Logan was able to see glaciers in the summertime.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look for student responses on Activity Page 2.1.1 to ensure understanding of land and water features. Students should be able to identify that mountains and valleys are land features and that streams, lakes, and glaciers are water features. If students do not have proper understanding of land and water features, go back through the Student Book, pages 12–15, and name the landforms that students see. It may be necessary to remind students that something can be a water feature even if it is frozen water (ice).

Review student responses on Water and Land (AP 2.1.1) to determine student understanding of the following concepts:

- Mountains and valleys are kinds of land features.
- Lakes, streams, snow, and glaciers are kinds of water features.
- Water can be liquid or solid.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw attention to the question board. Ask students what additional questions they have about glaciers, Glacier National Park, or maps, and add their questions to the question board.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their second stop: Glacier National Park. Students should be more and more familiar with the idea that water exists on Earth as a liquid or a solid. Students will be able to build from this knowledge as they learn about different ways that water can change landscapes.

LESSON 2.2

Let's Map It!

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: How do maps show different types of land and water?

Tie to the Anchoring Phenomenon: In Chapter 3 of the Student Book, Logan and his family use a map to find certain land features at Glacier National Park. Today, students engage in an activity where they practice using maps.

AT A GLANCE

Learning Objective

- ✓ Interpret land and water features on a topographical map and globe.

Instructional Activities

- student investigation

NGSS References

Disciplinary Core Idea: ESS2.B Plate Tectonics and Large-Scale System Interactions

Science and Engineering Practice: 2 Developing and Using Models

Crosscutting Concept: 3 Scale, Proportion, and Quantity

Students observe different types of maps and learn about how they are models of landscapes. Students will draw maps of their schoolyard to develop their skills in modeling as well as using scale and proportion.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

land low map scale
water

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

direction elevation high interpret
low topography view

Instructional Resources

Activity Page



AP 2.2.1

Activity Page
Map It! (AP 2.2.1)

Materials and Equipment

- colorful topographic maps (3–4)
- colored pencils (assorted colors per student)
- clipboards (1 per student)
- compass to identify north (teacher use)
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Online Resources



- Find three or four topographic maps to show students. You can search for topographic maps for specific locations online and display these or print them out. You can also use the United States Geological Survey site, which is devoted to mapping the United States. When searching for examples of maps, look for ones that have colorful contours that clearly differentiate between mountains, greenery, and water. The maps should include elevation data. Some maps should not have any labels (such as mountain or creek names). Prepare these as a slideshow.

See the Online Resources Guide for a link to the recommended map resources:

www.coreknowledge.org/cksci-online-resources

- The mapping activity in this lesson involves going outside. If there is inclement weather, you can have students map the inside of the school building or the classroom.

THE CORE LESSON 2.2

1. Focus student attention on Today's Question.

NGSS Elements



SEP 2

Online Resources



How do maps show different types of land and water?

Remind students that maps show where things are.

Show the class the first picture of a topographic map you accessed. **Ask students what they think the phrase “bird’s-eye view” means.**

» to look down from above, to look around pretending you are a bird

See the Online Resources Guide for a link to the recommended maps:

www.coreknowledge.org/cksci-online-resources

Explain that when students look at a map, they are looking at a view of the land from above. In other words, they are like birds that are high in the sky looking down onto the land. (See **Know the Standards 1.**)

Differentiation

SUPPORT—Some students may have a difficult time with spatial skills, which are important for studying maps. Have students do an activity where they act like birds flying in the sky. Prompt them to “look down” at the classroom and describe what they see.

Tie to the Anchoring Phenomenon

Logan and his family used a map to find trails, bodies of water, mountains, valleys, and the glacier that they saw at Glacier National Park.

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation: Map skills require spatial thinking skills, which help students understand phenomena related to the things that are around them and at different scales and views from what they usually see in the real world. Spatial thinking is an important skill for studying geography and other environmental and Earth sciences.

2. Interpret maps.

Online Resources



Continue to talk about the picture displayed for the class. Explain that students are looking at a topographic map, and explain what that is. (See **Know the Science 1.**) The area students are looking at has both land and water features.

See the Online Resources Guide for a link to the recommended maps:

www.coreknowledge.org/cksci-online-resources

NGSS Elements



DCI ESS2.B
CCC 3
SEP 2

Ask students what they think the blue lines on the map represent.

» water

- Talk about the relative sizes of the features on the map to set up the concept of scale. (See **Know the Science 2.**) **Ask students**, Do you think the lake is really this big in real life? Or is it smaller on the map?
 - » The lake is bigger in real life.
- Talk about how maps “shrink” the size of land features to fit them onto the picture but that a lot of math is used to come up with how big or small to make the land features on a map.
- Draw student attention to the numbers they see on the map. **Ask students if they can guess what those numbers mean.** Explain that the numbers represent how high above sea level the land is. (See **Know the Science 3.**)
- Discuss with students that people can tell what they are looking at when they see a topographic map because they read the elevation. For instance, if the elevation gets really high in one part of the map, they might be looking at a mountain or a hill. If the elevation gets really low in another part of the map, they might be looking at a valley.

Know the Science

TEACHER DEVELOPMENT

1. What Are Topographic Maps? The map that students are looking at is very simple form of a topographic map. Topography is the study of land features. A topographic map is a type of map that shows a variety of geographic features, like mountains, bodies of water, boundaries, and other structures. One of the most distinctive things about a more detailed topographic map is the presence of contour lines that show elevation above sea level.

2. How Is Scale Used in Maps? Maps use a mathematical concept known as scale. Scale is a ratio that allows a map to represent distance. To understand scale, you need to be familiar with different units of measurement. For instance, the scale on a map may be 1:1000000 cm. This means that one centimeter on the map is equal to one million centimeters on the ground (one kilometer). This is what allows maps to be accurate in terms of representing distance and space. Scale can be a challenging concept for young students. At this grade, students only need to understand relative scales to compare and describe objects, such as whether something is “bigger or smaller,” “closer or farther,” or “faster or slower.”

3. What Is Elevation? Elevation is a measure of an object’s position above or below sea level.

- Continue to work your way through the slideshow of topographic maps. For each map, stop and ask students to complete sentence frames that require them to interpret the map. Use the following as a guide:
 - The highest elevation on this map is _____. This is most likely a _____.
 - The lowest elevation on this map is _____. This is most likely a _____.
 - The water feature on the map can be found _____.

3. Make a map.

Activity Page



AP 2.2.1

NGSS Elements



DCI ESS2.B
SEP 2

Differentiation

- Let students know that now they are going to make their own maps of the schoolyard. (See **Know the Standards 2.**)
- Have students form small groups of mixed ability. It is important that at least one person in the group be able to demonstrate adequate spatial thinking skills.
- Distribute Map It! (AP 2.2.1) to each student, and review it together as a class. Tell students that they will draw a map of the schoolyard in the drawing box on Activity Page 2.2.1. Then, when students get back to the classroom, they will color in the maps to show what the different features are. Finally, students will answer the questions on the second page.
- Lead the class outside to the schoolyard. Remind students to take Activity Page 2.2.1 with them, along with a pencil and clipboard. Once outside, use the compass to identify where north, east, south, and west are. Prompt students to note the directions on their map before they draw anything else.
- Have students get into their groups. Tell students to figure out a walking path that they want to take around the yard. They will need to draw their path on Activity Page 2.2.1 and then draw all of the key things they see around them, such as trees, hills, buildings, playground equipment, and so on. Encourage different groups to take different paths around the schoolyard. Make sure students pay attention to the direction they are walking in so that the maps they draw are accurate.
- Lead the class back inside, and allow students to complete their map drawings and color them in.

SUPPORT—Some students may have a difficult time with spatial skills. Have students work on describing location in relation to objects in the classroom. Set up an area in the classroom with a variety of different objects scattered around. Ask students to practice describing which object is near, far away from, to the left of, to the right of, across from, or in between other objects. This can help students develop the language that they will need in order to work with maps.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 2 Developing and Using Models: Students gain practice drawing maps (two-dimensional models) of the land. Later, students will build on this practice when they develop models of land and water features to meet the Performance Expectation for 2-ESS2-2.

CHALLENGE—Challenge students with an activity that involves converting units of measure in real life to a scale for their maps. They can measure the number of steps it takes between objects in the schoolyard and then come up with a scale for their map that represents the ratio of those steps.

EXTEND—Have students make a topographic map of a part of their community for a take-home project, including elevation data.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings of their maps on Activity Page 2.2.1 to ensure understanding of how to draw the landscape from a bird's-eye view and how to incorporate different features onto a map. It may be necessary to remind students of the meaning of *elevation*.

Circulate around the room as students complete their drawings. Encourage students to use colors to represent different things on their maps. Students can also label the structures on their maps. Remind students that their maps should be drawn from a bird's-eye view.

Review student drawings and responses to the questions on Map It! (AP 2.2.1) to determine understanding of the following concepts:

- Maps show where things are located.
- Maps can show land features like mountains and water.
- Some objects are more north, east, south, or west than others.

Draw attention to the question board. Add any questions students have about identifying land and water features on a map.

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their second stop: Glacier National Park. Logan and his family use a map to find their way around the park. Students gain practice making and interpreting maps in this segment to meet the Performance Expectation 2-ESS2-2.

LESSON 2.3

How Does Water Flow?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: How does water move and collect on land?

Tie to the Anchoring Phenomenon: In Chapter 3 of the Student Book, Logan and his family come across flowing streams of water at Glacier National Park. Today, students will investigate the flow of water downstream.

AT A GLANCE

Learning Objectives

- ✓ Investigate the pattern of downhill flow of water.
- ✓ Relate the behavior of water on Earth's surface to its flow (rivers and streams) and the formation of reservoirs (ponds, lakes, ocean).

Instructional Activities

- teacher demonstration
- student observation
- class discussion

NGSS References

Disciplinary Core Idea: ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practices: 2 Developing and Using Models; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 1 Patterns

Students examine the flow of water and how water interacts with materials in a teacher-led demonstration that models the flow of water on Earth.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

downhill lake low model
ocean pond river stream

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

investigate

Instructional Resources

Activity Page



AP 2.3.1

Activity Page

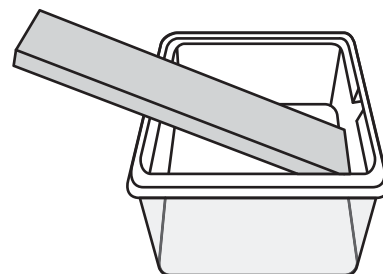
How Water Flows (AP 2.3.1)

Materials and Equipment

- medium-sized clear container or basin, 12" or longer at the base
- water (2 cups)
- measuring cup
- large rocks (2–3)
- blocks of ice (1–2)
- soil (1 cup)
- plank of wood
- heat lamp or hair dryer (optional)
- question board

Advance Preparation

- Set up an area in the classroom where you can perform the demonstration and all students can easily see what you are doing. The area should be close to an electrical outlet, since you may need to use a heat lamp or hair dryer for the demonstration.
- Set the plank so one end is on the container and sloped.
- Freeze two blocks of ice to simulate glaciers by freezing a pint-sized plastic container filled with water.
- Prepare the materials for the demonstration. Fill a measuring cup with water, and set it aside.



THE CORE LESSON 2.3

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.C

How does water move and collect on land?

Elicit a discussion about bodies of water that students have seen in person (e.g., streams, rivers, lakes, oceans, ponds). Explain that some bodies of water on Earth flow and other bodies of water collect the flow. (See **Know the Science 1.**)

Tell students that today they will investigate bodies of water that flow.

2. Conduct a demonstration.

NGSS Elements



DCI ESS2.C

CCC 1

SEP 2

- Have students turn to, or gather around, the area where you will do the demonstration. (See **Know the Standards 1** and **2.**)
- Conduct the following steps:
 - Step 1: Show students the plank of wood. Place it in one end of the container so the plank is slightly slanted at an angle. Explain that this represents a hill that someone might see out in nature.
 - Step 2: Tell students that you are going to pour some water onto the top of the plank. Explain that this represents what happens when it rains.

Ask students what they think will happen to the water when you pour it onto the plank.

» The water will flow down to the bottom of the container.

Know the Science

TEACHER DEVELOPMENT

1. Flow and Bodies of Water: To *flow* means to go from one place to another. This is what some bodies of water—like rivers and streams—do. Rivers and streams are examples of bodies of water that move. Some of them flow into estuaries, which feed into the open sea. Oceans, ponds, and lakes are bodies of water that do not flow to other places in the manner rivers do; however, oceans still move.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth's Surface Processes: Water flows downhill, which students observe in this demonstration. Most glaciers form high in the mountains. Because of their elevation, the glaciers are able to stay cold for most of the year. However, glaciers do move, and they can move downhill, just like liquid water does.

2. CCC 1 Patterns: Students observe in the demonstration that the flow of water stays the same. Water—in its liquid and frozen form—flows downhill.

- Step 3: Slowly pour one-third cup of water at the top of the plank. Discuss whether or not student projections were correct.
- Step 4: Show students the soil. Explain that the soil represents loose soil. Place the soil on the plank.
- Step 5: Show students the rocks. Explain that the rocks represent the natural shape and structure of the land. Place the rocks randomly along the plank and in the container at the bottom of the ramp.

Ask students if they think the water will flow in the same direction again.

- » Yes, the water will flow in the same direction.
- Step 6: Pour a little more water into the container. Discuss what students observed this second time. Students should confirm that the water flowed downhill both times.

Ask students to describe what happened when the flow of water made it to the rocks and soil.

- » The rocks make a path for the water. The rocks changed the direction of the water. The soil got washed away.
- Step 7: Show students the ice block. Tell them that it represents a glacier. Place the ice block at the top of the container.

Ask students what they think will happen if the glacier (ice block) starts to move. Will it flow in the same direction?

- » Yes, the ice block will flow downhill.
- Step 8: Give the block of ice a little nudge so that it slowly moves down the container and collects in the water at the bottom. Relate this to how glaciers move and where they end up. (See **Know the Science 2.**)

3. Summarize and discuss.

NGSS Elements



DCI ESS2.C
CCC 1
SEP 2

- Summarize what students observed from the demonstration. Invite the class to share what kinds of patterns they noticed. Emphasize that the water flowed in one direction and collected at the bottom of the slope.
- Draw student attention to the water that collected at the bottom.

Know the Science

TEACHER DEVELOPMENT

2. Glaciers: Glaciers are huge blocks of ice made by layers and layers of built-up snow. The weight of the ice and the force of gravity cause glaciers to move very, very slowly, even if they are melting. The ice flows down mountain valleys and even out into the sea. Friction at the bottom of the glacier makes the bottom move more slowly than the top of the glacier.

Ask students to describe the water that collected at the bottom of the container. Was it flowing or standing still?

» The water at the bottom was standing still. It was not flowing.

Activity Page



AP 2.3.1

NGSS Elements



DCI ESS2.C

SEP 8

CCC 1

Language Arts
Connection

- Explain that the flowing water in the demonstration modeled the behaviors of rivers and streams. The water at the bottom of the container represented bodies of water that do not flow, like lakes and ponds. (See **Know the Science 3** and **4**.)
- Distribute How Water Flows (AP 2.3.1), and review it as a class. Explain that students will complete the sentence frames based on what they learned from the demonstration. Put students into small groups of mixed ability, and have them work together and discuss their answers as a group. (See **Know the Standards 3** and **4**.)
- Circulate around the room as students work on Activity Page 2.3.1, and provide the following prompts:
 - Think back to what you saw in the demonstration.
 - Did the water flow from top to bottom or bottom to top?
 - Were the results the same each time water was poured into the container?

Know the Science

TEACHER DEVELOPMENT

3. Types of Lakes: It may be necessary to clarify that not all lakes and ponds have rivers or streams that flow into them. Lakes are bodies of water that are surrounded by land, and they are formed in many different ways. The water that you find in a lake can come from precipitation, melted ice, streams that flow into them, or even groundwater that seeps up to the surface. Some lakes lead into rivers. These are called open lakes.

4. The Flow of Water: Water flows downhill because of gravity. Water cannot flow uphill unless a force is acting on it. However, changes in the contour of the land can cause the path of water to change. Additionally, increased volumes of water can carve new paths to flow through the land.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 8 Obtaining, Evaluating, and Communicating Information: Students use what they have learned so far from the Student Book chapters, as well as from the demonstration, to answer questions about the flow of water.

4. Language Arts Connection: Students recall what they observed firsthand to answer questions about the natural behavior of water (ELA W.2.8).

SUPPORT—Some students may have a difficult time making connections between what they saw in the demonstration and answering the questions on Activity Page 2.3.1. If necessary, repeat the demonstration, or call those students up to participate in the same demonstration, this time as a hands-on activity. Students can answer the concept questions/sentence frames as they perform the demonstration. Alternatively, fill in the sentence frames together as a whole-class activity.

CHALLENGE—Give students a piece of drawing paper, and have them draw the path of a stream on one side of the paper. On the other side of the paper, have students draw the path of a stream after adding boulders and trees to the picture. Challenge students to determine how the flow of water will change.

EXTEND—Have students interpret a map of an area in your state that contains water and land features. Prompt students to trace the flow of the rivers or streams to any collections of water, like oceans, ponds, or lakes.

4. Check for understanding.

Monitor Progress

Formative Assessment

Students should be able to connect what they observed from the demonstration to complete the sentence frames.

Review student sentences on How Water Flows (AP 2.3.1) to determine understanding of the following concepts:

- Water flows downhill.
- The flow of water follows a repeated pattern.
- Some objects can change the path of water flow.
- Lakes and ponds are bodies of water that do not flow.
- Rivers and streams are bodies of water that flow.

See the Activity Page Answer Key for correct answers and sample student responses.

Visit the question board to see how many questions have been answered by the activities. Add any new questions students may have.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their second stop: Glacier National Park. Logan and his family see water features along their hike. Students learn more about bodies of water in this demonstration of how some bodies of water move and others do not.

LESSON 2.4

What Does Water Move?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: How can water and ice move dirt, sand, and rocks?

Tie to the Anchoring Phenomenon: In Chapter 3 of the Student Book, Logan and his family come across flowing streams of water at Glacier National Park. They also see a variety of other land features, like mountains and valleys. Today, students learn about how water can move dirt, sand, and rocks.

AT A GLANCE

Learning Objective

- ✓ Investigate the ability of ice to affect Earth's surface.

Instructional Activities

- teacher demonstration
- student observation

NGSS References

Disciplinary Core Ideas: ESS1.C The History of Planet Earth; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 7 Stability and Change

Students investigate the effect of the movement of glaciers on landscapes and the effect of slow and fast changes on Earth's surface.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

glacier

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

erosion friction investigate observe
sediment weathering

Instructional Resources

Activity Page



AP 2.4.1

Activity Page

Moving Ice (AP 2.4.1)

Materials and Equipment

- large shallow container
- sand
- small rocks or pebbles
- miniature “glacier”
- small (16 ounces or less) water bottle
- scissors
- freezer
- blocks
- spray bottle of water
- paper towels
- question board

Advance Preparation

Make a model glacier the night before the investigation.

Step 1: Pour two tablespoons of sand and some pebbles into a water bottle.

Step 2: Fill the water bottle halfway with water.

Step 3: Cap off the bottle, and place it into the freezer on its side until the water is frozen.

Right before the demonstration, cut the bottle apart, and remove the model glacier. Set up an area in the classroom where students can observe the demonstration. Add and level off an inch of sand and pebbles in the large shallow container. Spray the materials in the container until the water takes a moment to soak into the materials. This is the point at which they will be saturated. Set blocks under the corners of one end of the tray so it is propped up about two inches.

1. Focus student attention on Today's Question.

NGSS Elements



CCC 7

How can water and ice move dirt, sand, and rocks?

- **Ask students to describe how a leaf, a flower, a toy sailboat, or another object floats down a river, creek, or stream.**
 - » The object moves along with the water unless it is trapped by something in the water or lands on the shore.
- Emphasize that water has the ability to move or carry things. It can take a leaf from one place and carry it someplace else. Water can also do this with sediment, which is one way that the shape of the landscape changes over time. (See **Know the Science 1.**)

2. Facilitate the investigation.

Activity Page



AP 2.4.1

NGSS Elements



DCI ESS2.C

CCC 7

- Distribute Moving Ice (AP 2.4.1). Tell students that today they are going to see how glaciers (frozen water) change the way the land looks. Students will record their observations on Activity Page 2.4.1.
- Have the students gather around the demonstration area. Explain to students that you are going to do a demonstration on how a glacier will change the shape of the land over which it travels. (See **Know the Science 2.**)
- Spray the sand and rock landscapes with the water bottle until the sand is a little bit wet. It will be close to properly saturated when the water takes a moment to sink into the sand. Let students know that the land underneath a glacier will be very wet, just like the model landscape you are using.
- Draw student attention to the model glacier. **Ask what students think the model glacier is made of.**
 - » frozen water, sand, rocks

Know the Science

TEACHER DEVELOPMENT

1. Flowing Water and Moving Earth Materials: Flowing water has enough energy to pick up sediment from one place and carry it to another. A variety of factors affect how water is able to weather and erode sediment (dirt, sand, and rocks), including slope, speed, volume, and the shape of streambeds and rivers.

2. Modeling Glaciers: Glaciers are incredibly complex! Glaciers slide downhill at an average of about a meter a day. As they move, the sediment inside and below the glacier moves around. Most of this sediment is carried along the sides of the glacier as the ice moves downhill. Some of the sediment is moved within the glacier itself like a conveyor belt moves material. Some of the sediment is carried frozen into the base of the glacier and later released when the ice melts. Finally, some sediment is carried out away from the base of the glacier in meltwater streams where the glacier terminates.

- Place the model glacier at the top of the slope with the sediment side down.
- Have students record their first observation on Activity Page 2.4.1. Tell them to draw in the first drawing box what the landscape looks like.

Ask students to recall what a glacier is.

» A glacier is a mass of frozen water/ice.

- Start to slide the model glacier down the slope. When you reach the midpoint of the slope, tell students to record what happens on Activity Page 2.4.1 in the middle drawing box.

Ask students what they notice happening to the surface of the sand in the tray.

» The ice is starting to change the shape of the sand in the tray. The ice is pushing up the sand and rock in its path.

- Show students the side of the model glacier that was sliding against the sand.

Ask students what they see on the glacier's surface.

» The model glacier has picked up some sand.

Ask students what is happening to the glacier.

» It is picking up sand and rock; it is melting; it is leaving sand and rock in new places.

- Explain to students that the glacier is producing friction against the sediment (sand) underneath it as it moves. This is what causes the sediment to be moved around when the glacier rubs against it.
- Place the model glacier back on the slope, and continue to slide the model glacier to the bottom of the container.
- Have students draw what the landscape looks like now on Activity Page 2.4.1 in the bottom drawing box. Students should be drawing a very different picture from when they started. (See **Know the Standards 1.**)

SUPPORT—Some students may have a difficult time with making visual representations of the concepts they are learning about. Offer these students an opportunity to verbalize their understanding in a discussion, rather than through pictures.

CHALLENGE—Have students write a letter to Logan teaching him about how the landscape he sees at Glacier National Park was most likely created.

NGSS Elements



DCI ESS2.C

Differentiation

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth's Surface Processes: Students explore how water (glaciers) contributes to the changing landscape on Earth as it moves across the land.

EXTEND—Have students research a glacier that interests them and learn about the path it has traveled.

3. Summarize and discuss.

NGSS Elements



CCC 7
SEP 8

- Summarize what students observed from the demonstration. Elicit a discussion about how glaciers change landscapes through erosion and weathering.

Ask students if it is easy or hard for glaciers to move.

» It is hard to move heavy ice.

Ask students if they think these changes to the landscape happen quickly—as quickly as they saw in the investigation—or slowly over time. (See **Know the Standards 2.**)

» These changes happen slowly over time.

- Explain that flowing water, such as rivers, moves sediment, too. (See **Know the Science 3.**)

4. Check for understanding.

Monitor Progress

Formative Assessment

Students should be able to connect what they observed from the investigation to make their before, middle, and after drawings. Do not score students based on artistic ability, but rather on their understanding of the concepts.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 7 Stability and Change: Some changes to Earth's landscape happen quickly, such as changes caused by hurricanes, earthquakes, floods, or volcanic eruptions. However, when it comes to glaciers changing the landscape, these events happen slowly over time.

Know the Science

TEACHER DEVELOPMENT

3. Speed of Water Flow Affects Rates of Weathering and Erosion: Water weathers and erodes rock and soil. For example, the bottom and sides of a river are eroded due to flowing water. The slope, shape, volume, speed, and flow of a river all impact the amount of sediment in a river. Slope has to do with steepness. A steep river has faster flowing water. The volume of water in a river also affects the speed of the water. Water that moves faster carries more sediment. Faster flowing water can also cut away at rocks and other landforms, whereas slow flowing water may not. Rivers that flow more slowly often deposit more sediment on the bottom of the river, rather than carrying it downstream. When rivers have a lot of obstacles such as boulders, this can slow down the speed of the flow. Additionally, when rivers wind, the water slows down to move through the curves. Straight rivers can generally flow faster, thereby causing more weathering and erosion.

Discuss how the glaciers students modeled compare to the glaciers at Glacier National Park.

- » The glaciers at Glacier National Park are made of ice and are slowly melting and moving. The glaciers in the model are much, much smaller and move much more quickly.

Review student drawings on How Water Flows (AP 2.4.1) to determine understanding of the following concepts:

- Glaciers change the landscape.
- Water can cause weathering and erosion.
- Erosion can be a slow process.
- Water, even as glaciers, flows downhill.
- Glaciers carry sediment and deposit it in new places as they flow.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw attention to the question board to see if any student questions about glaciers as landforms have been answered by the activity. Add any new questions students have.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their second stop: Glacier National Park. Logan and his family see a glacier at the lookout. Students have learned more about how glaciers change the landscape.

LESSON 2.5

Where Can We Find Water?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: How are glaciers, mountain streams, and lakes related?

Tie to the Anchoring Phenomenon: Logan learns about mountains, ice, and water during his visit to Glacier National Park. Students will learn more about the different bodies of water that Logan sees along the way.

AT A GLANCE

Learning Objective

- ✓ Identify bodies of liquid water, including rivers, streams, and lakes.

Instructional Activities

- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Idea: ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 1 Patterns

Students learn about the role glaciers play in the formation of land features and their effect on bodies of water.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

glacier lake river stream

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 4

Student Book, Chapter 4
"Mountains, Ice, and Water"

Activity Page



AP 2.5.1

Activity Page
Solve a Riddle (AP 2.5.1)

Materials and Equipment

- putty
- question board
- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 2.5

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.C
CCC 1
SEP 8

How are glaciers, mountain streams, and lakes related?

- Remind students that they investigated how glaciers carve and shape the land as they slowly move.
- **Ask students to identify local streams, creeks, rivers, lakes, and ponds and discuss their knowledge and experience with them.**
 - » Some students may have been boating or swimming or wading. Others may have experienced dry spells or flooding.
- **Discuss what students know about the differences among different bodies of water by asking these questions:**
 - What is the difference between a lake and a pond?
 - » Accept all reasonable responses. A lake is bigger than a pond. Both are contained bodies of water.

- What are the differences among rivers, streams, and creeks?
 - » Accept all reasonable responses. All three bodies of water are moving. A river is the biggest, and a creek is the smallest.

2. Turn and talk.

NGSS Elements



DCI ESS2.C

CCC 1

SEP 8

Have students turn to a neighbor and discuss their thoughts about these questions:

- What do you think happens when glaciers melt?
 - » Accept all reasonable responses. The water flows down in a creek to a stream to a river to a lake or the ocean.
- What do you think is the difference between rivers and lakes?
 - » Accept all reasonable responses. A river is moving water. A lake is contained.

Give pairs a few minutes to discuss, and call on volunteers to share their answers.

Tell students that today they will read about how glaciers also help form different bodies of water.

3. Read together: “Mountains, Ice, and Water.”

Student Book

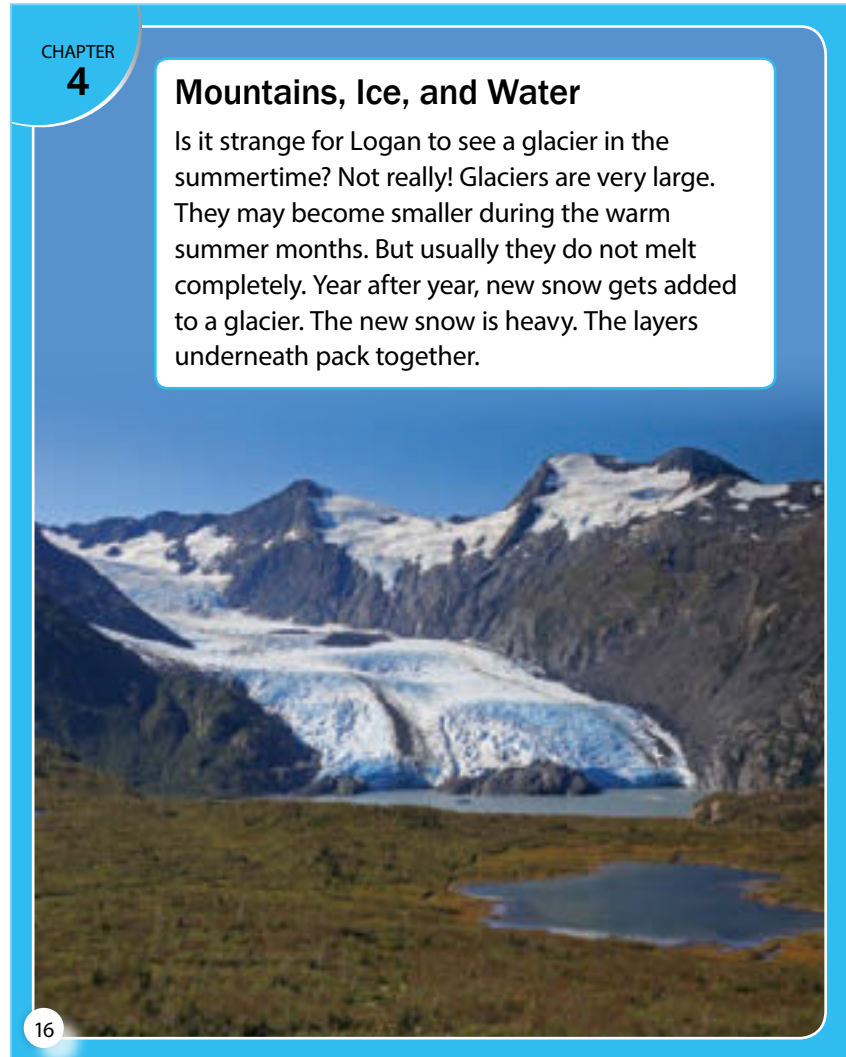


Ch. 4

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Page 16

Ask students to turn to page 16 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Mountains, Ice, and Water,” and tell them to pay special attention to the pictures of the different landforms as you read.



NGSS Elements



DCI ESS2.C

Ask students to look at the picture on page 16. Talk about what they see. Where is the glacier? Have students point to the glacier in the picture. (See **Know the Standards 1.**)

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth’s Surface Processes: Students read about glaciers and snow as frozen forms of water and view liquid forms of water as lakes in the picture.



LITERAL—What water in the picture is frozen? What water in the picture is liquid?

- » The snow on the mountains and the glacier are frozen. The lakes at the bottom of the mountain are liquid.

LITERAL—Why isn't it strange to see a glacier in the summertime?

- » It isn't strange because glaciers are so big and do not melt completely.

LITERAL—What keeps glaciers from melting completely? (See **Know the Science 1.**)

- » Snow is always being added to glaciers. This keeps them from melting completely.

CORE VOCABULARY—Ask students to describe a **glacier**. They should know that a glacier is a body of dense ice formed over years of snowfall that never melts. A glacier is constantly moving under its own weight.

Know the Science

TEACHER DEVELOPMENT

1. Glaciers: Glaciers are, in fact, melting more and more around the world due to global warming. Global warming is increasing the average temperatures in places where even glaciers exist. Even so, glaciers can still be seen year-round. Glacial ice can be hundreds of thousands of years old. The oldest ice is at the bottom of the glacier and the newest ice is at the top. The ice of glaciers behaves almost like a plastic. A glacier's characteristics are much different than that of an ice cube or block of ice.

Many glaciers form high in the mountains where it stays cold all year. The weight of the snow and ice and the melted water underneath it cause a glacier to move. Like any object on a steep hillside, a glacier can slide downhill. A glacier slowly flowing downhill can look like a river of ice.



17

- Describe how glaciers move. (See **Know the Science 2.**) The investigations that students did in the last class segment demonstrated how glaciers cause weathering and erosion, but glaciers actually go through an interesting process when the ice begins to move.

Differentiation

SUPPORT—Do a demonstration for students to show them how this might look. Roll some putty into the shape of a log, and explain that this represents a glacier. Grab the ends, and slowly start to pull it apart. Students will observe the putty sag in the middle, but the “glacier” will stay intact. Explain that this is similar to how ice moves. It flows faster in the middle, and the glacier deforms.

Know the Science**TEACHER DEVELOPMENT**

2. Gravity and Glaciers: Gravity is one of the forces at play in glacial movement. Glaciers actually go through a process called internal deformation, which happens when they start to move. The ice that makes up a glacier moves at different speeds. In this way, it behaves like a warm plastic. The ice in the middle of the glacier flows faster than the ice at the sides of the glacier.



LITERAL—Where do most glaciers form?

» Most glaciers form high in the mountains.

LITERAL—Which direction does a glacier flow?

» A glacier flows downhill.

LITERAL—What happens when a glacier flows to a place where the land meets the water?

» Pieces of the ice fall off into the water.

Page 18

Ask students to look at the three pictures on page 18. Talk about the landforms they see. Explain that these were all caused by glaciers.

Glaciers move rock and soil as they move. They can change the land around them in different ways. They can push and pile up large and small boulders. They can carve out U-shaped valleys. They can leave steep peaks at the tops of mountains.



This bowl-shaped land shows where a glacier used to be.



Matterhorn is a steep mountain peak in Europe that was carved by glaciers.



A glacier melted here long ago. It left behind boulders. It pushed these rocks down from the mountain.

SUPPORT—Talk about the different ways that glaciers can change the shape and appearance of the land. Refer back to the investigation that students did in the previous class. **Ask students if their glacier pushed and piled up the sand or carved out areas or hollows.**

LITERAL—What is the Matterhorn? How was it formed?

- » The Matterhorn is a steep mountain peak. It was formed by a glacier that carved it.



Draw student attention to the bottom picture.

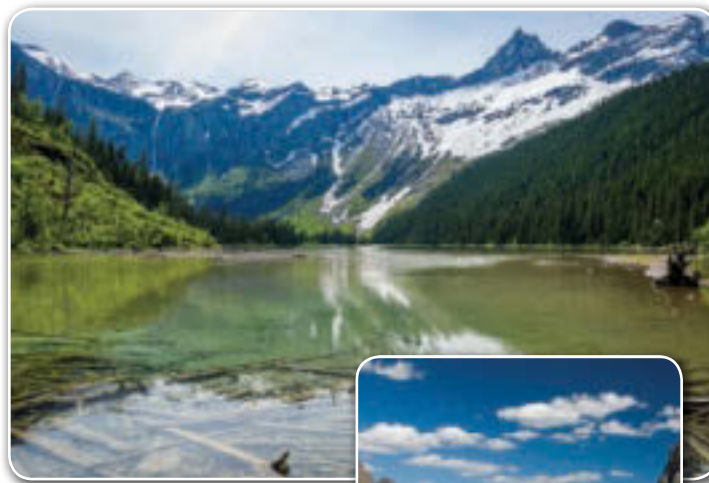
LITERAL—How did a glacier form this landscape?

- » A glacier melted there and left behind boulders. The boulders were pushed down from the mountain.

Page 19

Ask students to look at the two pictures on page 19. Focus on the water features. Talk about the different ways that glaciers contribute to the water features that are found near them.

Glaciers shaped the land in Glacier National Park. They also helped form its water features. Many glaciers melt a little in the summer. Water flows out from them. It flows into streams, rivers, and lakes. Some glaciers melt completely over time. When this happens, the hollow shape of the glacier is left behind. It fills with water, and a lake is formed.



Sliding glaciers can grind rock into a fine powder. The powder mixes with water in lakes. It can make them appear blue or green.





3D Learning: Students use their books to learn about rivers, lakes, and streams (liquid forms of water) and how glaciers (solid forms of water) can contribute to forming them over time. This is a pattern in nature that students begin to recognize.

CORE VOCABULARY—Explain that a **river** is a large body of water that flows from a higher to a lower elevation. A **stream** is also a flowing body of water, but streams are not as large as rivers. They are also usually shallower and not as wide as rivers either. Oftentimes, smaller streams flow into rivers. **Lakes**, on the other hand, are bodies of water that do not flow. Lakes are surrounded by higher land, so the water stays where it is. (See **Know the Standards 2.**)

LITERAL—How does a glacier help form water features?

- » When glaciers melt, water can flow out of them into streams, rivers, or lakes. Also, some glaciers melt completely and leave behind areas that form lakes because they fill with melted snow and ice.

4. Watch a video.

Online Resources



- Tell students that they are going to watch a video of glaciers in Greenland. Start the video at 1:11. Stop the video at 2:35.
- **Ask students how they think the glaciers they saw in the video are changing the landscape of Greenland.**
 - » Instead of ice, bare rock is exposed. Icebergs are falling into the ocean. Large rocks are moving into new positions.

NGSS Elements



DCI ESS2.C
SEP 8

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

- Have students form pairs. Distribute Solve a Riddle (AP 2.5.1) to each student. Tell students to work together to solve the riddles. Encourage students to talk about the descriptions, and prompt them to read page 19 in the Student Book again if they need to. (See **Know the Standards 3.**)

Activity Page



AP 2.5.1

Know the Standards

TEACHER DEVELOPMENT

2. PE 2-ESS2-3: The activities in this segment contribute in part to the Performance Expectation by having students learn about and identify bodies of water and where to find them on Earth. Students will continue to gather information about where water is found on Earth—and in what forms—throughout the unit.

3. SEP 8 Obtaining, Evaluating, and Communicating Information: Students use what they learned about from the Student Book and watched in the video to answer a scientific question about how glaciers are changing the landscape of Greenland.

Differentiation

SUPPORT—Some students may not have a developed understanding of the English language, which would make the riddles difficult to interpret. Allow these students to draw pictures of what a river, stream, and lake look like.

Online Resources



EXTEND—Explore glacial melt at Glacier National Park by accessing the National Park Service website. Display pictures that show how the glaciers have changed over the past century. Discuss where the melted water from the glaciers has gone. (See **Know the Standards 4.**)

See the Online Resources Guide for a link to the recommended website:

www.coreknowledge.org/cksci-online-resources

5. Check for understanding.

Monitor Progress

Formative Assessment

Look for student responses on Activity Page 2.5.1 to ensure understanding of water features and their connection to glaciers and mountains.

Use the following question prompts to monitor progress and gauge understanding:

- Where can you find water on Earth?
 - » lakes, rivers, streams, glaciers
- What forms can water be found in?
 - » liquid and solid/frozen ice
- What can you do to find out more information about water on Earth?
 - » read, watch videos, look things up on the internet

Review student responses on Solve a Riddle (AP 2.5.1) to determine student understanding of the following concepts:

- Lakes are still bodies of water.
- Rivers are large flowing bodies of water.
- Streams are smaller flowing bodies of water.
- Glaciers can help form rivers, lakes, and streams.

Know the Standards

TEACHER DEVELOPMENT

4. Differentiation: For students who want to learn more about glaciers, there are numerous things for them to find out. Glaciers are an important topic in the discussion of global warming and climate change, because of the threat of them melting and causing sea levels to rise around the world. Students can apply concepts of science and relate them to society to learn about the effects that melting glaciers can have on people.

See the Activity Page Answer Key for correct answers and sample student responses.

Review the answered and unanswered questions on the question board with students. Add any new questions that students may have about glaciers or bodies of water.

Tie to the Anchoring Phenomenon

Logan learns more about the glaciers he sees at Glacier National Park. Students become more familiar with how glaciers form and move and how they help create bodies of water on Earth.

LESSON 2.6

Modeling Land and Water Features

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can water change land?

Today's Question: How can we model a place's land and water?

Tie to the Anchoring Phenomenon: In Chapter 3 of the Student Book, Logan and his family see a variety of land and water features at Glacier National Park. Today, students learn how to model land and water features in an area that they learned about from Logan's trip.

AT A GLANCE

Learning Objective

- ✓ Model land and water features in a familiar area.

Instructional Activities

- modeling
- student presentation

NGSS References

Performance Expectation: 2-ESS2-2

Disciplinary Core Idea: ESS2.B Plate Tectonics and Large-Scale System Interactions

Science and Engineering Practice: 2 Developing and Using Models

Crosscutting Concept: 1 Patterns

Students build models of landforms that represent the shapes and kinds of land and bodies of water in specific areas.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

landform map model water

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

represent

Instructional Resources

Activity Pages



AP 2.6.1
AP 2.6.2

Activity Pages

Land and Water Flags (AP 2.6.1)
Scrapbook—Lesson 2
(AP 2.6.2)

Materials and Equipment

- flour (3 cups per group)
- salt (1 cup per group)
- water (1 cup per group)
- oil (3 tablespoons per group)
- green food coloring
- brown food coloring (or brown paint)
- blue food coloring
- large mixing bowl
- plastic resealable bags (4 per group)
- foam boards (1 per group)
- toothpicks (1 for each flag, multiplied by the number of groups)
- scissors (1 pair per group)
- glue (1 bottle per group)
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Make the salt dough the night before (or some time before) to save classroom time:
 - Step 1: Mix the flour and salt in the large mixing bowl.
 - Step 2: Gradually add the water, and form a ball. Knead the ball until it stays together.
 - Step 3: Divide the large ball of dough into four balls.
 - Step 4: Add green food coloring to one ball of dough, brown food coloring to another ball, and blue food coloring to another ball, and leave the fourth ball its regular color.
 - Step 5: Place each ball of dough into a resealable plastic bag. Seal well.

- Print Land and Water Flags (AP 2.6.1), and make enough copies to distribute one page to each group.
- Prepare areas of the classroom where students can work in small groups and use tables to make their models on. Have the materials already at each work area.

THE CORE LESSON 2.6

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.B

How can we model a place's land and water?

- Remind students that Logan is visiting Glacier National Park with his family.
- Ask students to list some of the land and water features that they have learned about in Chapters 3 and 4 of the Student Book.
 - » mountains, valleys, glaciers, rivers, lakes, streams
- Tell students that today they will make a model of the land and water features at Glacier National Park. (See **Know the Science.**)

2. Introduce the activity.

NGSS Elements



DCI ESS2.B

SEP 2

CCC 1

- Have students form small groups of mixed ability, and prompt them go to their assigned work areas, where the materials for the investigation are already set up. Explain that students will work together as a group to make a model of some of the land and water features that Logan learned about on his trip to Glacier National Park. This includes structures like hills, mountains, valleys, streams, rivers, lakes, and—of course—glaciers.
- If time allows, have students make models of the landscapes they drew in Lesson 1.
- Walk through the materials that students see in front of them:
 - Dough: Explain that students will use the dough for molding land and water features. The green dough can be used to represent greenery. The brown dough can represent rock. The natural dough can be used to represent sand, glaciers, or snowy mountaintops. And the blue dough represents water.

Know the Science

TEACHER DEVELOPMENT

Models and Science: A model is something that represents something else. Scientists use models all the time. Models help scientists study natural phenomena more closely. Models are usually smaller in scale than the thing in real life that is being studied. For instance, a globe is a model of planet Earth. A globe is much smaller than Earth, but it still looks just like Earth. In this activity, students are going to make a model of the land and water features at Glacier National Park. This means that they are going to make their idea of the land and water features come to life in a way that they can see and touch.

- Flags, toothpicks, glue, and scissors: Students will use the flags to label the land and water features in the model. Students will cut out the flags that they wish to use and glue them to the toothpicks. Assist as necessary. Then they can stick their toothpicks into the dough. If necessary, demonstrate for students how to make their flag labels. Clarify that they do not need to use all of the flags but that they need to have at least two land features and two water features.
- Foam board: This is the base for the model. Students will make their dough land and water features on the boards.

Differentiation

SUPPORT—Some students may have a difficult time understanding how they can make a model of the landforms using the dough. If necessary, give students practice molding the dough into different shapes or structures that you call out. This can get them used to seeing how the dough can be made to look like other things.

3. Facilitate the activity.

NGSS Elements



DCI ESS2.B

SEP 2

CCC 1

3D Learning

Differentiation

3D Learning: Students use their knowledge and Student Books to make models of the landforms they have encountered. (See **Know the Standards.**)

- Tell students to start working on their models. They must have at least two land features and at least two water features.
- Circulate around the room as groups work on their models. Provide assistance to individual groups as necessary. Make sure students are using the flags to correctly label the structures on the models.

SUPPORT—Some students may not know where to start when it comes to making models. Guide students to start by making the land features and figuring out where to put the water features in relation to the land features. For instance, a group might make a mountain with a valley. Then ask the group where they would put a glacier or a lake.

CHALLENGE—Have students draw maps of their models once the models are complete. Students can use construction paper and colored pencils. Tell students to draw their maps similarly to the topographic maps they learned about and saw in Lesson 2.2. Students should label their maps and draw them as precisely as possible.

Know the Standards

TEACHER DEVELOPMENT

PE 2-ESS2-2: Students make models of the topography that represent the kind of land and bodies of water that can be found at Glacier National Park. Students understand that land and water features have patterns. For instance, glaciers and rivers flow downhill; they never flow uphill. Lakes are always surrounded by higher land.

EXTEND—Give students the opportunity to make a model of the land and water features in their area or state. Provide students with a topographic map that you found that they can interpret, and have them translate an area of the map to base their models on.

- Give students time to wrap up their models.

4. Present the models.

NGSS Elements



DCI ESS2.B

SEP 2

CCC 1

Go around the room, and have groups share their models with the rest of the class. Prompt students to describe and answer questions about the land and water features they chose to model. **Ask** questions such as the following:

- Is this a land or water feature?
- How does it compare to other land or water features?
- How is it formed on Earth?

5. Check for understanding.

Monitor Progress

Formative Assessment

Students should be able to correctly identify the different structures in their models with the labeled flags. Check to ensure flags are placed correctly in the models. Do not score students based on artistic ability, but rather demonstration of the concepts.

Activity Page



AP 2.6.2

Distribute Scrapbook—Lesson 2 (AP 2.6.2). Remind students that they are going to be filling out scrapbook pages to document Logan’s trip around the United States.

Review student models and the placement of their labeled flags to determine understanding of the following concepts:

- Water features include glaciers, lakes, rivers, and streams.
- Land features are mountains, hills, and valleys.
- Valleys and lakes are surrounded by higher land.
- Rivers, streams, and glaciers flow downhill.
- Lakes do not flow, but glaciers can melt into lakes.
- Mountains are higher than hills.

See the Activity Page Answer Key for correct answers and sample student responses.

Ask students if they have any other questions about the land and water features that they have learned so far in the unit, and add them to the question board.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their second stop: Glacier National Park. Logan and his family see a variety of land and water features during their trip. Students make a model of the land and water features at Glacier National Park.

LESSON 3

Land, Water, and Changes: Examples in Yellowstone National Park

OVERVIEW

Guiding Question: How can volcanoes change land?

Lesson 3 Segments	Segment Questions	Advance Preparation
3.1 What Is Yellowstone National Park? Students read about Logan’s third stop to Yellowstone National Park and the landforms that can be found there.	How is Yellowstone National Park different from Glacier National Park?	Read Chapter 5 in the Student Book.
3.2 Geysers and Groundwater (2 days) Students work on a two-day investigation to learn how groundwater works and how geysers form.	What happens to water that soaks into the ground?	Gather materials for investigation. See Materials and Equipment.
3.3 What Are Volcanoes? Students read about volcanoes.	What are volcanoes?	Read Chapter 6 in the Student Book. Prepare to show a video.
3.4 Modeling Volcanoes and Earthquakes Students investigate how volcanoes work and get an introduction to the idea that earthquakes can change the land.	How can we model volcanoes and earthquakes?	Gather materials for student investigation. See Materials and Equipment.

What’s the Story?

Summary: In Lesson 3 (Segments 1–4), students explore what geysers and volcanoes are and how they change the shape of the land (2-ESS1-1 and 2-ESS2-3). Students participate in investigations where they observe how water can collect underground and come up out of the earth through geysers. Later, students make models of volcanoes. Students then observe how earthquakes can shape the land. The developing understanding of these phenomena in Lesson 3 prepares students for their work in Lesson 5, when they will build on their knowledge of landforms to study rock formations.

Learning Progression: Lesson 3 builds toward the Grade 2 target of 2-ESS1-1: *Use information from several sources to provide evidence that Earth events can occur quickly or slowly.*

Guiding Phenomenon: The natural landscape changes its shape and appearance due to Earth events that occur quickly or slowly. These changes can be explored by touring United States national parks. Geysers are landforms that shoot water out of them, and they often form in clusters around volcanoes. Volcanoes can change landforms quickly when they erupt.

Learning Objectives

By the end of Lesson 3, students will do the following:

- Describe plains, geysers, and volcanoes.
- Identify how water soaks into the ground.
- Describe how geysers and volcanoes work.
- Talk about how earthquakes can change the land.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (partial)

Performance Expectation: 2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area. (partial)

Performance Expectation: 2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid. (partial)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>2 Developing and Using Models</p> <p>Develop a model to represent patterns in the natural world.</p> <p>6 Constructing Explanations and Designing Solutions</p> <p>Make observations from several sources to construct an evidence-based account for natural phenomena.</p> <p>8 Obtaining, Evaluating, and Communicating Information</p> <p>Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.</p>	<p>ESS1.C The History of Planet Earth</p> <p>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.</p> <p>ESS2.B Plate Tectonics and Large-Scale System Interactions</p> <p>Maps show where things are located. One can map the shapes and kinds of land and water in any area.</p> <p>ESS2.C The Roles of Water in Earth’s Surface Processes</p> <p>Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.</p>	<p>1 Patterns</p> <p>Patterns in the natural world can be observed.</p> <p>7 Stability and Change</p> <p>Things may change slowly or rapidly.</p>

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 3.1

What Is Yellowstone National Park?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can volcanoes change land?

Today's Question: How is Yellowstone National Park different from Glacier National Park?

Tie to the Anchoring Phenomenon: Students learn about plains and the horizon as they join Logan and his family on their trip to Yellowstone National Park.

AT A GLANCE

Learning Objectives

- ✓ Identify plains.
- ✓ Define *horizon*.

Instructional Activities

- teacher Read Aloud
- class discussion
- student observation
- question generation

NGSS References

Disciplinary Core Ideas: ESS2.B Plate Tectonics and Large-Scale System Interactions; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 1 Asking Questions

Students learn about the land and water features at the volcanic Yellowstone National Park and then identify landforms they saw and ask questions about them.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

erupt **geyser** **horizon** **plains**
volcano

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 5

Student Book, Chapter 5

“Next Stop—Yellowstone National Park”

Activity Page

Yellowstone National Park
(AP 3.1.1)

Activity Page



AP 3.1.1

Materials and Equipment

- question board
- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 3.1

1. Introduce students to Lesson 3.

- Ask a volunteer to state the Big Question that you’ll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**
- Tell students that, before they can answer the unit’s Big Question about the land, they first need to understand the different kinds of landforms. So far, students have learned about glaciers, hills, mountains, valleys, rivers, and other bodies of water.
- Introduce Today’s Question: **How is Yellowstone National Park different from Glacier National Park?** Remind students that in this unit they will be taking a tour of some of the national parks in the United States along with Logan and his family as they learn about Earth’s landforms and history. **Ask students which parks they have toured so far.**
 - » Mount Rushmore National Memorial and Glacier National Park
- **Ask what students already know about Yellowstone National Park.**
 - » Accept all reasonable answers. Some students may know about bears there or about geysers.

- Explain that in Lesson 3, students will tour Yellowstone National Park to learn about plains, geysers, groundwater, volcanoes, and earthquakes to apply their understanding to the Big Question. Write the Lesson 3 Guiding Question where students can see it:

How can volcanoes change land?

Tie to the Anchoring Phenomenon

As students work through Lesson 3, they will learn how some landforms are changed over time to look how they do today, when Logan and his family go to visit them.

2. Read together: “Next Stop—Yellowstone National Park.”

Student Book



Ch. 5

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students. (See **Know the Standards 1.**)

NGSS Elements



DCI ESS2.C

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS2.C The Roles of Water in Earth’s Surface Processes: As students journey to Yellowstone National Park with Logan and his family in the Student Book, they learn about more places on Earth where water can be found. Geysers store water in underground reservoirs. Then, geysers shoot liquid water into the air.



Ask students to turn to page 20 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Next Stop—Yellowstone National Park,” and tell them to pay special attention to the pictures of the different landforms as you read.

CHAPTER
5

Next Stop—Yellowstone National Park

Logan’s family hits the road again. They make their way to Yellowstone National Park. Yellowstone spreads out over parts of three states—Wyoming, Montana, and Idaho. In Glacier National Park, Logan saw how snow and ice can shape land. In Yellowstone National Park, Logan sees some very hot water too!

This huge geyser called Old Faithful is Yellowstone’s most famous feature. A geyser is an underground pocket of water that gets heated. When it gets hot enough, the water shoots out of the ground. This happens the way a pot can boil over on a stove.

NGSS Elements


 DCI ESS2.C
SEP 1

Ask students to look at the picture on page 20. Talk about what they see. Explain that the picture shows a geyser and that water is shooting out of it.

CORE VOCABULARY—Explain that a **geyser** is an underground pocket of water. It gets heated, and when it becomes hot enough, water shoots out of the ground. (See **Know the Science 1.**)

Know the Science

TEACHER DEVELOPMENT

1. Geyser Mechanics: Geysers erupt when enough pressure due to heat builds up in the pockets of water underground. Steam forms during a geyser eruption in a way that is similar to a boiling tea kettle. When geysers erupt, jets of water and steam can shoot up at heights that range from a few feet to a few hundred feet. Like volcanoes, not all geysers around the world are active. Some of them are dormant. Geysers also tend to form around active volcanoes. This means that Logan and his family might be near a volcano.

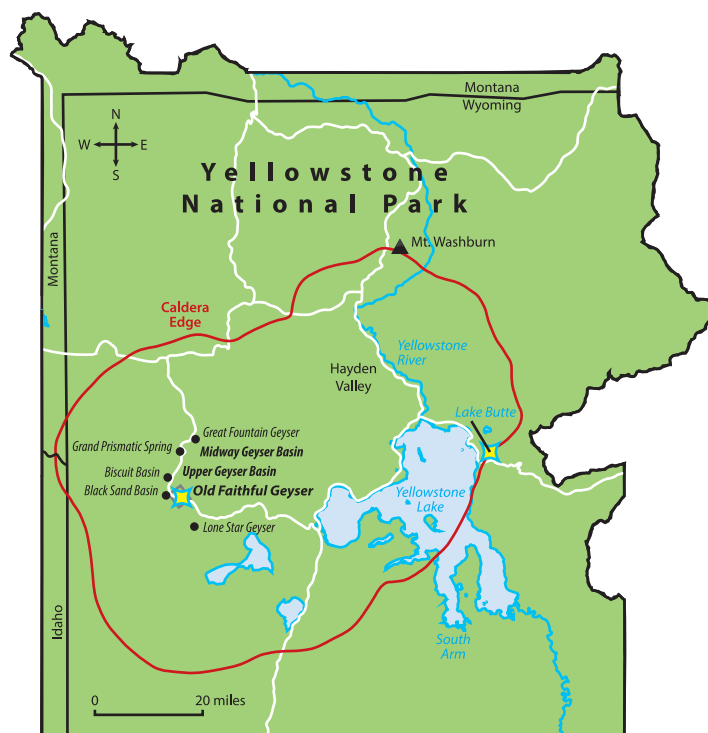
Draw student attention to the landscape besides the geyser. **Ask students to describe what they see.** Prompt students with questions like “Is the landscape flat or hilly?” and “Do you see a lot of tall trees?” Explain that students are looking at plains.

CORE VOCABULARY—Explain that **plains** are flat areas of land with grass and very few trees. Logan and his family can see plains at Yellowstone National Park.

Page 21

Ask students to look at the map on page 21. Talk about the map students see on the page. (See **Know the Standards 2.**)

Once again, Logan’s family uses a map of the park. The map shows the land and water features they have come to see. There is one very large lake in the park. There are a few smaller lakes, too. The map shows mountains. The area in the middle of the park seems flatter, though. This part is full of places called geyser basins.



21

NGSS Elements



DCI ESS2.B
SEP 1

LITERAL—What kinds of things can Logan and his family tell from this map?

- » They can tell where the land and water features are. They can tell where to find the lakes, mountains, flat parts (plains), and geysers.

Know the Standards

TEACHER DEVELOPMENT

2. DCI ESS2.B Plate Tectonics and Large-Scale System Interactions: Students were introduced to maps in Lesson 2. Here, students review how a map can be used to find key land features that Logan and his family want to see.

INFERENTIAL—How will the map help Logan and his family?

» The map will help Logan and his family find things at the park.

Page 22

Ask students to look at the two pictures on page 22. Explain that the pictures show geysers and that people are walking right near them.

The family visits a place called Midway Geyser Basin. Logan can feel heat as he and his family cross the boardwalk over Midway Geyser Basin. He can see steam rising off the hot springs around them. Where does the heat come from? It comes from inside Earth, beneath their feet. Logan and his family are walking across the top of a giant volcano!



22

LITERAL—What does Logan feel as he walks across the boardwalk of the geyser?

» He feels heat.

LITERAL—Where does the heat come from?

» It comes from inside Earth.

NGSS Elements



DCI ESS2.C

Draw student attention to the second picture. Have students point to the liquid water in the picture. Then point out that gaseous water is called water vapor. Water vapor is particles of water spread far apart by heat, such as the steam that is rising from the pool of water. Explain that steam is also water that can be found on Earth and is what happens to water when water gets very hot.

Ask students to look at the picture on page 23. Remind students that a lake is a body of water that stands still and does not flow.

Next, the family visits Yellowstone Lake. The lake sits in part of an area known as the Yellowstone Caldera. A caldera is the bowl-shaped crater at the center of a volcano. A volcano erupted here thousands of years ago. Logan can see mountains and forests around the lake. The lake is formed in the low area in the center of the caldera.



23

LITERAL—What landforms do you see in the picture?

» mountains with snow

LITERAL—What happened here thousands of years ago?

» A volcano erupted.

CORE VOCABULARY—Explain that a **volcano** is an opening in Earth's surface that allows hot melted rock and hot gases to erupt out of it.

CORE VOCABULARY—Explain that **erupt** means to explode. An **eruption** is when hot lava, ash, and gases shoot out of a volcano. (See **Know the Science 2.**)

Know the Science

TEACHER DEVELOPMENT

2. Do All Volcanoes Erupt? It may be necessary to clarify that only active volcanoes erupt. Some volcanoes exist around the world but are inactive (or dormant). This means that they no longer erupt. Tell students that they will learn more about volcanoes and eruptions in Chapter 6 of the Student Book.

CORE VOCABULARY—Talk to students about the meaning of the term **horizon**. Explain that the horizon is where the land meets the sky. **Ask students to describe the horizon they see in the picture on page 23.**

3. Draw the horizon.

Activity Page



AP 3.1.1

NGSS Elements



DCI ESS2.B

SEP 1

Differentiation

- Distribute Yellowstone National Park (AP 3.1.1) to each student. Tell students that they will complete the sentences and draw a picture of a horizon with some of the things that Logan saw at Yellowstone National Park, such as geysers, mountains, plains, and lakes. Tell them to label the landforms in the drawing. (See **Know the Standards 3**.)
- Circulate around the room as students draw, and ensure proper understanding of *horizon*, along with the landforms.

SUPPORT—If students are just learning English, they may have a difficult time remembering the names of the landforms they read about in Chapter 5, such as geysers, plains, and mountains. Alternatively, allow these students to draw pictures of what Logan and his family saw, instead of labeling their drawings.

CHALLENGE—Challenge students to explain why you can find water at geysers in two different forms.

EXTEND—Have students research active and dormant volcanoes in the United States or around the world. Ask students to present their findings to the class. Be prepared to discuss the term *extinct* with students, as they will come across it during their research. There is a difference between active, dormant, and extinct volcanoes. An erupting volcano is an active volcano that is having an eruption. A dormant volcano is an active volcano that is not erupting but is supposed to erupt again. An extinct volcano has not had an eruption for at least 10,000 years and is not expected to erupt again in a comparable time scale of the future.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look for student responses on Activity Page 3.1.1 to ensure understanding of land and water features that are specific to Yellowstone, as well as understanding of horizons. If students do not have proper understanding of land and water features, go back through the Student Book, pages 20–23, and name the landforms that students see.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 1 Asking Questions: Ask students what additional questions they have about Yellowstone National Park, geysers, plains, or horizons, and add their questions to the cumulative question board.

Ask students how Yellowstone National Park is different from Glacier National Park.

- » Yellowstone National Park has different landforms, like geysers, volcanoes, and plains. It does not have glaciers.

Ask students to compare geysers and glaciers.

- » Glaciers are frozen water in the form of unmelted snow and ice. They are found in cold climates. Geysers are eruptions of hot mineral water that come from underground.

Review student drawings and labels on Yellowstone National Park (AP 3.1.1) to determine student understanding of the following concepts:

- There are plains, geysers, volcanoes, mountains, and lakes at Yellowstone National Park.
- The horizon is where land meets the sky.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review any questions that have been answered and add any new questions students may have about Yellowstone National Park.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their third stop: Yellowstone National Park. Students should be more and more familiar with the idea that water exists on Earth as a liquid or a solid. Here, students will also learn how water can be found in the form of a gas—and as hot steam, which contains liquid water particles—that comes out of geysers.

LESSON 3.2

Geysers and Groundwater

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can volcanoes change land?

Today's Question: What happens to water that soaks into the ground?

Tie to the Anchoring Phenomenon: In Chapter 5 of the Student Book, Logan and his family encounter geysers. In today's segment, students will investigate how water can collect underground and how heat can cause it to bubble to the surface again.

AT A GLANCE

Learning Objectives

- ✓ Identify groundwater as a repository of Earth's water that is not visible.
- ✓ Describe geysers.

Instructional Activities (2 days)

- student investigation
- student observation
- teacher demonstration
- drawing

NGSS References

Disciplinary Core Idea: ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 2 Developing and Using Models

Crosscutting Concept: 1 Patterns

Students model the flow of groundwater through Earth's surface, and then they learn the process of groundwater turning into a geyser.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

erupt **geyser** **groundwater**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

examine investigate observe

Instructional Resources

Activity Pages



AP 3.2.1

AP 3.2.2

Activity Pages

Modeling Groundwater

(AP 3.2.1)

Geyser Go! (AP 3.2.2)

Materials and Equipment

Day 1:

- coarse sand and gravel
- plastic animal figurines (assortment, 2–3 per group)
- black marker
- safety pin
- clear plastic cups (2 per group)
- turkey basters (1 per group)
- clear containers (1 per group)
- water (2 cups per group)
- blue food coloring
- water bottles (1 per group)

Day 2:

- water (1 cup)
- small pot or saucepan
- electric burner
- aluminum foil
- metal funnel (taller than the depth of the pot)
- question board

Advance Preparation

Day 1:

Prepare some of the materials ahead of time.

- Draw rings around the perimeter of the plastic cups with a black marker.
- Poke small holes into the plastic cups along the rings with the pin.
- Fill the water bottles with water, and add blue food coloring to them.

Set up work areas around the classroom where students can carry out their investigations, and have the materials already available. Each work area will need the following:

- clear container
- coarse sand and gravel
- plastic animal figurines
- 1 clear plastic cup with rings drawn on and holes poked
- 1 clear plastic cup
- 1 turkey baster
- 2 cups of blue water in a water bottle

Day 2:

Prepare an area of the classroom where you can set up for the demonstration. You will need to be close to an outlet, since you will be using an electric burner.

THE CORE LESSON 3.2

1. Day 1: Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.C

What happens to water that soaks into the ground?

- **Ask students where they can find water on Earth.**
 - » We can find water in lakes, rivers, oceans, streams, and glaciers.
- Tell students that water can also be found in places where we cannot see it, like underground. Water that is underground is called *groundwater*.
- **Ask students if they have ever wondered what happens to the water when it rains. Ask students, Where does the water go?**
 - » Accept all reasonable answers. Some may say it soaks into the ground. Others may say it flows into creeks and drains.
- Explain that when it rains, most water soaks into the ground. This water may collect underground in pockets of soil or rock. But it can also spread around once it is underground and go to different areas. Tell them that today they will investigate groundwater. (See **Know the Science 1.**)

Know the Science

TEACHER DEVELOPMENT

1. The Flow of Groundwater: At this grade level, students need to learn that water seeps into the ground from the surface when it rains. Students do not yet need to learn about aquifers, water tables, and saturated and unsaturated zones. Groundwater is fresh water, and this means it is available for human use. People pump groundwater up through wells, which they can then use for drinking, domestic purposes, agriculture, and mining. But this water is in short supply. Only about one percent or less of water on Earth is found in rivers, in lakes, or as groundwater. It is important to clarify that groundwater does not make up a lot of Earth's water.

2. Preview the investigation.

NGSS Elements



CCC 1

DCI ESS2.C

Language Arts
Connection

Activity Page



AP 3.2.1

- Have students form small groups of mixed ability, and prompt them to move to their work areas. Then introduce students to the investigation. (See **Know the Standards 1.**)
- Talk through the materials that students see in front of them. Explain that you will call out the steps for students to carry out during the investigation.
- Distribute Modeling Groundwater (AP 3.2.1), and go over it as a class. Tell students that they will be recording their observations by drawing what they see in the various boxes. (See **Know the Standards 2.**)

3. Facilitate the investigation.

NGSS Elements



DCI ESS2.C

SEP 2

- Call out the steps for students to follow in their groups. As students complete the steps, circulate around the room, and ensure that all students in the groups have a chance to participate in the activity. (See **Know the Standards 3.**)
 - STEP 1: Fill the container with sand and gravel.
 - STEP 2: Make a depression in one of the corners of the container. Clear the sand and gravel away from this area as much as you can. Explain that this area will be for a lake.
 - STEP 3: Dig a small area somewhere in the middle of the container that is big enough to set the plastic cup into. Explain that the plastic cup (with the rings drawn on it) represents a well. (See **Know the Science 2.**)
 - STEP 4: Have students place their animal figurines anywhere in the sand. Tell students that the animals are just there to help make the model more realistic.

Know the Standards

TEACHER DEVELOPMENT

1. CCC 1 Patterns: In this investigation, students will be observing patterns in nature involving the water cycle and how water flows from the sky to the ground.

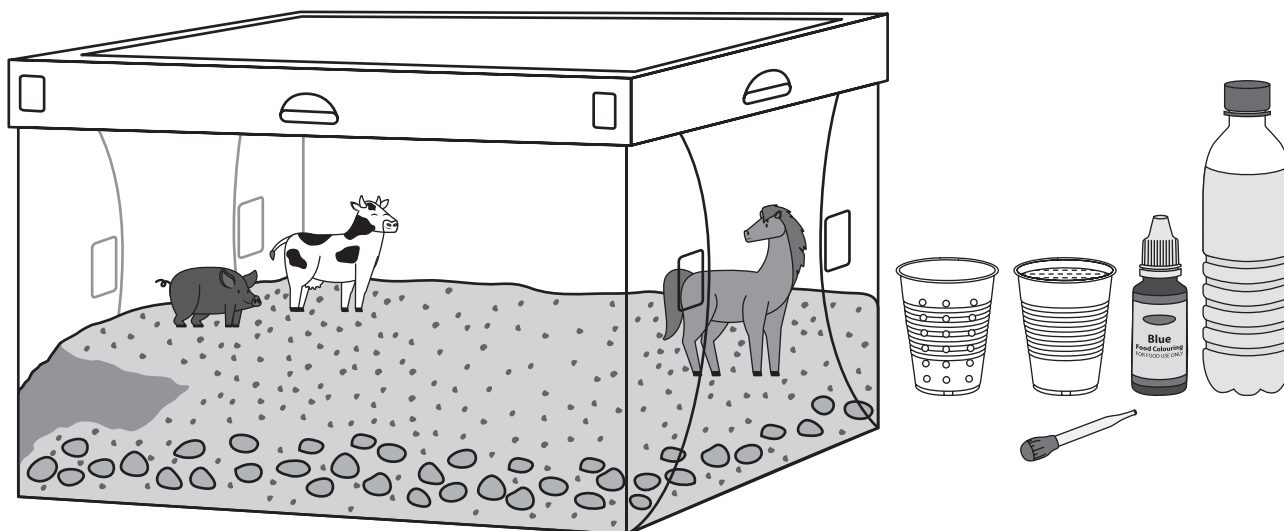
2. Language Arts Connection: Students are asked questions that require them to make connections between scientific concepts that they observe in their investigation with models (ELA RI.2.3).

3. DCI ESS2.C The Roles of Water in Earth's Surface Processes: Students learn through the investigation that water can be found beneath Earth's surface, in places where they cannot see. This water can end up in other bodies of water that we do see, such as lakes.

Know the Science

TEACHER DEVELOPMENT

2. What Is a Well? A well is a hole in the ground that can be used to extract water or oil that is beneath Earth's surface.



- Prompt students to draw their first picture on Activity Page 3.2.1.
 - STEP 5: It's time to make it rain on the land! Tell students to pour the blue water from the water bottle over the sand throughout the container. Clarify that they should not pour the water into the well or the area where the lake will be.

Ask students what happens to the well and the lake.

» They both fill with water.

Ask students how they think the well and lake could fill with water if they did not pour water into them.

» They filled with water because the water from the ground spread into them.

- Prompt students to draw their second picture on Activity Page 3.2.1.
 - STEP 6: Tell students to use the turkey baster to remove the water from the well and empty the baster into the second plastic cup. Explain that this is similar to what people do to get the water out of a well so that they can use it.
- Prompt students to pause and notice what happens to the well after they empty it with the turkey baster.

Ask students to describe what they see.

» The well fills back up with water!

- STEP 7: Have students keep emptying the well with the turkey baster, letting it fill, and emptying it again. They should do this until the well no longer fills with water. Students will notice that it takes longer and longer for the well to refill.

Ask students why they think it is taking longer for the well to refill with water.

» because there is not as much water in the ground

Ask students to describe what is happening to the lake.

» The lake is shrinking.

- When there is hardly any more water refilling the well, tell students to make their third drawings on Activity Page 3.2.1.
 - STEP 8: Then, have students make it rain again. Tell students to pour more blue water from their water bottles (or from the plastic cup where they were discarding the water from the container) back over the sand and gravel. (See **Know the Science 3.**)
- Give students time to repeat their investigation a second time, by pumping the well until it becomes empty. Instruct them to complete the fourth drawing.

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time carrying out the steps based on verbal directions. Alternatively, give students a sheet that has pictures of the steps that they can follow.

CHALLENGE—Using measuring cups, challenge students to measure the amount of water that they are pouring into the container, along with the amount of water that they are removing from the well. Have students compare the numbers and talk about whether they are removing the same amount of water that is being added.

NGSS Elements



DCI ESS2.C

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more about where water is found on Earth by teaching them about the water cycle. Students can expand their knowledge of finding water in lakes, in oceans, in rivers, underground, and so on, to learning about how water can be found in the sky in different forms.

1. Day 2: Refocus student attention on Today's Question.

NGSS Elements



DCI ESS2.C

What happens to water that soaks into the ground?

Remind students that Logan and his family saw geysers at Yellowstone National Park and that geysers shoot boiling hot water and steam up into the air. Tell students that they already learned that water can collect underground and that they modeled groundwater. Explain that today they will see what happens when underground water becomes hot and bubbles up to the surface again.

2. Prepare the demonstration.

NGSS Elements



DCI ESS2.C

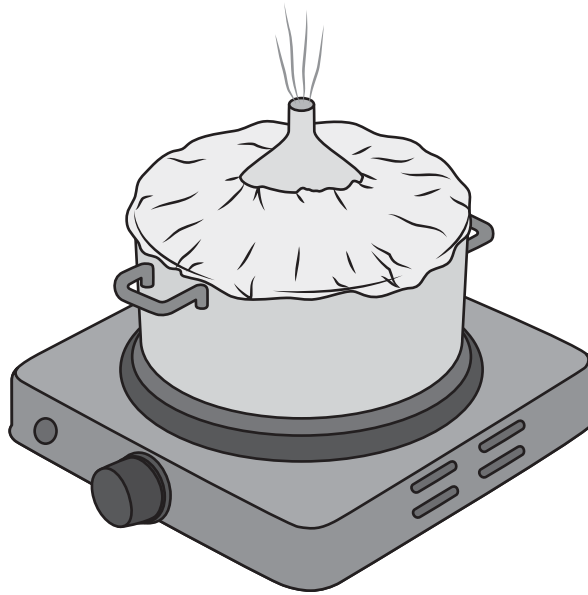
SEP 2

- Set up your pot, water, and electric burner in a place in the classroom where students can see or stand around you.
- Fill the pot with water. Place the pot on the burner, but do not turn the burner on.

Know the Science

TEACHER DEVELOPMENT

3. Modeling a Well: This represents how the water cycle works. Water continuously cycles through Earth, and groundwater is replenished by rain and snow that seep into the soil, sand, dirt, and rocks.



Ask what students observe about the water.

- » The water is standing still.
- Turn the burner on. Wait for the water to heat up. Once it starts to bubble, **ask students what they observe.**
 - » The water is moving around a lot.
- Explain that hot water moves around a lot because of the energy from the heat and that this is similar to what happens with geysers. (See **Know the Science 4.**)

3. Perform the demonstration.

NGSS Elements



DCI ESS2.C
SEP 2

- Turn off the burner, and allow the water to cool. Leave the water in the pot. Place the funnel in the center of the pot, upside down (the spout should be sticking up out of the water). Cover the pot with the aluminum foil, but poke a hole in the foil for the spout to stick out of. Keep the area around the spout as closed as possible, which might require some extra forming of the foil.
- Explain that this setup represents a geyser. The foil is the land that we see on Earth's surface. And the water is below the surface, in the ground.
- Turn the burner on again. **Ask students what will happen to the water below the ground.**
 - » It will start to bubble and boil.

Know the Science

TEACHER DEVELOPMENT

4. Geyser Mechanics: Geysers have a lot going on beneath them. Water has collected in a big pool, called a reservoir, and the water, when it soaks into the earth, is cool. The reservoir sits on top of a rock layer that separates the water from the magma that is just under it. If the rock layer is thin enough, the heat from the magma heats the water in the reservoir. When the water becomes hot enough, it begins to bubble.

- Tell students to pay close attention to the spout. Then talk about what students observe. Students will see steam and water coming out from the spout. (See **Know the Science 5.**)

4. Turn and talk.

Activity Page



AP 3.2.2

- Distribute Geyser Go! (AP 3.2.2) to students, and review it as a class. Explain that students will use the words in the word bank to label the picture. Allow students to work in pairs to complete Activity Page 3.2.2.

5. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings of their models on Activity Page 3.2.1 to ensure understanding of the presence and absence of groundwater and the pattern that ensues. Check the labels on Activity Page 3.2.2 to see that students understand the basic concepts of a geyser.

Review student drawings on Modeling Groundwater (AP 3.2.1) and their labels on Geyser Go! (AP 3.2.2) to determine understanding of the following concepts:

- Groundwater comes from water on Earth's surface (rain and snow).
- Groundwater can spread throughout the earth to fill lakes and wells.
- Groundwater can be used up and replenished again.
- Geysers have water underneath them that becomes very hot.
- Geysers shoot water out from the earth.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review any questions that have been answered and add any new questions students may have about geysers.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their third stop: Yellowstone National Park. Students have learned about groundwater and how geysers work to better understand the sites that Logan sees at Yellowstone National Park.

Know the Science

TEACHER DEVELOPMENT

5. How a Geyser Works: Since the water beneath a geyser is trapped underground, the steam creates pressure, which continues to build. The water has nowhere to go when it is in the reservoir. So when it finds its way out of the reservoir through the cracks in the earth, the pressure causes it to burst out of the geyser with a lot of force!

LESSON 3.3

What Are Volcanoes?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can volcanoes change land?

Today's Question: What are volcanoes?

Tie to the Anchoring Phenomenon: Students learn more about volcanoes and how they can change the landscape as they join Logan and his family on their trip to Yellowstone National Park.

AT A GLANCE

Learning Objective

- ✓ Describe volcanoes.

Instructional Activities

- teacher Read Aloud
- class discussion
- student observation

NGSS References

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Crosscutting Concepts: 2 Cause and Effect;
7 Stability and Change

Students learn about volcano formation and the different features associated with volcano formation. Students then support their learning through completing an acrostic about volcanoes.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

ash crater erupt lava
volcano

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 6

Activity Page



AP 3.3.1

Student Book, Chapter 6
"Heat Below Earth's Surface"

Activity Page
About Volcanoes (AP 3.3.1)

Materials and Equipment

- internet access and the means to project images/video for whole-class viewing
- question board

THE CORE LESSON 3.3

1. Focus student attention on Today's Question.

Online Resources



What are volcanoes?

- **Ask students what they think of when they hear about volcanoes.**
» explosive eruptions, fire, lava, smoke, gas

NGSS Elements



DCI ESS1.C

- Play a volcano video for students. Some of the concepts may be difficult for many students, but tell them to pay attention to the images of the volcanoes that they see.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

- **Ask students what kinds of things they noticed in the video.**
» explosive eruptions, fire, lava, smoke, gas
- Explain that the volcanoes that Logan sees at Yellowstone National Park are going to look very different. (See **Know the Science 1**.)

Know the Science

TEACHER DEVELOPMENT

1. Active and Dormant Volcanoes: Some volcanoes are active, and others are not. Not all volcanoes have the same shape or behave in the same way. When volcanoes are inactive, they are considered dormant.

2. Read together: “Heat Below Earth’s Surface.”

Student Book



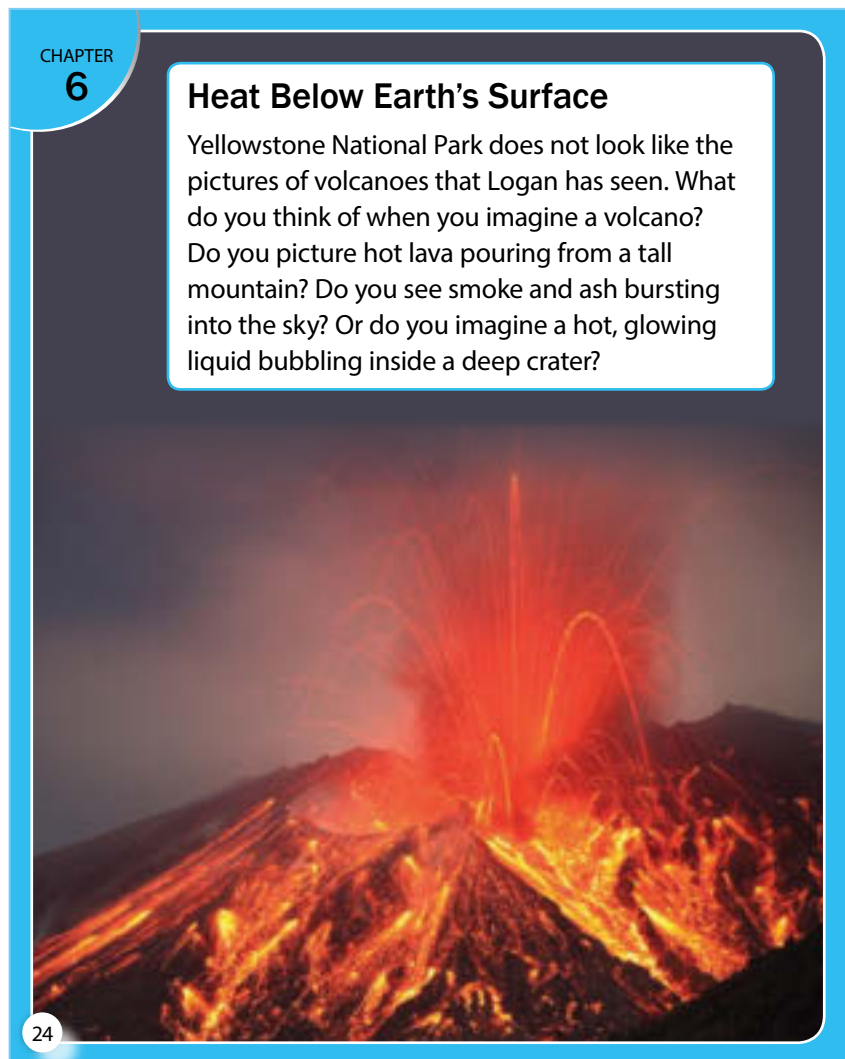
Ch. 6

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 24

Ask students to turn to page 24 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Heat Below Earth’s Surface” and tell them to pay special attention to the pictures of the volcanoes as you read.



NGSS Elements



DCI ESS1.C

Ask students to look at the picture on page 24. Talk about what students see.

LITERAL—How can you describe what you see?

» hot, fiery explosion from the top of a mountain

CORE VOCABULARY—Ask students to describe that **volcano**.

» a mountain or hill with a crater or vent from which lava and ash explode

CORE VOCABULARY—Explain that **lava** is molten rock that spews out of volcanoes. It comes from deep beneath Earth's surface. It can reach two thousand degrees Fahrenheit.

CORE VOCABULARY—Explain that **ash** is what remains after a fire. Ash is made up of tiny pieces of rock thrown out of the volcano by the gas exploding. Sometimes volcanoes can throw ashes into the sky when they erupt.

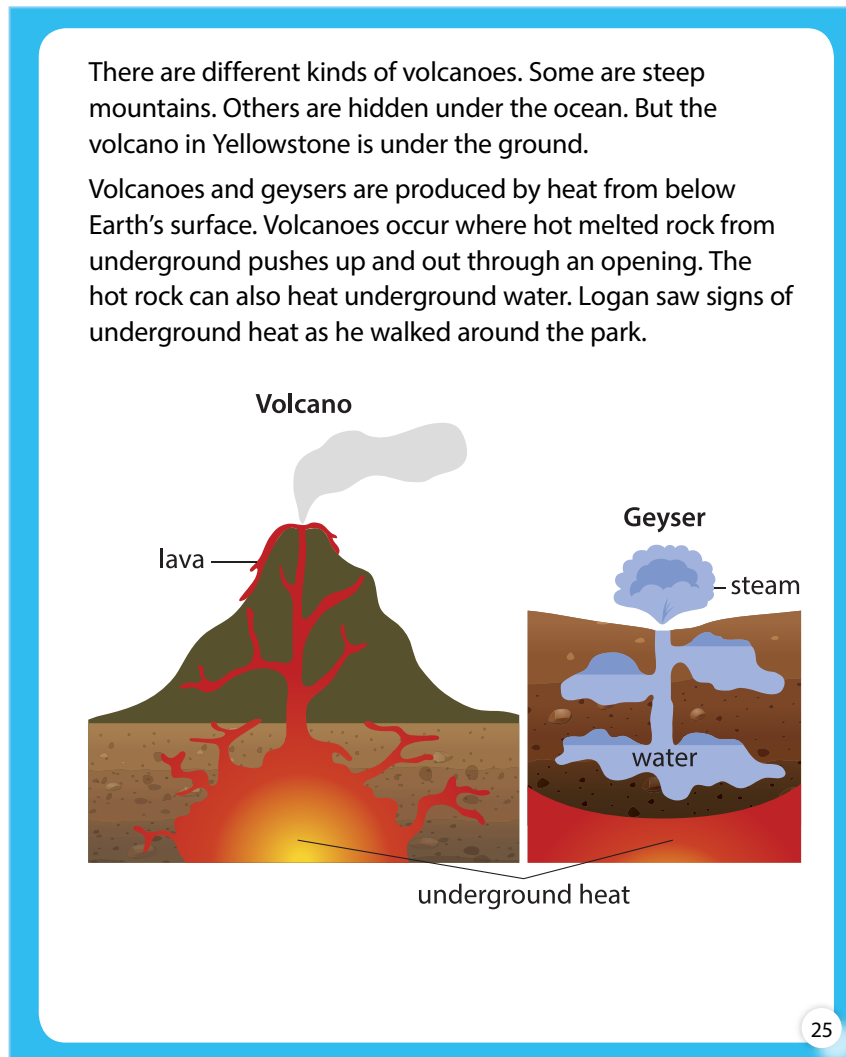
CORE VOCABULARY—Explain that a **crater** is a large depression in the ground that is shaped like a bowl. Some volcanoes make craters.

EVALUATIVE—How does a volcano compare to a geyser?

» Both are explosions of materials that are underground. Hot water comes out of geysers. Fiery magma or hot ash comes out of volcanoes.

Page 25

Ask students to look at the pictures on page 25. Talk about what students see. Explain that the first picture shows a cross section of underground heat in a magma chamber both forming a volcano and heating water of hot springs and geysers.



CORE VOCABULARY—Explain that to **erupt** is to explode. A volcanic **eruption** is when hot lava or ash explodes out of a volcano.

LITERAL—What are some different kinds of volcanoes?

- » Some are steep mountains. Some are hidden in the ocean. Others are underground.

LITERAL—What kind of volcano is the one at Yellowstone National Park?

- » It is an underground volcano.

Page 26

Ask students to look at the two pictures on page 26.

Millions of years ago, huge eruptions happened where Yellowstone is now. The ground caved in after each one. Deep craters were suddenly left behind. Hot liquid still flows miles under these craters. Heat from the liquid causes many of Yellowstone's features.



A hot spring is a pool of hot water. The water is heated from beneath the ground.

Steam vents do not have pools of water like hot springs. Hot water underground turns into steam and flows out of cracks in the earth.



26

NGSS Elements



DCI ESS1.C

CCC 2

CCC 7

LITERAL—What did the eruption at Yellowstone cause (in terms of landforms)?

- » It caused the ground to cave. It caused deep craters to be left behind. It caused hot springs.

SUPPORT—Explain that a hot spring is a pool of water that is heated from under the ground.



SUPPORT—Explain that a steam vent is where hot water underground turns into steam and flows out of the cracks of the earth.

INFERENTIAL—Do you think changes to the land caused by eruptions happen quickly or slowly? Why? (See **Know the Standards 1** and **2**.)

» These changes happen quickly. This is because a volcano can destroy things around it when it erupts.

Page 27

Ask students to look at the two pictures on page 27. Explain that the top picture shows a geyser releasing water and steam. The bottom picture shows mud pots.

A geyser forms when hot water bubbles up to the surface. The small opening does not let the water move around like it can in a hot spring. Pressure builds until steam and water explode from the ground.



Hot water and steam mix with clay soil to form these mud pots.



27

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.C The History of Planet Earth and CCC 7 Stability and Change: Some events change landforms quickly, and others change them slowly. Eruptions from volcanoes can change landforms quickly due to their destructive nature.

2. Language Arts Connection: Students satisfy a connection to the ELA standard CCSS.ELA-Literacy.RI.2.1 by answering questions about the nature of changes caused by volcanoes to demonstrate understanding of key details in the Student Book.

LITERAL—How does a geyser form?

» It forms when hot water bubbles up to the surface.

Differentiation

SUPPORT—Have students recall what they learned during the demonstration with boiling water. They saw the water become hot and start to move around. Once there was enough steam and pressure, it started to spew out the top of the funnel.

SUPPORT—Explain that a **mud pot** is a mixture of clay soil and hot water and steam. You can find bubbling mud there, because the mud is still hot.

3. Describe volcanoes.

Activity Page



AP 3.3.1

NGSS Elements



DCI ESS1.C

CCC 2

CCC 7

Differentiation

- Distribute About Volcanoes (AP 3.3.1) to each student. Tell students that they will draw a picture of a volcano. Then students will write descriptions of a volcano for each line, using words that start with the first letter that is already there.
- If necessary, model for students how to complete the descriptions. For example, “V can stand for very hot,” or “L can stand for lava.”
- Circulate around the room as students work on Activity Page 3.3.1, and provide assistance if students get stuck on any of the letters.

SUPPORT—If students are just learning English, they may have a difficult time coming up with words that begin with the letters listed on Activity Page 3.3.1. Instead, have students just draw pictures of a volcano, or ask them to write down any words that come to mind when they think about volcanoes.

CHALLENGE—Challenge students to draw pictures of the different types of volcanoes they read about in the Student Book on page 25.

EXTEND—If students researched active and dormant volcanoes in the United States or around the world, have them expand their research to learn about the types of volcanoes there are.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look for student responses on About Volcanoes (AP 3.3.1) to ensure understanding of volcanoes so far. Do not score students based on artistic ability.

Review student drawings and their descriptions on About Volcanoes (AP 3.3.1) to determine student understanding of the following concepts:

- Volcanoes erupt.
- Volcanoes can change the land.
- Volcanoes spew hot lava, gases, and ash.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review any questions that have been answered and add any new questions students may have about volcanoes.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their third stop: Yellowstone National Park. Students learn about volcanoes, which are another type of landform that Logan sees on his road trip around the United States. Students start to learn that volcanoes can change the land.

LESSON 3.4

Modeling Volcanoes and Earthquakes

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can volcanoes change land?

Today's Question: How can we model volcanoes and earthquakes?

Tie to the Anchoring Phenomenon: Logan and his family encounter a volcano at Yellowstone National Park. In this lesson, students learn about how volcanoes and earthquakes can shape the land.

AT A GLANCE

Learning Objectives

- ✓ Describe earthquakes and volcanoes.
- ✓ Relate earthquakes and volcanoes to the structure of Earth's layers.

Instructional Activities

- student investigation
- student observation
- teacher demonstration

NGSS References

Performance Expectation: 2-ESS1-1

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Science and Engineering Practices:
2 Developing and Using Models; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students investigate the flow of lava through modeling and learn about the causes and effects of earthquakes.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

earthquake

volcano

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

eruption

investigate

model

Instructional Resources

Activity Pages



AP 3.4.1
AP 3.4.2

Activity Pages

Look at an Earthquake
(AP 3.4.1)
Scrapbook—Lesson 3
(AP 3.4.2)

Materials and Equipment

- white glue ($\frac{2}{3}$ cup)
- baking soda ($\frac{1}{2}$ teaspoon)
- water ($\frac{1}{4}$ cup)
- shaving cream (2–3 cups)
- contact lens solution (1.5 tablespoons; solution must contain boric acid and sodium borate)
- orange food coloring
- water bottles (1 per group)
- mixing bowl
- fork or spatula
- air-dry clay or dough (1 cup per group)
- plate
- whipped cream (or shaving cream)
- graham crackers
- small bowl of water
- internet access and the means to project images/video for whole-class viewing (optional)
- question board

Advance Preparation

Make the fluffy slime ahead of time. The fluffiness only lasts about a day, so try to make this the night before the activity. You may need to triple the ingredients to make a large enough batch for the number of students in your classroom.

Recipe:

Step 1: Add the white glue to the bowl.

Step 2: Add the water and baking soda, and then mix.

Step 3: Add the shaving cream, and mix.

Step 4: Add the orange food coloring, and mix.

Step 5: Slowly add one tablespoon of contact solution. Knead the mixture for five minutes. Then add the rest of the contact solution, and keep kneading.

Store the fluffy slime in an airtight container.

Make a small, clay volcano ahead of time to show students. See the “Prepare for the activity” section in this segment for details.

THE CORE LESSON 3.4

1. Focus student attention on Today’s Question.

NGSS Elements



DCI ESS1.C
SEP 2

How can we model volcanoes and earthquakes?

- Review what students learned about volcanoes and volcanic eruptions.
 - » There are different kinds of volcanoes. Lava, gases, and ash explode out of volcanoes during volcanic eruptions. Volcanic eruptions quickly change the land.
- **Ask students what they know about earthquakes.** (See **Know the Science 1.**)
 - » Accept reasonable responses. Some students may have experienced an earthquake. Others may know about famous earthquakes.
- Introduce the day’s activities. Explain that students will model volcanic eruptions and then look at how earthquakes can shape the land.

Know the Science

TEACHER DEVELOPMENT

1. Earthquakes: An earthquake is a sudden shaking of the ground as the result of movements under Earth’s surface or volcanic action. Earthquake magnitudes are measured on the Richter scale. Earthquakes can be mild or cause serious damage to roads, bridges, and buildings.

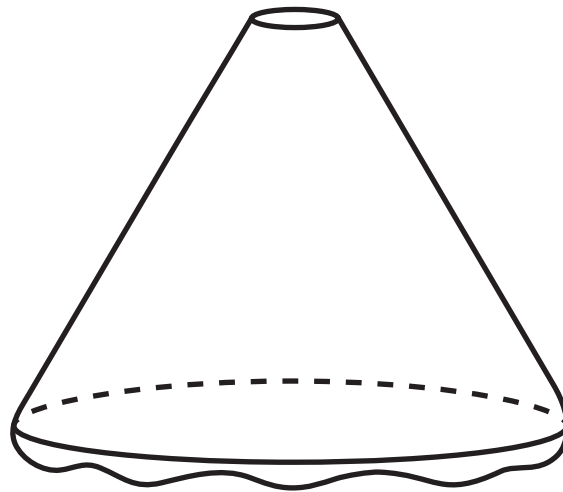
2. Prepare for the activity.

NGSS Elements



DCI ESS1.C
SEP 2

- Have students form small groups of mixed ability. Distribute the air-dry clay to groups.
- Explain that students will be making volcanoes! Show students a sample of what they will be making. Students will use the clay to sculpt small cones that represent volcanoes. Students need to leave a hole at the top to represent the opening of a volcano where lava flows. (See **Know the Standards 1.**)
- Prompt students to work together in their groups to make their volcanoes. Tell students to make their cones very small (about 3 inches in diameter, 2 inches tall, and the hole in the middle should be about ½ to 1 inch).



- Circulate around the room as groups work on their models. Provide assistance and guidance as necessary. Make sure students have a tunnel going from the bottom of their model to the top, where the slime will flow out when students push it up to make lava.

3. Facilitate the investigation.

NGSS Elements



SEP 2
DCI ESS1.C

- Pass out the fluffy slime to each group. Tell students that they will act out how a volcano erupts with lava. The orange slime represents the lava.
- Tell students to pick a volunteer in the group to go first and do the following:
 - Place the soft lava in the palm of one hand.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 2 Developing and Using Models: Students use a model volcano to learn about how volcanoes work.

- Then, press the lava up against the bottom of the hard cone/volcano. (See **Know the Science 2.**)
- Repeat this so each student in the group has a chance to push the lava through the volcano.

Ask students what they notice happening.

- » The slime/lava comes out of the volcano at the top.

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time carrying out the steps based on verbal cues. Alternatively, model what students should do, and have them copy you.

CHALLENGE—Give students data on the speed at which lava flows (6–30 mph), and show them pictures of the types of damage volcanic eruptions have caused. Then have students write about whether they think volcanic eruptions can change the landscape around them quickly or over a long period of time.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more by researching famous volcanic eruptions and how they changed the landscapes around them.

- As students take turns working on their demonstrations, circulate around the room, and talk about the lava (slime) that comes out of the volcano. Remind students that the lava is very hot and can burn whatever is in its path. Explain that lava also cools off and that, when it does, it hardens into rock.
- Use the following question prompts to elicit a discussion about how volcanic eruptions can change the landscape around them:
 - How can hot lava change the land?
 - » It can burn down trees and houses.
 - How can lava change the land when it cools?
 - » It can make new, large rocky structures.

NGSS Elements



CCC 7

Know the Science

TEACHER DEVELOPMENT

2. Volcano Eruption: Volcanoes erupt because of the pressure that builds up below them. In this model, students apply pressure to the fluffy slime by pushing up against the cone, thus forcing the slime through the hole at the top. This is how lava flows out of volcanoes; the eruption is a reaction to a force below the lava.

4. Guide more demonstrations.

NGSS Elements



SEP 2

DCI ESS1.C

3D Learning

Activity Page



AP 3.4.1

3D Learning: The demonstration requires students to use what they have learned and observed so far throughout the unit to discuss whether earthquakes make quick or slow changes to Earth's surface.

- Distribute Look at an Earthquake (AP 3.4.1). Introduce students to an abbreviated and simplified concept of Earth's layers and plate tectonics. (See **Know the Science 3.**) The goal is to help students understand that these layers can move and shift during an earthquake, which is what causes structural changes to the landscape. (See **Know the Standards 2.**)
- Set up your demonstration. Pour whipped cream (or shaving cream) on the plate. Take two graham crackers, and quickly dip one end of them into water. Place the graham crackers on the plate, with the soggy sides facing each other. Explain that the graham crackers represent Earth's hard crust and that the whipped cream below it represents the mantle.
- To make sure all students can see the demonstration, have them gather around, or perform the demonstration under a camera that displays it on a monitor in the classroom.
- Prompt students to draw what they see on Activity Page 3.4.1 in the top box.
- Tell students that now you are going to pretend there is an earthquake. Make the graham crackers push against each other until they fold up in the center and crack in the middle. **Ask students to describe what they see.**
 - » The graham crackers folded up in the middle. The graham crackers cracked.
- Prompt students to draw what they see in the bottom box on Activity Page 3.4.1.

Know the Science

TEACHER DEVELOPMENT

3. Earth's Crust: The outermost layer of Earth is the crust. It is hard and acts like a shell, surrounding the planet. The crust has cracks in it, which form big separate pieces. These are called tectonic plates, and they fit together like a puzzle around Earth. Beneath the crust is the mantle, which is the largest layer and is made up of small portions of molten rock. With enough pressure and heat, the mantle can become soft and flow like liquid. This makes the big plates in Earth's crust move, which can result in the formation of mountains and volcanoes.

Know the Standards

TEACHER DEVELOPMENT

2. PE 2-ESS1-1: The activities in this segment contribute in part to the Performance Expectation by having students use information from various sources to determine whether events on Earth happen relatively quickly or slowly. However, students won't complete this until the capstone at the end of the unit, when they finish gathering evidence from various sources throughout the unit.

Ask students what kind of landforms this could form on Earth.

- » This could form mountains or volcanoes.
- Summarize the demonstration by discussing whether the earthquake made fast changes to Earth's surface or slow changes. Students should be able to recognize that fast changes were made.

5. Check for understanding.

Monitor Progress

Activity Page



AP 3.4.2

Formative Assessment

Distribute Scrapbook—Lesson 3 (AP 3.4.2). Ask students to complete the log for Yellowstone National Park.

Look at student drawings on Activity Page 3.4.1 to ensure understanding of the fact that the earthquake changed the way the surface of Earth looked and that earthquakes usually cause rapid changes to Earth's surface. Do not score students on artistic ability.

Ask students to compare volcanoes and earthquakes.

- » Earthquakes and volcanoes are the result of pressure building up under Earth's surface. Earthquakes result in shaking, and volcanoes result in eruptions of lava, ash, and gases.

Review student responses, drawings, and descriptions to determine student understanding of the following concepts:

- Earthquakes and volcanoes make quick changes to Earth's surface.
- Earthquakes and volcanoes are the result of pressure building under Earth's surface.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about volcanoes and earthquakes.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their third stop: Yellowstone National Park. Students have learned about volcanoes, which Logan sees at the park, and how they are formed and what happens when they erupt.

LESSON 4

Land, Water, and Changes: Examples in Yosemite National Park

OVERVIEW

Guiding Question: How can land move quickly?

Lesson 4 Segments	Segment Questions	Advance Preparation
4.1 What Is Yosemite National Park? Students read about Logan's fourth stop, at Yosemite National Park to see the landforms there.	How has land in Yosemite National Park changed slowly and quickly?	Read Chapter 7 in the Student Book.
4.2 What Is a Landslide? Students investigate landslides by setting up models to simulate landslides with and without water.	What is a landslide?	Gather materials for investigation. See Materials and Equipment.
4.3 Preventing Landslides Students compare various solutions to preventing landslides and use rubrics to figure out the best solution.	How can people prevent landslides?	Gather materials for activity. See Materials and Equipment.

What's the Story?

Summary: In Lesson 4 (Segments 1–3), students explore how the landscape at Yosemite National Park was formed and changed due to mass movements of land (2-ESS1-1). Students participate in an investigation where they observe how landslides occur and participate in an activity where they compare different solutions to help address the problems with landslides (2-ESS2-1). The developing understanding of these phenomena in Lesson 4 prepares students for their work in Lesson 6, when they will build on their knowledge of landforms to study the land formations at the seashore.

Learning Progression: Lesson 4 builds toward the Grade 2 target of 2-ESS1-1: *Use information from several sources to provide evidence that Earth events can occur quickly or slowly*; and 2-ESS2-1: *Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land*.

Guiding Phenomenon: The natural landscape changes its shape and appearance due to Earth events that occur quickly or slowly. Some of the rock formations, such as Half Dome, that are seen at Yosemite National Park were created very slowly but experienced fast changes to them due to mass movements of land. Water and wind are two natural forces that, over time, can weather and erode rock or earth, causing it to become vulnerable during earthquakes or rainstorms. Certain events can cause the land to fall and collapse suddenly, thus causing quick changes to the landscape.

Learning Objectives

By the end of Lesson 4, students will do the following:

- Describe landslides.
- Identify how long it takes for landforms to be created.
- Describe how mass land movements can occur suddenly and make quick changes to the landscape.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (partial)

Performance Expectation: 2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. (partial)

<p>Science and Engineering Practice</p> <p>6 Constructing Explanations and Designing Solutions</p> <p>Compare multiple solutions to a problem.</p>	<p>Disciplinary Core Ideas</p> <p>ESS1.C The History of Planet Earth</p> <p>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.</p> <p>ESS2.A Earth Materials and Systems</p> <p>Wind and water can change the shape of the land.</p> <p>ETS1.C Optimizing the Design Solution</p> <p>Because there is always more than one possible solution to a problem, it is useful to compare and test designs.</p>	<p>Crosscutting Concept</p> <p>7 Stability and Change</p> <p>Things may change slowly or rapidly.</p>
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www.coreknowledge.org/cksci-online-resources

LESSON 4.1

What Is Yosemite National Park?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can land move quickly?

Today's Question: How has land in Yosemite National Park changed slowly and quickly?

Tie to the Anchoring Phenomenon: Students learn about the formation of and changes to land as they join Logan and his family on their trip to Yosemite National Park.

AT A GLANCE

Learning Objectives

- ✓ Describe mass movements (landslides, mudslides and rockslides).
- ✓ Differentiate between examples of weathering/erosion that occur over a long time and mass movements that can occur suddenly.

Instructional Activities

- teacher Read Aloud
- class discussion
- question generation

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ESS1.C The History of Planet Earth

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 7 Stability and Change

Students learn about how landforms in Yosemite National Park were formed through different Earth processes. Students then identify fast and slow changes to landforms.

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Core Vocabulary and Language of Instruction

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landslide **mudslide** **rockslide** **steep**
waterfall

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 7

Student Book, Chapter 7
“Next Stop—Yosemite
National Park”

Activity Page



AP 4.1.1

Activity Page
Yosemite National Park
(AP 4.1.1)

Materials and Equipment

- question board

THE CORE LESSON 4.1

1. Introduce students to Lesson 4.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**

Tell students that, before they can answer the unit's Big Question about the land, they need to continue learning about different kinds of landforms. So far, students have learned about glaciers, hills, mountains, valleys, geysers, volcanoes, and various bodies of water. In Lesson 4, students will learn about the ways in which the land changes quickly to apply their understanding to the Big Question. Write the Lesson 4 Guiding Question where students can see it:

How can land move quickly?

- Introduce Today's Question: **How has land in Yosemite National Park changed slowly and quickly?**

- Remind students that in this unit they have been taking a tour of some of the national parks in the United States along with Logan and his family as they learn about Earth's landforms and history.
- Review with students the parks they have toured so far.
 - » Mount Rushmore National Memorial, Glacier National Park, and Yellowstone National Park
- **Ask what students already know about Yosemite National Park in California.**
 - » Accept all reasonable answers. Some students may know there are famous rock formations there.
- Explain that today students are going to start on an expedition to explore landforms at Yosemite.

Tie to the Anchoring Phenomenon

NGSS Elements



CCC 7

As students work through Lesson 4, they will learn how some landforms form over time and others change very quickly when Logan and his family visit Yosemite National Park.

2. Read together: “Next Stop—Yosemite National Park.”

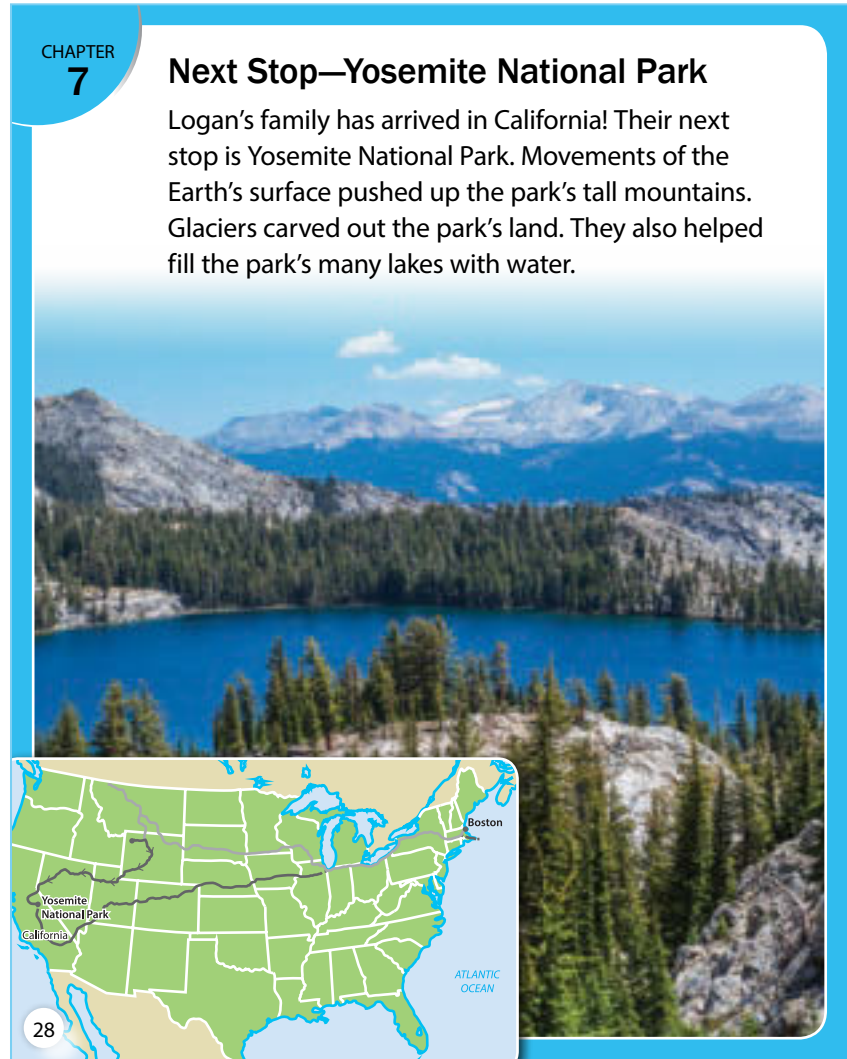
Student Book



Ch. 7

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Ask students to turn to page 28 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Next Stop—Yosemite National Park,” and tell them to pay special attention to the land formations as you read.



Ask students to look at the photograph on page 28. Talk about what students notice about the landscape.

SUPPORT—Students have already learned the Core Vocabulary words *mountain*, *glacier*, and *lake*. Review their meanings with students.

LITERAL—Where is Yosemite National Park?

» It is in California.

LITERAL—What formed the park’s tall mountains?

» The movement of the surface of Earth pushed them up.

LITERAL—What process created the area with the lakes?

» Glaciers carved up the land and filled the lakes.

Page 29

Ask students to look at the two pictures on page 29.

As Logan's family enters the park, they drive over a road through a very rocky area. In the past, rain, wind, and ice broke off chunks of rock along the side of the hill. Gravity pulled the loose rock and soil down the hill. The road is safe now, but what if there is another rockslide?



29

LITERAL—What made chunks of rock break off this rocky area?

» rain, wind, and ice

CORE VOCABULARY—Explain that a **rockslide** is what happens when rocks fall downward. This usually happens rapidly, rather than gradually. Rockslides happen at inclines, where gravity can pull rocks down.

INFERENTIAL—Do you think a rockslide can change the landscape? How?

» Yes, it can change the way the landscape looks. Pieces of a rock or entire areas of land can fall.

INFERENTIAL—Why do you think there is a sign for rockslides?

» to warn people because rockslides can be dangerous

NGSS Elements



DCI ESS2.A



Ask students to look at the picture on page 30. Explain that the picture shows a waterfall. (See **Know the Standards 1** and **2**.)

Yosemite is full of other natural wonders. It is known for its many waterfalls. They roar to life in spring and summer when snow melts. Waterfalls form when water from rivers and streams pours over high rock ledges. Over time, the flowing water can carve a groove there. Yosemite Falls is one of the tallest waterfalls in the world! It is over two thousand feet high.



30

CORE VOCABULARY—Explain that a **waterfall** is a place where water flows over the edge of a cliff or mountain. The water collects at the bottom.

INFERENTIAL—When do you think you see the most waterfalls? Why?

» spring and summer, because the snow melts

Know the Standards

TEACHER DEVELOPMENT

1. ESS2.A Earth Materials and Systems: Over time, the force of waterfalls changes the landscape by carving out grooves where the water falls.

2. ESS2.C The Roles of Water in Earth's Surface Processes: Students have already learned that water can be found in flowing bodies, such as rivers and streams. Now, students learn that those flowing bodies of water can sometimes lead to waterfalls.

INFERENTIAL—Do waterfalls change the landscape? How?

» Yes, they can make grooves over where they fall over time.

Page 31

Ask students to look at the picture on page 31. Explain that students are looking at a structure called Half Dome. (See **Know the Science.**)

Logan and his family visit a strange rock formation called Half Dome. It is tall and wide and curved at the top. One half of Half Dome is smooth and steep. The other half is round. Logan is surprised to see people trying to climb the steep side! He wonders why one side of this rock is shaped so differently from the others.



CORE VOCABULARY—Explain that **steep** means a very sharp slope.

SUPPORT—If necessary, model the concept of steepness for students. Use textbooks and a ruler. Pile the textbooks up, and make a ramp with the ruler. Show students how the slope gets steeper and steeper as you add more books.

Know the Science

TEACHER DEVELOPMENT

Half Dome: Half Dome is classified as a monolith, a word that means “one stone,” but it is not the largest rock in the world. That record belongs to Uluru, also known as Ayer’s Rock, in Australia. At 1,142 feet tall from the desert floor, it is not as tall as Half Dome at 1,340 feet, but Uluru is 2.2 miles long and 1.5 miles wide. Uluru is about as large as the mountain prominence on which Half Dome sits.

LITERAL—What does Half Dome look like?

- » It is tall, it is wide, and it is curved at the top. It is smooth and steep on one side. It is round on the other side.

Page 32

Ask students to look at the picture on page 32. Talk about how water contributes to the changes of rock. Then discuss how wind contributes to these changes, too. (See **Know the Standards 3.**)

Fast and Slow Changes Shape the Land

Half Dome began as a giant underground rock that was pushed to the surface. The rounded areas became curved as layers of rock were ground away by rock, ice, wind, and water. The steep flat wall got its shape when huge pieces fell off. These processes took millions of years. But did some changes take place quickly?



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Know the Standards

TEACHER DEVELOPMENT

3. CCC 7 Stability and Change: Although its name may suggest otherwise, Half Dome was never a whole dome. Glaciers were responsible for cutting the base of the giant rock, carrying a lot of it away. Many of the rocks that were left behind fell apart over time, creating the unique shape you see today. The landscape around it was changed during the slow formation of Half Dome, as well as by the rapid changes of when the side fell off to make it look the way it does today.



LITERAL—How did Half Dome start?

- » It might have started as a big underground rock.

LITERAL—How did Half Dome go from being underground to aboveground?

- » It was pushed up to the surface.

LITERAL—How did Half Dome get its steep flat wall?

- » Huge pieces of rock fell off.

Page 33



Ask students to look at the picture on page 33. Talk about the landscape, and relate it to the concept of rockslides. (See **Know the Standards 4.**)

It took many years for rain, wind, and ice to weaken the rocks on the hill in Yosemite. But then a rockslide happened suddenly. It caused a fast change to the land around it. Rockslides are dangerous because they happen with no warning. Buildings that are close to steep rock walls, like this little cabin in Europe, can be hit by falling and sliding rocks during a rockslide.



33

Know the Standards

TEACHER DEVELOPMENT

4. ESS2.A Earth Materials and Systems: Review with students that rain, wind, and ice can weaken rock formations but that these changes take a really long time to happen.

LITERAL—What process took a long time? What process took a short amount of time?

- » It took a long time for rain, wind, and ice to weaken the rocks. It took a short amount of time for the rocks to suddenly fall.

LITERAL—Why are rockslides dangerous?

- » They can happen with no warning. People or buildings can be hit.

NGSS Elements



CCC 7

Page 34

Ask students to look at the pictures on page 34. Explain that each picture shows a way to prevent rockslides. (See **Know the Standards 5.**)

People have found a few ways to prevent rockslides. Workers can put wire netting over the loose rocks to keep them from falling.



They can use a wall to hold a slope in place.

They can use giant bolts to keep large slabs of rock from moving.



34

NGSS Elements



DCI ETS1.C

LITERAL—How can nets be used to prevent rockslides?

- » They can cover loose rocks to keep them from falling.

Know the Standards

TEACHER DEVELOPMENT

5. ETS1.C Optimizing the Design Solution: Students learn about prevention methods that are used to solve the problem of rockslides.

LITERAL—How can a wall be used to prevent rockslides?

» A wall can hold a slope in place.

LITERAL—How can giant bolts be used to prevent rockslides?

» They can keep large slabs of rock from moving.

Differentiation

SUPPORT—Have students turn and talk with a neighbor about which prevention method they think works best and why.

Page 35

Ask students to look at the pictures on page 35. Explain that the top picture shows a mudslide. The bottom picture shows a landslide. (See **Know the Standards 6.**)

NGSS Elements



DCI ESS1.C

Like rockslides, mudslides and landslides can happen very fast. Mudslides happen when a lot of water mixes with soil on a hill. The soil loosens. It can suddenly slide down a steep slope. A mudslide can flow over anything in its path.



A landslide can also happen when soil is dry or when plants have been destroyed by fire. Plant roots hold soil in place on a hill. If the roots are not strong enough, the earth can slide downhill.



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Know the Standards

TEACHER DEVELOPMENT

6. ESS1.C The History of Planet Earth: Mudslides and landslides are changes to the land that happen suddenly and quickly, often without warning. However, the land can weaken over time due to various factors. It can take years of weakening before sudden mudslides or landslides happen.

CORE VOCABULARY—Explain that a **mudslide** is when a lot of water mixes with soil on a hill and the soil loosens, sliding down the hill as mud.

CORE VOCABULARY—Explain that a **landslide** is when dry land, or soil, loosens and the earth slides down a hill.

Differentiation

SUPPORT—Use question prompts to ensure students understand the difference between mudslides, landslides, and rockslides.

INTERPRETIVE—What is the difference between a mudslide and a landslide?

- » Mudslides happen when a lot of water mixes with soil on a hill. Landslides happen when soil is dry or when plants have been destroyed by fire.

INTERPRETIVE—Do mudslides, rockslides, and landslides make quick or slow changes to the land?

- » quick

3. Summarize landscape changes.

Activity Page



AP 4.1.1

- Distribute Yosemite National Park (AP 4.1.1) to each student. Tell students that they will draw a picture that represents a slow change to Yosemite National Park and that then they will draw a picture that represents a fast change to Yosemite National Park.
- Tell students to label the force that is causing the slow change (i.e., wind, rain, ice).
- Circulate around the room as students draw, and ask guiding questions, such as the following:
 - What role do wind, water, and ice play in the changes?
 - Does wind/water/ice make fast changes or slow changes to rock?
 - How can you show a slow change in your picture? How can you show a fast change?

NGSS Elements



DCI ESS1.C
SEP 1

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time articulating the slow and fast change concepts of the landscape via their illustrations. Alternatively, have these students draw a picture of a rockslide.

CHALLENGE—Challenge students to draw a series of pictures that show how Half Dome would have been pushed up to the surface and how part of it would have fallen off to create the dome shape we see today. This can be done as a flip-book activity or with a series of drawing boxes, like a comic strip.

EXTEND—Have students research recent mudslides or landslides in the United States and where and why they happened.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings on Activity Page 4.1.1 to ensure understanding that the landscape changes when pieces of the land fall or mass movements happen. If students do not have proper understanding of this, go back through the Student Book, and allow students to look at the pictures.

Review student drawings and labels on Yosemite National Park (AP 4.1.1) to determine student understanding of the following concepts:

- Water, wind, and ice can change the shape of rocks over time.
- Half Dome took a long time to form.
- Rocks and parts of the land can fall and change suddenly.

See the Activity Page Answer Key for correct answers and sample student responses.

Ask students what additional questions they have about Yosemite National Park, and add their questions to question board.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their fourth stop: Yosemite National Park. Students have learned how the landscape is able to change due to slow processes, like weathering, and fast events, like landslides.

LESSON 4.2

What Is a Landslide?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can land move quickly?

Today's Question: What is a landslide?

Tie to the Anchoring Phenomenon: Logan and his family learn about how the land was formed at Yosemite National Park. In this lesson, students learn about how mass movements, like landslides, happen suddenly and change the land.

AT A GLANCE

Learning Objective

- ✓ Explain how weathering/erosion by water can be a problem for people (specific to landslides).

Instructional Activities

- student investigation
- student observation

NGSS References

Performance Expectation: 2-ESS1-1

Disciplinary Core Ideas: ESS1.C The History of Planet Earth; ESS2.A Earth Materials and Systems

Science and Engineering Practices: 2 Developing and Using Models; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students use modeling to investigate the effects of landslides and mudslides on humans.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

landslide

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

investigate model

Instructional Resources

Activity Pages



AP 4.2.1
AP 4.2.2

Activity Pages

Paper House Template
(AP 4.2.1)
Landslide Investigation
(AP 4.2.2)

Materials and Equipment

- plastic/wooden chutes (1 per group)
- aluminum pans (1 per group)
- potting rocks (1 cup per group)
- soil (1 cup per group)
- duct tape
- paper cups (1 per group)
- water (1 cup per group)
- disposable spoons (1 per group)
- scissors (1 per group)
- plastic resealable bags (2 per group)
- question board

Advance Preparation

Fill plastic sandwich bags with one cup of potting rocks, enough so that each group gets one bag of rocks. Then fill remaining plastic sandwich bags with one cup of soil, enough so that each group gets one bag of soil. Pour water into the paper cups, enough so that each group gets one cup.

Set up the classroom with different work areas where groups can do their investigations with adequate table space. Have the following materials ready to go at each work area:

- 1 disposable spoon
- premade bags of potting rocks and soil
- 1 pair of scissors
- 1 cup of water
- duct tape (or cut the strips of tape in advance for students)
- 1 aluminum pan
- 1 chute
- 1 copy of Paper House Template (AP 4.2.1)
- 1 spool of clear tape

THE CORE LESSON 4.2

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS1.C

What is a landslide?

- **Ask students to suggest what they think a landslide is.**
 - » Some may have experience with landslides. Some may think it is like a playground slide made of mud. Accept any reasonable answer.
- Introduce the day's activities. Explain that students will investigate what happens during a landslide.

2. Facilitate the investigation.

NGSS Elements



SEP 2

PE 2-ESS1-1

3D Learning

Activity Pages



AP 4.2.1

AP 4.2.2

3D Learning: Students carry out an investigation to observe how the landscape changes quickly due to natural processes, such as earthquakes or rain.

- Have students form small groups of mixed ability, and assign each group to a work area. Explain that students will be doing two investigations to see what happens during a landslide: one that involves water and one that does not. They will do the investigation without water first. (See **Know the Standards 1** and **2**.)
- Distribute Landslide Investigation (AP 4.2.2) to each student. Tell students that they will record their observations on Activity Page 4.2.2.
- Draw student attention to Paper House Template (AP 4.2.1). Explain that students will cut out the shapes on the page and fold them to make houses that they use in their investigation. If necessary, model for students how to cut out and fold the paper to make the houses.
 - Students will cut out the strips of boxes for the walls. Students will fold the strip along the dotted lines and then tape it shut. For the roof, students will cut out the boxes and fold them in half along the dotted line. Tell students

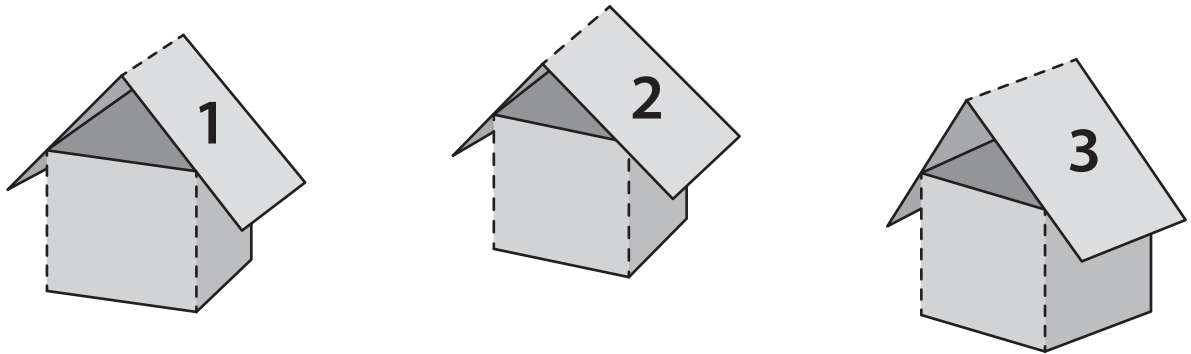
Know the Standards

TEACHER DEVELOPMENT

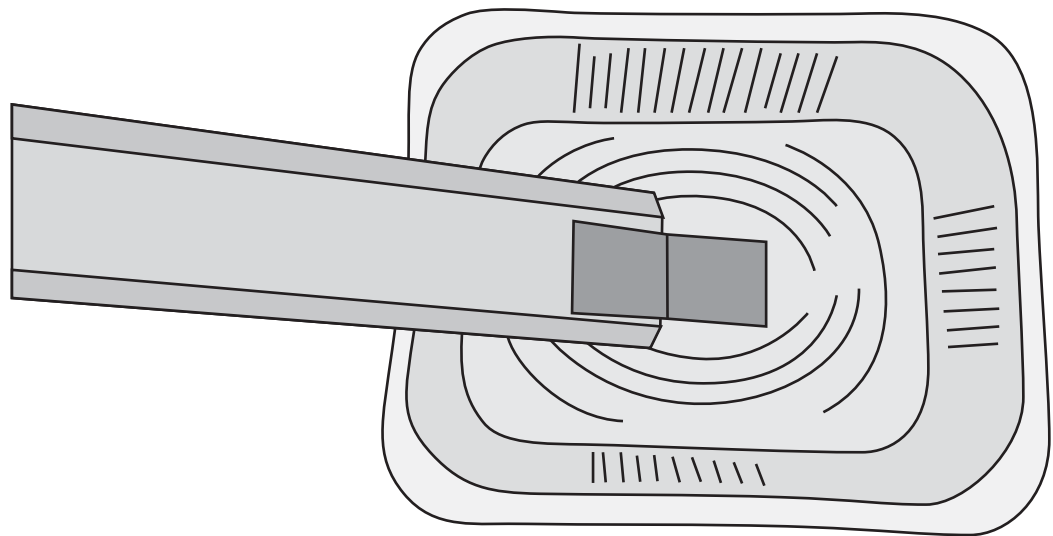
1. PE 2-ESS1-1: The activities in this segment contribute in part to the Performance Expectation by having students use information from various sources to determine whether events on Earth happen relatively quickly or slowly. However, students won't complete this until the capstone, when they finish gathering evidence from various sources throughout the unit.

2. SEP 2 Developing and Using Models: Students set up models to investigate how landslides occur without water during rockslides.

to label each roof 1, 2, and 3 or A, B, and C. Then students can simply place the triangular roof over the square box house to look like this:



- Walk through the materials that students see at their work areas. Explain how to set up the first investigation (without water), and have students follow along:
 - Tell students to duct-tape the chute to the inside of the aluminum pan. The end of the chute should be nearly centered in the pan. Explain that this represents the side of a mountain or hill.



- Tell students to place their paper houses randomly inside the aluminum pan. One house should be close to the chute, and the two others can be off to the side. The houses represent where people live. Some people live very close to mountains/hills.
 - Tell students to use their plastic spoon to pour some potting rock onto the top of the chute but to not let the rocks fall down the chute yet. The rock represents the type of land at the top of the mountain/hill.
- Circulate around the room, and ensure students have set up their investigations correctly.

- Cue students to draw their first pictures on Activity Page 4.2.2. Students should draw the setup, including the houses and where they are positioned in the aluminum pan. Prompt them to label their houses correctly.
- Cue students to create an earthquake. Tell students to jiggle the chute until the rocks start to fall. Warn students to not jiggle the chute so hard that the duct tape becomes undone.
- Once all groups have had a chance to make their earthquakes, discuss the results:
 - What happened to the rocks at the top of the mountain/hill?
 - What happened to the houses at the bottom?
 - Were some houses more impacted than others?
 - Which house had the most damage? Which houses were safer?
- Have students draw their second picture on Activity Page 4.2.2 to show the results.
- Now tell students that they are going to set up their next investigation. Have groups take turns pouring the rocks out of the aluminum pans and into the trash. Tell students to hold on to their houses and to keep the chute intact. (See **Know the Standards 3.**)
 - Tell students to reset their houses in the pan.
 - Tell students to use their plastic spoon to pour some soil onto the top of the chute but to not let the soil fall down the chute yet. The soil represents the type of land at the top of the mountain/hill.
- Circulate around the room, and ensure students have set up their investigations correctly.
- Cue students to draw their first pictures on Activity Page 4.2.2. Students should draw the setup, including the houses and where they are positioned in the aluminum pan. Prompt students to label their houses correctly.
- Cue students to make it rain! Students should pour some water from the cups directly onto the soil at the top of the chute. Have students keep pouring the water until the soil rushes down the chute.
- Once all groups have had a chance to make it rain, discuss the results:
 - What happened to the soil at the top of the mountain/hill?
 - What happened to the houses at the bottom?
 - Were some houses more impacted than others?
 - Which house had the most damage? Which houses were safer?

Know the Standards

TEACHER DEVELOPMENT

3. SEP 2 Developing and Using Models: Students set up models to investigate how landslides occur with water during mudslides.

SUPPORT—If students are just learning English, they may have a difficult time carrying out the steps based on verbal cues. Alternatively, model what students should do, and have them copy you.

CHALLENGE—Offer students a simple mathematical problem to solve. Have students figure out the number of houses that were impacted by the landslide out of the total number of houses used.

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more by researching recent landslides and how they changed the landscape.

3. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings on Activity Page 4.2.2 to ensure understanding of the fact that the landscape looks different after a landslide.

Summarize the results of the investigations with students. Discuss why the results of the weathering were problems for people in the area. **Ask students whether the events that happened made fast or slow changes to the land around them.**

» The landslides made fast changes to the land around them.

Review student drawings on Landslide Investigation (AP 4.2.2) to determine understanding of the following concepts:

- Landslides change the way the landscape looks.
- Landslides can damage houses and be a problem for people.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about landslides, rockslides, or mudslides.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their fourth stop: Yosemite National Park. Students have learned about various land formations, which Logan sees at the park, and how they are formed over a long period of time. Students also learn that sometimes these formations can be reshaped by sudden events and that these changes can happen quickly.

LESSON 4.3

Preventing Landslides

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can land move quickly?

Today's Question: How can people prevent landslides?

Tie to the Anchoring Phenomenon: Logan and his family encounter landscapes that were shaped by rockslides and landslides at Yosemite National Park. In this segment, students will compare solutions to preventing landslides.

AT A GLANCE

Learning Objectives

- ✓ Explore design solutions related to water weathering/erosion problems.
- ✓ Evaluate solutions against desired features (criteria).

Instructional Activities

- student investigation
- student observation
- class discussion

NGSS References

Performance Expectations: 2-ESS1-1; 2-ESS2-1

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

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students consider the dangers of landslides and solutions to prevent or reduce landslides and establish criteria for landslide prevention solutions.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

landslide **prevent** **score** **solution**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

analyze **compare**

Instructional Resources

Activity Pages



AP 4.3.1

AP 4.3.2

Activity Pages

Solution Scorecard (AP 4.3.1)
Scrapbook—Lesson 4
(AP 4.3.2)

Materials and Equipment

- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Online Resources



Prepare a slideshow of landslide solution pictures to show students. Find pictures of the following:

- the side of a rock wall with netting over it
- the side of a mountain or hill with a wall built into it
- the side of a mountain or hill with bolts sticking out of the rock
- the side of a mountain or hill with lots of trees planted on the land

See the Online Resources Guide for a link to the recommended images:

www.coreknowledge.org/cksci-online-resources

THE CORE LESSON 4.3

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS1.C

How can people prevent landslides?

- Open the class with a discussion about the dangers involved in landslides. **Ask students to share their ideas about how landslides can be dangerous.**
 - » Landslides can happen when people are driving on roads. Landslides can cause people's homes to fall down or to become crushed. There are a lot of reasons why people try to prevent landslides.

2. Prepare for the activity.

NGSS Elements



DCI ETS1.C
SEP 6

Activity Page



AP 4.3.1

- Tell the class that today they are going to look at some solutions to help prevent landslides. Remind students that they learned about these solutions in Chapter 7 of the Student Book.
- Distribute Solution Scorecard (AP 4.3.1), and review it together as a class. Explain that students will work as a class to come up with the features that the solutions need to have in order for them to work well (criteria). Then students will use those criteria to score each solution. (See **Know the Science** and **Know the Standards 1.**)

Know the Science

TEACHER DEVELOPMENT

Criteria Development: You and the students will be identifying the criteria for the solutions as students work on completing the scorecard, or rubric. Students will use the scorecard on Activity Page 4.3.1 to compare solutions and figure out which one is the best, based on whether it meets all the criteria that you establish as a class.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ETS1.C Optimizing the Design Solution: Students are establishing their list of criteria to be used when comparing design solutions.

- As a class, come up with a list of criteria (desirable features) that the landslide solution should have. Examples of some criteria include the following:
 - being strong
 - not being in the way (of roads or houses)
 - being okay in the sun
 - being waterproof
 - being fireproof
 - looking good

Math Connection

- Record the list on a large sheet of paper or the board while students write their own lists on the left side of the table on Activity Page 4.3.1. Make sure students have all of the criteria written down before you continue.

CHALLENGE—Challenge students to include economic criteria. For example, if the homes being destroyed by a possible landslide are worth \$200,000 and are only occupied during the winter, and if the landslides only happen during the summer, it is not worth spending two million dollars on the landslide prevention measures.

3. Facilitate the activity.

NGSS Elements



3D Learning

Online Resources



3D Learning: Students compare multiple solutions to the problem of landslides, using what they know about how water can change the shape of the land quickly or slowly over a long period of time. Students use this information to determine the best solution.

- Start the slideshow. Use the following talking points and question prompts for each picture: (See **Know the Standards 2.**)
 - Look at the picture. What do you think the solution is here?
 - How do you think the _____ (solution) works?

See the Online Resources Guide for a link to the recommended images:

www.coreknowledge.org/cksci-online-resources

NGSS Elements



DCI ETS1.C

Language Arts Connection

- As you show students each solution, talk about it in more depth. Explain to students what the goal of the solutions are, using the following points:
 - Nets: The nets are designed to catch rocks that fall. They also help keep the rocks in place.
 - Walls: The walls are made of concrete. These get built into the sides of mountains or hills to keep the land in place.

Know the Standards

TEACHER DEVELOPMENT

2. Language Arts Connection: Students make and describe connections between scientific concepts that have to do with what causes landslides and the ways in which people design solutions to address problems in nature (ELA RI.2.3).



- Bolts: Giant bolts are drilled into the rock to keep giant slabs from moving and shifting, such as during earthquakes.
- Trees: Trees, grass, and other plants can be planted in areas that are vulnerable. The plants establish roots inside the earth, which helps keep the land in place. Having plants on top of the soil also keeps soil from washing away when it rains.
- Talk about the drawbacks of the solutions. Explain that any time you are comparing solutions, you have to look at what is good and what is not good about the solution:
 - Nets: Nets have openings in them. Can rocks fit through those openings?
 - Walls: The walls are made of concrete. Concrete can sometimes crack during events like strong earthquakes.
 - Bolts: Bolts can become loose over time.
 - Trees: Trees can burn down in a fire. They can also be knocked down in a flash flood.
- As you stop to discuss each picture, have the students talk about what they notice about the specific features. Prompt students to take out their scorecards on Activity Page 4.3.1. As a class, go through all of the criteria that the students listed earlier, and talk about whether or not the solutions meet the criteria. (See **Know the Standards 3.**)
- Go over with students how to assign a score to each solution. Tell them that a “3” is great, a “2” is good, and a “1” is okay. Students will put a number in each box. The solution is scored for each criterion.
- Plan the activity so that students discuss and score one solution at a time, before moving on to the next solution in the slideshow.

SUPPORT—Some students may have a difficult time understanding how to tell the difference between a solution that is great, good, or okay and then understanding how to assign a final score. Allow these students to write “Yes” or “No” in the table on Activity Page 4.3.1 instead of assigning each solution a score from 1 to 3.

CHALLENGE—Offer students a mathematical opportunity to come up with an average score for each solution.

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more by researching other types of solutions that are used to address problems with weathering and erosion (not just specific to landslides).

Differentiation

Math Connection

Know the Standards

TEACHER DEVELOPMENT

3. DCI ETS1.C Optimizing the Design Solution: Remind students that even if they like one solution better than another, it is important to use the criteria as a checklist. Engineers cannot make decisions based off of the things they like or don’t like. Engineers stick with the lists and make decisions based on the features and functions of solutions. To optimize a design means to change it and make it better.

4. Summarize and discuss.

NGSS Elements



PE 2-ESS1-1
PE 2-ESS2-1
SEP 6

- Once students have had a chance to complete their scores for each solution, discuss the results as a class. (See **Know the Standards 4.**)
Ask students which solution they think is the best, in terms of meeting all the criteria. Then ask students which solution they think is the worst.
- Encourage students to have different opinions for a discussion. As you talk about the solutions, always draw students back to the criteria to use as a guide when supporting their claims about which solutions they think are best/worst.

5. Check for understanding.

Monitor Progress

Formative Assessment

Activity Page



AP 4.3.2

Check that students understood how to score the solution according to the criteria.

Distribute Scrapbook—Lesson 4 (AP 4.3.2), and prompt students to take a few minutes to complete it.

Review student scores on Solution Scorecard (AP 4.3.1) and Scrapbook—Lesson 4 (AP 4.3.2) to determine understanding of the following concepts:

- Some solutions meet the criteria, and other solutions do not.
- Some changes in Yosemite happen quickly, and others happen slowly.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about landslides, rockslides, mudslides, or other changes to landforms.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their fourth stop: Yosemite National Park. Students have learned about large landforms and how they formed and changed over the years.

Know the Standards

TEACHER DEVELOPMENT

4. PE 2-ESS2-1: The activities in this segment contribute to the Performance Expectation by having students compare four solutions that are designed to address the problem of landslides. A landslide is a type of rapid change that happens to areas that have mountains or hills and vulnerable earth. These changes affect the shape of the land.

LESSON 5

Land, Water, and Changes: Examples in Arches National Park

OVERVIEW

Guiding Question: How do rock arches form and change?

Lesson 5 Segments	Segment Questions	Advance Preparation
5.1 What Is Arches National Park? Students read about Logan’s fifth stop, to Arches National Park, and the landforms that can be found there.	How do rock formations in Arches National Park change slowly and quickly?	Read Chapter 8 in the Student Book. Gather materials for demonstration. See Materials and Equipment.
5.2 How Can Sandstone Be Shaped? Students work on an investigation to learn how water shapes rock, and they observe a demonstration on weathering and erosion from wind.	How can wind and water shape sandstone?	Gather and prepare materials for investigation and demonstration. See Materials and Equipment.

What’s the Story?

Summary: In Lesson 5 (Segments 1–2), students explore what rock arches are and how they are formed (2-ESS1-1). Students participate in an investigation where they observe how water can change the way these rock formations look over time, after weathering and erosion. Students also see a demonstration on how wind contributes to weathering and erosion of rock. The developing understanding of these phenomena in Lesson 5 prepares students for their work in Lesson 6, when they will build on their knowledge of landforms to study changes to land.

Learning Progression: Lesson 5 builds toward the Grade 2 targets of 2-ESS1-1: *Use information from several sources to provide evidence that Earth events can occur quickly or slowly;* and 2-ESS2-1: *Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*

Guiding Phenomenon: The natural landscape changes its shape and appearance due to Earth events that occur quickly or slowly. Rock arches are landforms that take a long time to form. Among the landforms that can be investigated in America’s national parks, rock arches can be explored by visiting Arches National Park. Water and wind are two natural forces that, over time, can weather and erode rock into the shape of arches. Certain events can cause these arches to fall and collapse suddenly, thus causing quick changes to the landscape (2-ESS1-1).

Learning Objectives

By the end of Lesson 5, students will do the following:

- Describe rock arches.
- Identify how long it takes for rock arches to form.
- Describe how rock arches can fall and collapse suddenly.
- Talk about how changes to rock formations also change the landscape.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly (partial).

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
6 Constructing Explanations and Designing Solutions Make observations from several sources to construct an evidence-based account for natural phenomena.	ESS1.C The History of Planet Earth Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.	7 Stability and Change Things may change slowly or rapidly.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Advance Preparation

In Lesson 5.2, students will be investigating weathering using model sandstones. Gather the materials as shown in the lesson segment, and make the model sandstones two days before the investigation. This will give them time to fully dry before the investigation.

LESSON 5.1

What Is Arches National Park?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How do rock arches form and change?

Today's Question: How do rock formations in Arches National Park change slowly and quickly?

Tie to the Anchoring Phenomenon: Students learn about the formation and changes of rock arches as they join Logan and his family on their trip to Arches National Park.

AT A GLANCE

Learning Objectives

- ✓ Describe sandstone formations.
- ✓ Differentiate between examples of weathering/erosion that occur over a long time and mass movements (collapses) that can occur suddenly.

Instructional Activities

- teacher Read Aloud
- class discussion
- question generation
- teacher demonstration

NGSS References

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Science and Engineering Practices: 1 Asking Questions; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students learn about rock formations and the processes that shape the rock formations. Students ask questions and construct explanations about the formation of rock formations.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

arch rock

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe

Instructional Resources

Student Book



Ch. 8

Student Book, Chapter 8
"Next Stop—Arches National Park"

Activity Page



AP 5.1.1

Activity Page
Arches National Park (AP 5.1.1)

Materials and Equipment

- river rocks (or other type of flat rock, like tiles that can be stacked) (4–6)
- timer
- question board

THE CORE LESSON 5.1

1. Introduce students to Lesson 5.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**

Tell students that, before they can answer the unit's Big Question about the land, they need to continue learning about different kinds of landforms. So far, students have learned about glaciers, hills, mountains, valleys, geysers, volcanoes, and various bodies of water. In Lesson 5, students will learn about rock arches and sandstone to apply their understanding to the Big Question. Write the Lesson 5 Guiding Question where students can see it:

How do rock arches form and change?

Tie to the Anchoring Phenomenon

As students work through Lesson 5, they will learn how some landforms are changed over time to look how they do today, when Logan and his family go to visit them.

- Introduce Today's Question: **How do rock formations in Arches National Park change slowly and quickly?** Remind students that in this unit they will be taking a tour of some of the national parks in the United States along with Logan and his family as they learn about Earth's landforms and history. **Ask students which parks they have toured so far.**
 - » Mount Rushmore National Memorial, Glacier National Park, Yellowstone National Park, and Yosemite National Park
- **Ask what students already know about Arches National Park in Utah.**
 - » Accept all reasonable answers. Some students may know there are interesting rock formations there.
- Draw student attention to the rocks. Tell them that you are going to stack them. Ask a volunteer to time you. Hand the volunteer the timer, and have the volunteer start the timer when you start stacking the rocks. Stack the rocks at a slower than average pace for emphasis.
- Have the student stop the timer when you are done stacking the rocks.
- Now tell the class that you are going to knock down your stack. You want to see whether it takes a longer or shorter amount of time to knock down the rocks than it did to pile them up.
- Have the student start the timer. Then knock the rocks down, and have the student stop the timer. Talk about the results. Explain that it often takes a longer time to form something, like a rock formation, than it does to destroy it. Let students know they will read more about this today.

2. Read together: "Next Stop—Arches National Park."

Student Book



Ch. 8


While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.


Ask students to turn to page 36 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Next Stop—Arches National Park,” and tell them to pay special attention to the pictures of the rock formations as you read.

CHAPTER
8

Next Stop—Arches National Park

On the road again! Next Logan’s family arrives at Arches National Park in Utah. It is different from the other parks they have visited. It is sandy, and the summer weather here is hot. There are few trees. It feels and looks like a desert. Tall red rocks rise from the land. The rocks are all different shapes and sizes.





36

Ask students to look at the photograph on page 36. Talk about what students notice in the picture. Draw student attention to the landscape.



Explain that a desert is a place that does not get a lot of rain. The United States has deserts in Utah, Arizona, Texas, New Mexico, Nevada, and California. Deserts are usually dry and very hot and get a lot of strong sun. (See **Know the Standards 1.**)

LITERAL—How is the landscape here different from Yellowstone National Park, Glacier National Park, and Yosemite National Park?

» There are not many trees. There are a lot more visible rocks. It looks like a desert.

Page 37

Ask students to look at the two pictures on page 37.

Logan sees how this park got its name. He notices that many of the rock formations are shaped like arches. Most of them stand alone. Others, like Double Arch, have formed right next to each other. All of the rock formations in Arches are made of a kind of rock called sandstone. Sandstone is made up of tiny grains of rock and other materials.



37

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.C The History of Planet Earth: Help students make a connection between the fact that Arches National Park is in a desert and the fact that the desert only gets a few inches of rain a year. Based on the amount of rain that occurs in this park, it makes sense that changes to the rock would take place over a long time.

CORE VOCABULARY—Explain that an **arch** is a curved structure usually spanning an opening in a building or bridge. The arch can support the weight of a bridge, roof, or wall. Natural rock arches are created by wind and rain erosion, where an arch forms with an opening underneath. Ask students to point out arches in nearby buildings or create one out of paper.

INFERENTIAL—Why do you think this park is called Arches National Park?

- » The rocks are shaped like arches.

CORE VOCABULARY—Ask students to describe a **rock**.

- » solid material that makes up the surface of Earth; found in different colors and sizes

Explain that sandstone is a type of rock that is made up of tiny grains of sand and other materials.

INFERENTIAL—What natural processes do you think caused the rocks to look this way in Arches National Park?

- » blowing wind, flowing water

Ask students to look at the two pictures on page 38. Explain that the pictures show different rock shapes besides arches. Elicit a discussion about what these rock shapes look like or resemble.

Arches are a common rock shape in the park. But there are others too. Some rocks are shaped like tall columns. They are called pinnacles.



Other areas have many thick walls of standing rock. They are called fins. Some fins eventually become arches. Logan wonders how this happens.



38

LITERAL—What are the tall columns of rock called?

» pinnacles

LITERAL—What are the areas with thick walls of standing rock called?

» fins

INTERPRETIVE—What do fins, pinnacles, and arches in Arches National Park have in common?

» They are all made of sandstone.

Ask students to look at the picture on page 39. Talk about how water contributes to the changes of rock. Then discuss how wind contributes to these changes, too.

Water and Wind Shape the Land

What caused these unusual rock shapes to form? Arches National Park is in a desert. But it gets about nine inches of rain per year. That is all that is needed for the rocks to change little by little. Wind and water wear away at surfaces of the sandstone. Tiny pieces break off and blow away or wash away. Unusual rock shapes form.



LITERAL—What does wind do to sandstone?

- » It carries tiny bits of sand. The sand grinds against the rock. This can form a hole. A small hole can lead to a big arch.

LITERAL—Does this take a long time to happen or a short amount of time?

- » a long time

INTERPRETIVE—What are the two causes of rock erosion?

- » water and wind

INTERPRETIVE—Would water or wind be most likely to cause more erosion in a desert?

- » wind because it doesn't rain very much

NGSS Elements



DCI ESS1.C
CCC 7



Ask students to look at the two pictures on page 40. Discuss the weather in the desert and what causes slow and quick changes to rocks.

Water soaks into the tiny spaces in a rock's surface. Wind carries tiny bits of sand that grind against rock from the outside. A hole begins to form when enough of the rock wears away. A small hole can turn into a big arch. This takes a long time.



The top of an arch can fall. The collapse can leave two pillars and a pile of boulders. This happens suddenly.



40

LITERAL—Describe how the arches were formed.

- » Slowly, little amounts of rain washed away small bits of rock, and wind carried bits of sand away. A small hole formed and turned into a big hole over time.

INTERPRETIVE—In the second picture, what part of the rock is wearing away the most?

- » The narrow part under the top.

INTERPRETIVE—What could happen if there were a big wind storm?

- » The top of the rock could fall.

INTERPRETIVE—If an arch falls, does this happen quickly or over a long time?

» It happens quickly/suddenly.

Page 41

NGSS Elements



DCI ESS1.C

CCC 7

SEP 6

Ask students to look at the pictures on page 41 as you read aloud. Talk about the landscape students see in the pictures. (See **Know the Standards 2** and **3**.)

Rock arches can form in other places besides the desert. Wind and water along the rocky ocean shore can produce arches. Like the desert arches, these also take a long time to form. But they can change quickly, too. Arches become weaker as water and wind wear them away. They can suddenly crumble. An earthquake recently caused a rock arch in Puerto Rico to fall. A storm caused the top of the arch pictured below to fall into the sea.



41

LITERAL—Where else can rock arches form, besides the desert?

» along the shore

Know the Standards

TEACHER DEVELOPMENT

2. ESS1.C The History of Planet Earth: Review with students the various ways that quick changes can happen to rock arches.

3. CCC 7 Stability and Change: There are many ways for rock arches to crumble and fall. These events happen suddenly, even if the arches have been wearing away over a long period of time.

EVALUATIVE—Along the shore, would water or wind cause more change to rocks?

» water because the sea is constantly moving against rocks

Differentiation

SUPPORT—Have students turn and talk with a neighbor about the three ways that arches can fall and crumble, based on this page: (1) arches becoming weaker from the wear from water and wind, (2) storms causing arches to fall, and (3) earthquakes causing arches to fall. Then ask students to talk about whether these changes happen suddenly or over a long time.

3. Summarize landscape changes.

Activity Page



AP 5.1.1

NGSS Elements



DCI ESS1.C

CCC 7

SEP 1

- Distribute Arches National Park (AP 5.1.1) to each student. Tell students that they will draw a picture that represents a slow change to Arches National Park and that then they will draw a picture that represents a fast change to Arches National Park.
- Tell students to label their drawings. Students should label the force that is causing the slow change (e.g., wind, rain) and the force that is causing the fast change, for example wind, water, storms, earthquake.
- Circulate around the room as students draw, and ask guiding questions, such as the following:
 - What role do wind and water play in the changes?
 - Does wind/water make fast changes or slow changes to rock?
 - How can you show a slow change in your picture? How can you show a fast change?

SUPPORT—If students are just learning English, they may have a difficult time articulating the slow and fast change concepts of the rock arches via their illustrations. Alternatively, have these students draw pictures of a rock arch.

Differentiation

CHALLENGE—Challenge students to draw a series of pictures that show a large rock formation and the slow, gradual process of water or wind carving away at the sandstone until an arch is formed. This can be done as a flip-book activity or with a series of drawing boxes, like a comic strip.

EXTEND—Have students research mechanical and chemical weathering and the differences between them. Water can cause both.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings on Activity Page 5.1.1 to ensure understanding that the landscape changes when rock arches fall. If students do not have proper understanding of this, go back through the Student Book, and allow students to look at the pictures.

Review student drawings and labels on Arches National Park (AP 5.1.1) to determine student understanding of the following concepts:

- Water and wind can change the shape of rocks over time.
- Rock arches take a long time to form.
- Rock arches can fall suddenly.
- When rock arches fall, they change the landscape.

See the Activity Page Answer Key for correct answers and sample student responses.

Ask students what additional questions they have about Arches National Park, and add their questions to the question board.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their fifth stop: Arches National Park. Students have learned how water and wind contribute to the way the landscape looks.

LESSON 5.2

How Can Sandstone Be Shaped?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How do rock arches form and change?

Today's Question: How can wind and water shape sandstone?

Tie to the Anchoring Phenomenon: Logan and his family encounter rock arches at Arches National Park. In this lesson, students learn about how sandstone can be shaped by wind and water.

AT A GLANCE

Learning Objectives

- ✓ Investigate the ability of water to wear away earth material.
- ✓ Investigate the ability of air to wear away earth material.

Instructional Activities

- student investigation
- student observation

NGSS References

Performance Expectation: 2-ESS1-1

Disciplinary Core Idea: ESS1.C The History of Planet Earth

Science and Engineering Practices: 1 Asking Questions; 2 Developing and Using Models; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students investigate the processes of weathering through an interaction with a model of sandstone. Students then investigate the erosion of the weathered materials from the sandstone.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

sandstone **water** **wind**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

investigate

model

Instructional Resources

Activity Pages



AP 5.2.1

AP 5.2.2

AP 5.2.3

Activity Pages

Water Changes Rock (AP 5.2.1)

Wind Changes Rock (AP 5.2.2)

Scrapbook—Lesson 5 (AP 5.2.3)

Materials and Equipment

Student use:

- eyedroppers (1 per group)
- trays (1 per group)
- parchment or wax paper
- water (1 cup per group)
- straws (1 per student)

Teacher preparation:

- sand
- cornstarch
- water
- bowl
- mixing spoon
- teaspoon
- measuring cups (1 cup, liquid and dry)
- plastic cups (1 per group)
- question board

Advance Preparation

Gather the materials as shown in the lesson segment, and make the model sandstones two days before the investigation. Each group will get a sandstone made from one cup of sand.

- To make the sandstones, mix the ingredients in the following ratio:
 - 1 cup sand
 - 3 tsp cornstarch
 - 3 oz water

Scoop out sand using the one cup measuring cup. Allow excess water to drain out. Pack the sand firmly into the cup. Then place the cup upside down on each parchment papered tray, and tap the cup to get the sand to release

Allow this to dry for two days. The cornstarch will help bind the sand together. As students drop water onto the model sandstones, weathering will occur.

Pour water into each of the plastic cups, enough for each group to get one.

THE CORE LESSON 5.2

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS1.C

How can wind and water shape sandstone?

- Review how the rocks in Arches National Park change slowly and quickly by wind and water.
 - » They can fall and change quickly. Over time, wind and rain can erode rocks. Rain can also dissolve rocks and change their color.
- Introduce the day's activities. Explain that students will investigate what happens when water and wind contact sandstone.

2. Prepare for the activity.

Activity Page



AP 5.2.1

NGSS Elements



SEP 1

- Have students form small groups of mixed ability. Distribute the materials to each group. (See **Know the Science 1.**)
- Distribute Water Changes Rock (AP 5.2.1). Review Activity Page 5.2.1 together as a class. Explain that students will use the drawing boxes to record their observations during the investigation. Remind students that scientists record and document their findings as part of science. (See **Know the Standards 1.**)

Know the Science

TEACHER DEVELOPMENT

1. Modeling Sandstone: The sand in these models is bound together by the cornstarch, not unlike materials in nature that cement sand together to make sandstone. For the purposes of this activity, it serves well as a material that represents sandstone and allows for students to weather it with wind and water.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 1 Asking Questions: Questions are what drive scientists to explore and investigate the natural world. Ask students what they wonder about with respect to this investigation. For example, students may wonder if the water will wash away the sand or whether the wind will be able to blow it away.

3. Facilitate the activity.

NGSS Elements



3D Learning

3D Learning: Students investigate natural processes (wind and water erosion) that cause changes to rock formations over long periods of time.

- Tell students to draw their first picture on Activity Page 5.2.1.
- Tell students to fill their droppers with water from the plastic cup. Prompt students to slowly drop water onto the model sandstone. (See **Know the Science 2.**)

NGSS Elements



SEP 2

Ask students what they observe happening to the shape of the rock.

» The shape of the rock is changing.

- Prompt students to record the second drawing on Activity Page 5.2.1 to illustrate what the rock formation looks like now.

SUPPORT—If students are just learning English, they may have a difficult time carrying out the steps based on verbal cues. Alternatively, model what students should do, and have them copy you.

Differentiation

CHALLENGE—Offer students a simple mathematical problem to solve. Give students a scenario that involves water erosion, along with data that they can use to figure out how long it would take for rock to be weathered and eroded by water. Students can solve for the unknown amount of time.

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more by researching other rock formations and how they changed because of weathering and erosion.

Know the Science

TEACHER DEVELOPMENT

2. Sandstone Weathering: Water will dissolve and change the shape of the model sandstones quickly. However, water does not change the shape of sandstone formations, which are much larger and much more solid, this quickly in nature.

4. Guide more demonstrations.

Activity Page



AP 5.2.2

- Distribute Wind Changes Rock (AP 5.2.2). Review Activity Page 5.2.2 together as a class. Explain that students will use the drawing boxes to record their observations during the investigation. Remind students that scientists record and document their findings as part of science.
- Distribute straws to the students. Explain that students are going to blow on the sand that weathered off the model sandstone and on the model sandstone to see what will happen. Clarify for students that the real erosional agent is not the wind itself, but the grains of hard sand it carries that abrade the rock. (See **Know the Standards 2**.)

NGSS Elements



PE 2-ESS1-1

SEP 6

CCC 7

Ask students what they noticed happening to the loose grains of sand.

- » The grains of sand blew around.

Ask students what they noticed happening to the sandstone.

- » Sand started to come off the sandstone.
- Summarize the demonstration by discussing how wind can blow against the sandstone over time and cause the sandstone to change shape. This is one way that the rock arches were formed. Have students draw before and after drawings of the sandstone.

5. Check for understanding.

Activity Page



AP 5.2.3

Formative Assessment

Distribute Scrapbook—Lesson 5 (AP 5.2.3). Ask students to complete the log for Arches National Park.

Look at student drawings on Activity Page 5.2.1 and Activity Page 5.2.2 to ensure understanding of the fact that water and wind can weather and erode rock.

Review student drawings on Water Changes Rock (AP 5.2.1) and Wind Changes Rock (AP 5.2.2) to determine understanding of the following concepts:

- Rock formations can change because of water.
- Rock formations can change because of wind.

NGSS Elements



PE 2-ESS1-1

Know the Standards

TEACHER DEVELOPMENT

2. PE 2-ESS1-1: The activities in this segment contribute in part to the Performance Expectation by having students use information from various sources to determine whether events on Earth happen relatively quickly or slowly. However, students won't complete this until the capstone, when they finish gathering evidence from various sources throughout the unit.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about changes to rock landforms.

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In this lesson, students follow Logan and his family to their fifth stop: Arches National Park. Students have learned about rock arches, which Logan sees at the park, and how they are formed and what happens when they collapse.

LESSON 6

Land, Water, and Changes: Examples at Cape Cod National Seashore

OVERVIEW

Guiding Question: How can wind and water affect sand and sand formations?

Lesson 6 Segments	Segment Questions	Advance Preparation
6.1 What Is Cape Cod National Seashore? Students read about Logan’s final stop, Cape Cod National Seashore, and the landforms that can be found there.	How does sand make up changing landforms along the ocean shoreline?	Read Chapter 9 in the Student Book.
6.2 Sand on the Move! Students investigate sand erosion from wind and water.	How can we model changing dunes and beaches?	Gather materials for investigation. See Materials and Equipment.
6.3 Sand Dunes and Beaches Students read about the solutions that are designed to help protect sand from changing.	How can wind and water affect sand dunes and beaches?	Read Chapter 10 in the Student Book.
6.4 Protecting Sand Dunes Students compare various solutions for preventing sand dune erosion and use rubrics to figure out the best solution.	How can people protect sand dunes from erosion?	Gather materials for activity. See Materials and Equipment.

What’s the Story?

Summary: In Lesson 6 (Segments 1–4), students explore how the sandy landscapes at Cape Cod National Seashore were formed and how they can change slowly over time due to ongoing erosion, or rapidly due to events like hurricanes (2-ESS1-1). Students participate in an investigation where they observe how sand dunes and shorelines can change from wind and water, as well as participate in an activity where they compare different solutions to help address the problems with sand erosion (2-ESS2-1). The developing understanding of these phenomena in Lesson 6 prepares students for the Unit Capstone, when they piece together all the information they learned about various landforms, their formation, and ways they change.

Learning Progression: Lesson 6 builds toward the Grade 2 targets of 2-ESS1-1: *Use information from several sources to provide evidence that Earth events can occur quickly or slowly*; and 2-ESS2-1: *Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land*.

Guiding Phenomenon: The natural landscape changes its shape and appearance due to Earth events that occur quickly or slowly. Some of the sand formations such as the shoreline and sand dunes that are seen at Cape Cod National Seashore were formed over time. They can erode over time, too, but can also be changed suddenly due to severe storms. Water and wind are two natural forces that, over time, can weather, erode, and deposit sand, causing the landscape to change.

Learning Objectives

By the end of Lesson 6, students will do the following:

- Describe sand landforms, such as dunes and beaches.
- Explain how sand dunes and beaches are formed.
- Describe how erosion from wind and water can change dunes and beaches.
- Identify solutions to prevent sand erosion from wind and water.

NGSS Standards and Dimensions

Performance Expectation: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (partial)

Performance Expectation: 2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. (partial)

Science and Engineering Practice	Disciplinary Core Ideas	Crosscutting Concept
<p>6 Constructing Explanations and Designing Solutions</p> <p>Compare multiple solutions to a problem.</p>	<p>ESS1.C The History of Planet Earth</p> <p>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.</p> <p>ESS2.A Earth Materials and Systems</p> <p>Wind and water can change the shape of the land.</p> <p>ETS1.C Optimizing the Design Solution</p> <p>Because there is always more than one possible solution to a problem, it is useful to compare and test designs.</p>	<p>7 Stability and Change</p> <p>Things may change slowly or rapidly.</p>

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 6.1

What Is Cape Cod National Seashore?

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can wind and water affect sand and sand formations?

Today's Question: How does sand make up changing landforms along the ocean shoreline?

Tie to the Anchoring Phenomenon: Students learn about the ocean as a body of water and beaches and dunes as landforms, as they join Logan and his family on their final stop, Cape Cod National Seashore.

AT A GLANCE

Learning Objectives

- ✓ Identify the ocean as a body of water; differentiate fresh water from salt water.
- ✓ Interpret water features on a globe.
- ✓ Identify beaches and dunes as landforms.

Instructional Activities

- teacher Read Aloud
- class discussion
- question generation

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ESS1.C The History of Planet Earth; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practices: 1 Asking Questions; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 7 Stability and Change

Students examine sand to observe its properties and how landforms are created from it. Students then learn about sand landforms and sights they would see around Cape Cod National Seashore.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

dune ocean sand seashore

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe shoreline

Instructional Resources

Student Book



Ch. 9

Student Book, Chapter 9
"Last Stop—A Day at the Beach"

Activity Page



AP 6.1.1

Activity Page
Cape Cod National Seashore
(AP 6.1.1)

Materials and Equipment

- globe
- lunch trays (1 per group)
- sand (1 cup per group)
- question board

Advance Preparation

Pour one cup of sand onto each tray. Have the trays ready to pass out to students in pairs.

THE CORE LESSON 6.1

1. Introduce students to Lesson 6.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How can things that happen on Earth change the land?**

Tell students that they are close to being able to answer the unit's Big Question about the land. However, there is still one last type of landform and one last body of water to learn about. In Lesson 6, students will learn about the role that the water

and wind affecting sand and sand formations near the ocean play in making quick or slow changes to the land, to apply their understanding to the Big Question. Write the Lesson 6 Guiding Question where students can see it:

How can wind and water affect sand and sand formations?

- Introduce Today's Question: **How does sand make up changing landforms along the ocean shoreline?**
- Remind students that in this unit they have been taking a tour of some of the national parks in the United States along with Logan and his family as they learn about Earth's landforms and history.
- Review with students the parks they have toured so far.
 - » Mount Rushmore National Memorial, Glacier National Park, Yellowstone National Park, Yosemite National Park, and Arches National Park
- **Ask what students already know about Cape Cod in Massachusetts.**
 - » Accept all reasonable answers. Some students may know beaches there.
- Explain that today students are going to start on an expedition to explore landforms on Cape Cod.

Tie to the Anchoring Phenomenon

As students work through Lesson 6, they will learn how sand dunes form over time and how coastal erosion causes problems when Logan and his family visit Cape Cod National Seashore.

2. Turn and talk.

- Have students form pairs. Distribute a tray of sand to each pair.
- Tell students that they have sand in front of them. Invite students to observe the sand. Review what it means to observe something—students can look at it, listen to it, touch it, move it, and so on (Caution students against blowing or throwing the sand, as it can get into the eyes.)
- Encourage pairs to talk about what they notice about the sand, such as its texture, shape, weight, et cetera.
- Prompt students to form the sand into piles.

Ask students if the sand can be built up into little hills.

- » Yes, we can shape the sand into little hills.
- Explain that in real life, these hills of sand are called sand dunes. Students will learn about sand dunes in the Student Book today.
- Assist students in discarding the sand, and collect all of the trays.

3. Read together: “Last Stop—A Day at the Beach.”

Student Book



Ch. 9

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 42

Ask students to turn to page 42 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Last Stop—A Day at the Beach,” and tell them to pay special attention to the sandy formations as you read.

CHAPTER
9

Last Stop—A Day at the Beach

The end of summer break is near. Soon Logan will be back in school. Logan and his family have finally returned home from their adventure. On Saturday morning, Logan’s mom asks if they would like to spend one last day at the seashore. Logan loves the beach and dunes! They pack up the car and head to the Cape Cod National Seashore.





Ask students to look at the main picture on page 42. Talk about what students notice about the landscape. (See **Know the Standards 1.**)

LITERAL—Where do Logan and his family go?

» Cape Cod National Seashore

LITERAL—What kind of place does this look like?

» It looks like a beach.

CORE VOCABULARY—Explain that a **seashore** is an area that borders the sea.

CORE VOCABULARY—Explain that the **ocean** is a large body of salt water. Most of the water on Earth is found in the ocean.

Differentiation

SUPPORT—Ask students to speculate what a **shoreline** is. Discuss each word of the compound word.

» A shore is the land along the edge of a body of water. A line is a long narrow mark. A shoreline then is the line along the edge of a body of water where the water meets the land.

Have students trace the shoreline in the map.

CORE VOCABULARY—Explain that **sand** is made up of tiny pieces of rock and broken seashells. It is very light and is easily blown by the wind.

Know the Standards

TEACHER DEVELOPMENT

1. ESS1.C The History of Planet Earth: Students will read more about how sand dunes form in Chapter 10. For now, invite students to speculate and talk about whether they think the sand dunes form in a short or long amount of time, based on what they have learned about how landscapes form from Logan's journey across the United States.

Ask students to look at the picture on page 43. Talk about what students notice in the picture. (See **Know the Standards 2** and **3**.)

NGSS Elements



DCI ESS2.A
DCI ESS2.C

Logan and his family make their way to the beach. They walk a long sandy path with grassy mounds of sand all around them. They reach the place where the ocean meets the land. Ocean waves roll onto the beach, one after the other, never stopping. Sand stretches along the waterline as far as Logan can see.



CORE VOCABULARY—Explain that a **dune** is a hill of sand that is piled up from wind.

INFERENTIAL—Do you think sand dunes like this took a long time or a short time to form?

» a long time

Know the Standards

TEACHER DEVELOPMENT

2. ESS2.A Earth Materials and Systems: This chapter sets the stage for what students will learn in the next chapter about how sandy landscapes form from wind and water. Now, you can invite students to talk about whether or not they think the ocean had a part in shaping the landscape at the beach, such as the shape of the shoreline, the dunes, or any of the rocks that they see on the beach.

3. ESS2.C The Roles of Water in Earth's Surface Processes: Students have already learned that water can be found in flowing bodies, such as rivers and streams. Now, they learn that water can be found in the ocean at the beach.

LITERAL—What kinds of things do you notice about the landscape?

» There is a lot of sand; there is grass on the sand; there is water.

INTERPRETIVE—How far does the sand stretch?

» all along the shoreline

INTERPRETIVE—At the shoreline, is it usually windy or calm?

» windy

Differentiation

SUPPORT—Help students grasp the concept of how massive the ocean is. Show students a globe, and invite volunteers to come up and trace the ocean around the world with their finger. If you don't have a globe, you can do this same activity with a map. Emphasize the enormity of the ocean and how it wraps around the planet.

SUPPORT—Clarify that sand dunes can take a long time (thousands of years) to form when compared to a human lifetime but a very short time compared to uplift and erosion to form Yosemite (about sixty-five million years). Even the time to form Yosemite is very short compared to the length of time Earth has existed.

Ask students to look at the picture on page 44. Talk about what students notice about the landscape. The page talks about what Logan can hear at the beach.

The beach and the dunes here are never silent. Logan can hear the steady sound of ocean waves splashing onto the beach. But often, the sound of the water is covered up by the even louder steady wind. Logan notices that it seems to be windy here all the time. Down on the beach, the umbrella flaps in the breeze. Up on the dunes, the grasses rustle and sway.



44

NGSS Elements



DCI ESS2.A
DCI ESS2.C
CCC 7

INFERENTIAL—How do you think the wind impacts all the sand?

- » The wind could possibly blow the sand around on the beach.

Logan also notices some things here in this natural area that were built by people. He sees wooden fences along the paths that cross the dunes to the beach. He sees more fences across the tops of many dunes. He sees signs telling people to keep off the dunes. And every so often along the beach, Logan notices a long pile of large rocks. The rocks are arranged in a narrow pile extending from the beach out into the ocean water.



45

INFERENTIAL—What do you think the fences are for?

- » The fences also protect the sand dunes from being walked on or blowing away.

INFERENTIAL—Why do you think there are signs telling people to keep off most parts of the dunes?

- » The dunes can be dangerous. People can fall. The fences also protect the sand dunes from being walked on or blowing away.

INFERENTIAL—Why is sand collecting behind the fences?

- » The wind blows that sand, and the fence slows it down from moving away.

4. Summarize the landscape.

Activity Page



AP 6.1.1

NGSS Elements



DCI ESS2.A

- Distribute Cape Cod National Seashore (AP 6.1.1) to each student. Tell students that they will draw a picture that represents what Logan saw at the beach.
- Circulate around the room as students draw, and ask guiding questions, such as the following:
 - Was the sand on the beach flat, piled in small hills, or both?
 - What was the landscape like? Were there any mountains, or was it mostly flat?
 - Did it have a body of water? What is that water body called? How does it move? Does it flow like a river or stream, or does it sit still like a lake? Or does it do something else?
 - Did Logan see any plants? Where did they grow?

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time understanding all of the things that Logan described about the landscape. Alternatively, have these students draw pictures based on the pictures they see in Chapter 9, rather than on Logan’s descriptions.

CHALLENGE—Challenge students to draw a picture that represents how they think the sand dunes got there.

EXTEND—Have students research sand dunes that are found at beaches and in deserts. Talk about what is similar or different about beach and desert dunes.

5. Check for understanding.

Monitor Progress

Formative Assessment

Review student drawings on Cape Cod National Seashore (AP 6.1.1) to determine student understanding of the following concepts:

- The ocean is found at the beach.
- There are sand dunes at the beach.
- Plants and animals live in the beach habitat.

See the Activity Page Answer Key for correct answers and sample student responses.

Ask students what additional questions they have about the beach/seashore, and add their questions to the question board. Let students know that they will learn more about sand dunes in the next chapter.

Tie to the Anchoring Phenomenon

In this final lesson of the unit, students follow Logan and his family as they spend the day at the beach. Students are introduced to the landscape at beaches, including sand dunes, and will investigate this further in the lesson.

LESSON 6.2

Sand on the Move!

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can wind and water affect sand and sand formations?

Today's Question: How can we model changing dunes and beaches?

Tie to the Anchoring Phenomenon: Students learn that sand makes up landforms called beaches and dunes as they join Logan and his family on their final stop, Cape Cod National Seashore. Today, students investigate how wind and water can make sand move.

AT A GLANCE

Learning Objective

- ✓ Investigate the ability of air and water to move sand.

Instructional Activities

- student investigation
- drawing

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 7 Stability and Change

Students investigate the weathering and erosion effects of wind and water on sand landforms.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

dune ocean sand water
wind

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

investigate shoreline

Instructional Resources

Activity Page



AP 6.2.1

Activity Page
Exploring Sand (AP 6.2.1)

Materials and Equipment

- straws (1 per student)
- shallow aluminum pans (1 per group)
- sand (2–3 cups per group)
- water (2 cups per group)
- rulers (1 per group)
- question board

Advance Preparation

Prepare workstations around the classroom for small groups to do their investigations. Pour sand into the aluminum pans. Set the water on the side in a separate container or cup.

THE CORE LESSON 6.2

1. Focus student attention on Today’s Question.

NGSS Elements



DCI ESS2.A

How can we model changing dunes and beaches?

- Review what students learned from Chapter 9 in the Student Book about dunes.
 - » Dunes are made of sand and form hills. They blow around. They come in different sizes.
- Tell students that today they will investigate how sand dunes change.

2. Prepare for the investigation.

- Have students form small groups, and assign them to different workstations in the room.
- Go over the materials that students see in front of them. Explain that they will carry out two investigations. The first will show how wind changes and moves sand, and the second will show how water changes and moves sand.



- Distribute Exploring Sand (AP 6.2.1) to each student, and review it together as a class. Explain that students will use it to record their findings. For the first section, students will draw what the sand dune looks like before the wind and then after the wind. For the second section, students will use a ruler to see how tall the sand dune is before the water and then after the water.

3. Facilitate the investigation.



- Help students set up for the first investigation (wind). Prompt students to build a sand dune with the sand in their aluminum pans. (See **Know the Science** and **Know the Standards 1 and 2.**)
- Tell students to draw how the sand dune looks on Activity Page 6.2.1.
- Now have students take turns blowing the sand through the straw. Students can blow the sand as much as they want to.

Ask students to observe what happens to the sand when the wind reaches it.

- » The sand blows away or moves around.
- When each student has had a chance to blow the sand around a few times, prompt students to draw the final shape of the sand dune on Activity Page 6.2.1.
- Use the following questions to start a class discussion:
 - Does the sand dune look different from when you started?
 - What is different about the sand dune now?
 - What happened to the sand?
- Now have students set up for the second investigation using water. Prompt students to make another sand dune in the aluminum pans, ideally on one side of the pan.

Know the Science

TEACHER DEVELOPMENT

Measurement and Data: Remind students that scientists take measurements and record data when studying things in the natural world. This helps them remember what they investigate and make comparisons later on when they collect more data. Here, students will compare their starting data to the ending data to see that water erosion changes sand landforms.

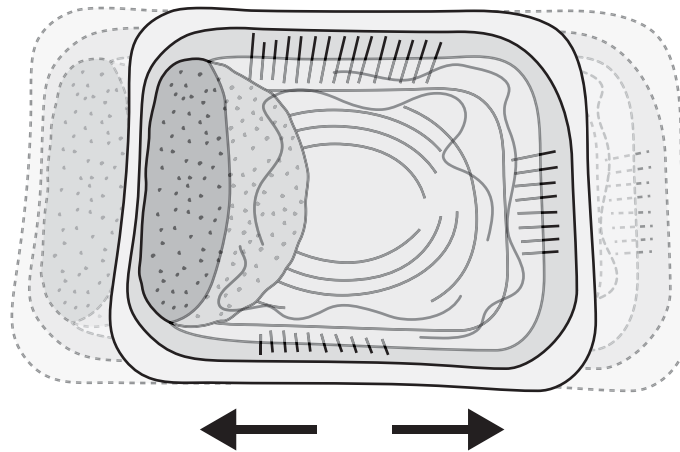
Know the Standards

TEACHER DEVELOPMENT

- 1. ESS2.A Earth Materials and Systems:** Students investigate how wind and water change landscapes.
- 2. SEP Developing and Using Models:** Students use model sand landforms to investigate how wind and water weather and erode dunes.



- Tell students to stick the ruler into the sand dune until the bottom of the ruler reaches the pan. Have students read the number on the ruler and write it down on Activity Page 6.2.1. Each group will have a different number depending on how tall they make their sand dune. Now have students draw the shape of the sand dune on Activity Page 6.2.1.
- When all students are ready, instruct the groups to pour water into the nonsandy side of the pan. Explain that they will make the water act like the ocean. Tell them to be careful, because this part can get messy. They will gently rock the aluminum pan back and forth to make the water move forward and back, touching the sand. Two students in the group can do the rocking, each holding one end of the pan. (See **Know the Standards 3** and **4**.)



- Circulate around the room as students rock the water to simulate the forward and backward motion of the ocean. Make sure students are rocking the pans such that the water touches and changes the sand.
- Encourage students to take turns rocking, so let students know when they should switch and have another set of students take hold of the ends of the pans.

Ask students to describe what they notice happening to the sand.

- » The sand is moving; the sand is going into the water; the sand dune is shrinking.

Know the Standards

TEACHER DEVELOPMENT

3. ESS2.C The Roles of Water in Earth's Surface Processes: Students learn that the ocean is another place on Earth to find water, and they simulate it in this investigation to see how water is capable of causing weathering and erosion.

4. CCC 7 Stability and Change: Students investigate a process that takes a long time to occur in nature. Changes to sand by wind or water erosion happen slowly.

- When students are done, have them take another measurement of the sand dune with the ruler. Prompt students to write the new number on Activity Page 6.2.1 and then draw what the sand dune looks like in the second box.
- Use the following questions to start a class discussion:
 - Does the sand dune look different from when you started?
 - What is different about the sand dune now?
 - What happened to the sand along the ocean shore?

Ask students if they think these changes to sand happen slowly or quickly in nature. Help them determine this based on relative information they have about other types of changes, like landslides and rock arches.

» We think it takes a long time for sand to change from wind and water. It could happen slowly if the wind is gentle and quickly during a storm.

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time listening to and comprehending the instructions for the investigations. Alternatively, demonstrate the steps for students, and have them follow along in their groups.

CHALLENGE—Challenge students to find the difference between the starting height of the sand dune and the ending height of the sand dune and record that number somewhere on Activity Page 6.2.1.

EXTEND—Have students research how long it takes for sand dunes to form.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look at student drawings on Activity Page 6.2.1 to ensure understanding of how sand landforms, like dunes and shorelines, change when they are eroded over time.

Review student drawings on Exploring Sand (AP 6.2.1) to determine student understanding of the following concept:

- Wind and water change the shape of sand.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about sand dunes and other landforms at the seashore.

Tie to the Anchoring Phenomenon

In this final lesson of the unit, students follow Logan and his family as they spend the day at the beach. Students are introduced to the landscape at beaches, including sand dunes and the shoreline, which is what students investigated in this segment.

LESSON 6.3

Sand Dunes and Beaches

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can wind and water affect sand and sand formations?

Today's Question: How can wind and water affect sand dunes and beaches?

Tie to the Anchoring Phenomenon: Students learn about beaches and sand dunes as landforms, as they join Logan and his family on their final stop, Cape Cod National Seashore.

AT A GLANCE

Learning Objective

- ✓ Explain how erosion (by wind and water) of coastal sand landforms (dunes and beaches) can be a problem for people.

Instructional Activities

- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Ideas: ESS2.A Earth Materials and Systems; ESS1.C The History of Planet Earth; ESS2.C The Roles of Water in Earth's Surface Processes

Science and Engineering Practices: 1 Asking Questions; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 7 Stability and Change

Students read about efforts and methods to reduce wind erosion in areas with sand dunes.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

dune

ocean

sand

seashore

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

example identify notice observe shoreline

Instructional Resources

Student Book



Ch. 10

Student Book, Chapter 10
"Wind, Water, and Moving Sand"

Activity Page



AP 6.3.1

Activity Page
Draw a Solution (AP 6.3.1)

Materials and Equipment

- internet access and the means to project images/video for whole-class viewing
- question board

THE CORE LESSON 6.3

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.A

How can wind and water affect sand dunes and beaches?

- Review what students learned about dunes.
 - » Dunes are made of sand and form hills. They blow around. They come in different sizes.
- Remind students that in the previous class segment they investigated how wind and water moved sand. Today, students will read more about how sand moves from wind and water.

2. Read together: “Wind, Water, and Moving Sand.”

Student Book



Ch. 10

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 46


Ask students to turn to page 46 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Wind, Water, and Moving Sand,” and tell them to pay special attention to the sandy formations as you read.

CHAPTER
10

Wind, Water, and Moving Sand

Cape Cod National Seashore has forty miles of sandy beaches and eight thousand acres of sand dunes. That is a lot of sand! Waves, wind, and storms change land that is made up of loose sand. Compared to most changes of rock, changes to sand landforms take less time.

Sand is made up of tiny pieces of rock and broken seashells. Ocean waves push rocks and shells around under the water. The pieces crash into each other. They break apart. Waves wash sand to the shore. It collects there. A beach forms. Wind blows sand into piles away from the waterline. The dry sand piles up to form dunes.



46



DCI ESS1.C

DCI ESS2.A

CCC 7

Math Connection

Ask students to look at the picture on page 46. Talk about what students notice about the sand. (See **Know the Standards 1** and **2**.)

CORE VOCABULARY—Explain that **sand** is made up of tiny pieces of rock and broken seashells.

LITERAL—How does a beach form?

» Waves wash sand to the shore, where it collects.

LITERAL—How does a sand dune form?

» Wind blows sand into piles away from the water.

LITERAL—How much sand does Cape Cod National Seashore have?

» It has 8,000 acres of sand dunes.

SUPPORT—Use this opportunity to discuss just how big 8,000 acres of sand dunes is in relative terms that students can understand. Compare this size to the average-sized schoolyard. A schoolyard is typically 1 acre for every 100 students. Prompt students to visualize the size of the schoolyard at your school, and then challenge them to do the math to figure out how many schoolyards it would take to make up the eight thousand acres of sand dunes.

Know the Standards

TEACHER DEVELOPMENT

1. ESS1.C The History of Planet Earth: Students learn about how long it takes for sand landforms to change, relative to changes that are made to rocks. Compared to rocks, sand formations change in a shorter amount of time.

2. ESS2.A Earth Materials and Systems: Wind and water both play a role in shaping sandy landforms. Water helps shape shorelines, and wind creates piles that turn into dunes.



Ask students to look at the two pictures on page 47. Discuss why changing landforms due to wind or water could be bad for people who live near the ocean. (See **Know the Standards 3.**)

Beaches and dunes are always changing. Wind and water move sand easily. Waves that push sand up to form a beach also wash the sand away. This can take a long time. Or it can happen very quickly.

Waves don't always come straight into the shore. They often come toward the shore at an angle. They push sand up or down the shoreline. People build structures to protect beaches. A jetty or wall can keep waves from pushing sand away from a beach.

Big storms like hurricanes can cause waves to be much larger than usual. Big waves can move a lot of sand at once. A large storm can completely wash a beach away in just a day or two.



Know the Standards

TEACHER DEVELOPMENT

3. CCC 7 Stability and Change: Heavy winds and large waves of water can change sand landforms—like beaches and dunes—in a shorter amount of time than it would typically take. This usually happens in the presence of a storm, like a hurricane.



LITERAL—Is it hard or easy for wind and water to move sand?

» It is easy.

INFERENTIAL—Think about the investigation you did with sand. Why do you think it is easy for wind and water to move sand?

» Sand is small and light.

EVALUATIVE—What are some advantages and disadvantages to having a house on the beach?

» In good weather, it can be beautiful, and you can go for a swim or walk along the beach anytime. But because the sand is always shifting, your property might not be on a solid foundation and might be blown away or eroded by water.

Differentiation

SUPPORT—Explain that a hurricane is a big storm that has fast winds and a lot of rain. It causes large waves in the ocean, too. Talk about the relationship between big waves and how they move sand around.

Ask students to look at the pictures on page 48. Talk about what students notice about the landscape and the plants. (See **Know the Standards 4.**)

Sand dunes change shape and size with the wind. Sometimes people want to keep dunes from blowing away. Dunes are home to plants and animals. Dunes also keep ocean water from flooding dry land where people live.

Grasses that grow on dunes help protect the dunes. Their roots hold some of the sand in place. Their leaves block some of the wind from pushing on the sand. Plants keep rain from washing sand away from a dune. Beach grass grows naturally in dunes by beaches. People also add plants to dunes that they want to protect.



48

LITERAL—Why do people sometimes want to keep sand dunes from blowing away?

- » Animals and plants live there. And dunes keep ocean water from flooding dry land where people live.

LITERAL—How do plants protect sand dunes?

- » Roots hold some sand in place. Leaves block some wind from blowing the sand. Plants keep rain from washing the sand away.

NGSS Elements



DCI ESS2.A
CCC 7

Know the Standards

TEACHER DEVELOPMENT

4. DCI ESS2.A Earth Materials and Systems: The weathering and erosion of sand dunes can be a problem for some people. Sand dunes are helpful for keeping water away from where people live. If sand dunes get washed away by water or blown away by wind, homes could be flooded. People come up with solutions for keeping sand in place as much as possible.

INFERENTIAL—What can people do if they want to protect sand dunes?

- » They can add plants to dunes.

EVALUATIVE—Why might people want to protect sand dunes?

- » Keeping the dunes there will help the animals that live near them and keep the area good for recreation and housing.

Page 49

Ask students to look at the picture on page 49. Talk about the fences that students see in the picture.

Do you remember the fences that Logan saw when he explored the dunes? Fences are another way that people prevent changes to sand dunes. Fences keep people on narrow paths that cross the dunes to reach the beach. That way, people don't walk on the beach grasses that help hold the dune in place.

Fences can block the wind, too. They keep too much sand from blowing away from a dune. A fence can also help a dune form where there isn't one. A fence in a flat area where sand blows can cause the sand to collect into a pile. Over time, the pile grows large enough to form a dune.



LITERAL—How do fences help keep sand in place?

- » They keep people from walking on sand. They can block the wind from blowing sand away.

LITERAL—How can a fence help a sand dune form?

- » It can keep the sand from blowing away or from piling up in the wrong place.

NGSS Elements



DCI ESS2.A
CCC 7

EVALUATIVE—Why might people not want fences near the dunes?

- » They might not want the fences there because they are not natural. People might get hurt if they step on some fence a dune covered.

Differentiation

SUPPORT—Discuss with students where you see fences in the community. Students may have seen fences around construction sites, people's homes, apartment complexes, or dumpsters. Talk about the various uses for fences. Explain that fences are simple solutions to different kinds of problems.

3. Show more examples.

Online Resources



- Show students a video of waves crashing into a jetty. Talk about what the jetty is doing to the waves as they crash into it. (See **Know the Science.**)

Ask students if they think the jetty will help protect the shoreline. If yes, how?

- » Yes, it will break up the wave so that it is not as big and strong.

NGSS Elements



DCI ESS2.A
CCC 7

- Show students a picture of a shoreline before Hurricane Sandy and after Hurricane Sandy so students can see the effects that hurricanes have on sand.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

Ask students what they notice about the size of the natural dunes after the hurricane.

- » They got smaller.

Ask students what they notice about the size of the beach after the hurricane.

- » It got thinner/narrower.

Activity Page



AP 6.3.1

- Distribute Draw a Solution (AP 6.3.1) to each student. Tell students that they will draw a picture that shows one of the solutions they learned about today to keep sand dunes from changing too much. Then students will turn and talk with a partner to share how their solution will keep sand from blowing away or moving.

Know the Science

TEACHER DEVELOPMENT

Jetty Construction: Jetties are structures built perpendicular to the beach immediately upstream and/or downstream of an inlet to interrupt the longshore drift. They slow sediment influx into the inlet, keeping the position of the channel stable and making it safe for navigation. Like groins, they result in the build-up of sediment on the upstream side and the erosion of the beach on the downstream side.



- Circulate around the room as students work on their responses, and ask guiding questions, such as the following:
 - How does wind change the shape of sand dunes?
 - How does water change the shape of sand dunes?
 - How can you keep sand dunes from changing too much?
- If necessary, remind students that they learned about jetties, fences, and vegetation.

Differentiation

SUPPORT—If students are just learning English, they may have a difficult time understanding all of the things you read about in Chapter 10. Alternatively, allow these students to look back at the chapter and pick something to draw.

CHALLENGE—Challenge students to draw a series of pictures that show water or wind changing the shape of the shoreline or a sand dune.

EXTEND—Have students research a hurricane and the effect it had on the shoreline.

4. Check for understanding.

Monitor Progress

Formative Assessment

Look at student responses on Activity Page 6.3.1 to ensure understanding of how different solutions can help keep sand in place.

Review student responses on Draw a Solution (AP 6.3.1) to determine student understanding of the following concepts:

- Wind can blow sand away.
- Water can wash sand away.
- Water can push sand up where it doesn't belong.
- Fences, jetties, and vegetation are solutions to keep sand from changing.

See the Activity Page Answer Key for correct answers and sample student responses.

Draw student attention to the question board to review questions that have been answered and include any new questions students have about sand dunes.

Tie to the Anchoring Phenomenon

In this final lesson of the unit, students follow Logan and his family as they spend the day at the beach. Students are introduced to the landscape at beaches, including shorelines and sand dunes, and will look at some solutions to erosion next.

LESSON 6.4

Protecting Sand Dunes

Big Question: How can things that happen on Earth change the land?

Lesson Guiding Question: How can wind and water affect sand and sand formations?

Today's Question: How can people protect sand dunes from erosion?

Tie to the Anchoring Phenomenon: Students learn that sand is fragile, and sand formations can change easily from wind and water. As they join Logan and his family on their final stop to Cape Cod National Seashore, students will compare some of the solutions to preventing the unwanted erosion of sand.

AT A GLANCE

Learning Objectives

- ✓ Explore design solutions to coastal weathering/erosion problems.
- ✓ Design solutions to slow or prevent wind changing the shape of land.
- ✓ Evaluate solutions against desired features (criteria).
- ✓ Compare and contrast solutions.

Instructional Activities

- student investigation
- class discussion

NGSS References

Performance Expectation: 2-ESS2-1

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

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 7 Stability and Change

Students establish a list of criteria to be applied to engineering solutions where people seek to protect sand dunes from erosion.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

dune **problem** **score** **solution**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

analyze **compare** **evaluate**

Instructional Resources

Activity Pages



AP 6.4.1
AP 6.4.2

Activity Pages

Solution Scorecard (AP 6.4.1)
Scrapbook—Lesson 6
(AP 6.4.2)

Materials and Equipment

- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Online Resources



Prepare a slideshow of pictures that show solutions to sand dune erosion. Find pictures of the following:

- a fence along a sand dune at the beach
- a jetty in the ocean
- vegetation growing on sand dunes

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

THE CORE LESSON 6.4

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS2.A

How can people protect sand dunes from erosion?

- Open with a class discussion about the problems associated with sand dune and shoreline erosion.
- **Ask students to share their ideas about how it can be bad when sand dunes are blown away by wind or when shorelines are washed away by water.**
 - » Sand dunes can protect homes from ocean waves. When the sand dunes disappear, waves and water can come up to a home at the beach. Sand dunes also help block wind. People live along shorelines. When shorelines are washed away, the sand does not protect them from the ocean water.

2. Prepare for the activity.

NGSS Elements



DCI ETS1.C

SEP 6

CCC 7

Activity Page



AP 6.4.1

- Tell the class that today they are going to look at some solutions to help prevent sand dunes and shorelines from changing too much from wind and water. (See **Know the Standards 1.**)
- Distribute Solution Scorecard (AP 6.4.1), and review it together as a class. Explain that students will work as a class to come up with the features that the solutions need to have for them to work well (criteria). Then students will use those criteria to score each solution. (See **Know the Science.**)

Know the Standards

TEACHER DEVELOPMENT

1. DCI ETS1.C Optimizing the Design Solution: Students are establishing their list of criteria to be used when comparing design solutions.

Know the Science

TEACHER DEVELOPMENT

Identifying Criteria: You and the students will be identifying the criteria for the solutions as students work on completing the scorecard, or rubric. Students will use the scorecard on Activity Page 6.4.1 to compare solutions and figure out which one is the best, based on whether it meets all the criteria that you establish as a class.

3. Identify criteria.

NGSS Elements



DCI ETS1.C

SEP 6

CCC 7

- As a class, come up with a list of criteria (desirable features) that the solution should have. Examples of some criteria include the following:
 - keeping sand in place as much as possible
 - being okay in the sun
 - not being able to blow away
 - being strong enough to stand up to waves
- Record the list on a large sheet of paper or on the board while students write their own lists on the left side of the table on Activity Page 6.4.1. Make sure students have all of the criteria written down before you continue.

4. Facilitate the activity.

NGSS Elements



CCC 7

DCI ETS1.C

3D Learning

3D Learning: Students compare multiple solutions to the problem of sand erosion, using what they know about how water and wind can change the shape of the land quickly or slowly over a long period of time. They use this information to determine the best solution.

- Start the slideshow. Use the following talking points and question prompts for each picture: (See **Know the Standards 2.**)
 - Look at the picture. What do you think the solution is here?
 - How do you think the _____ (solution) works?

Online Resources



See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

- As you show students each solution, talk about it in more depth. Explain to students what the goal of the solutions are, using the following points:
 - Jetties: The jetties stick out into the ocean. They break up large waves. They keep the waves from hitting the shore.
 - Fences: The fences keep people from walking over the dunes. The fences also help block some of the wind.
 - Vegetation: The plants that grow on the sand dunes help keep the sand in place. Their roots grow down and help hold sand in place. They also cover the top of the sand dune so it does not blow away.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 7 Stability and Change: Remind students that sand dune erosion can happen quickly—such as in the case of a hurricane. Or sand dune erosion can take a long time to occur. Students should think about both fast and slow erosion when looking at the solutions.



- Talk about the drawbacks of the solutions. Explain that any time you are comparing solutions you have to look at what is good and what is not good about the solution. (See **Know the Standards 3.**)
 - Jetties: Jetties might not be big enough to break up large waves from hurricanes and other storms. Jetties also change the way the beach looks.
 - Fences: Fences could blow over with large winds from hurricanes. People can climb fences and still walk on the sand dunes.
 - Vegetation: Plants can burn in a fire. Some animals might eat the plants. Plants may not be very strong. They could be washed away in a hurricane.
- As you stop to discuss each picture, have the students talk about what they notice about the specific features. Prompt students to take out their scorecards on Activity Page 6.4.1. As a class, go through all of the criteria that the students listed earlier, and talk about whether or not the solutions meet the criteria. (See **Know the Standards 4.**)
- Go over with students how to assign a score to each solution. Tell them that a “3” is great, a “2” is good, and a “1” is okay. Students will put a number in each box.
- Plan the activity so that students discuss and score one solution at a time, before moving on to the next solution in the slideshow.

Differentiation

SUPPORT—Some students may have a difficult time understanding how to tell the difference between a solution that is great, good, or okay and then understanding how to assign a final score. Allow these students to write “Yes” or “No” in the table on Activity Page 6.4.1 instead of assigning each solution a score from 1 to 3.

CHALLENGE—Offer students a mathematical opportunity to come up with an average score for each solution.

EXTEND—If students have already met the Performance Expectation for this lesson, invite them to learn more by researching other types of solutions that are used to address problems with weathering and erosion (not just specific to sand dunes and beaches).

Know the Standards

TEACHER DEVELOPMENT

3. DCI ETS1.C Optimizing the Design Solution: Remind students that, even if they like one solution better than another, it is important to use the criteria as a checklist. Engineers cannot make decisions based off of the things they like or don’t like. Engineers have to stick with the lists and make decisions based on the features and functions of solutions.

4. Language Arts Connection: Students satisfy a connection to the ELA standard CCSS.ELA-Literacy.RI.2.3 when they make and describe connections between scientific concepts that have to do with what causes erosion of sand and the ways in which people design solutions to address problems in nature.

5. Summarize and discuss.

NGSS Elements



DCI ESS1.C
SEP 8
CCC 7
PE 2-ESS2-1

- Once students have had a chance to complete their scores for each solution, discuss the results as a class. (See **Know the Standards 5.**)
- **Ask students which solution they think is the best, in terms of meeting all the criteria. Then ask them which solution they think is the worst.**
- Encourage students to have different opinions for a discussion. As you talk about the solutions, always draw students back to the criteria to use as a guide when supporting their claims about which solutions they think are best/worst.

6. Check for understanding.

Monitor Progress

Formative Assessment

Activity Page



AP 6.4.2

Check that students understood how to score the solutions according to the criteria.

Distribute Scrapbook—Lesson 6 (AP 6.4.2), and prompt students to take a few minutes to complete it.

Review student scores on Solution Scorecard (AP 6.4.1) and Scrapbook—Lesson 6 (AP 6.4.2) to determine understanding of the following concepts:

- Some solutions meet the criteria, and other solutions do not.
- Some changes to sand at the beach happen quickly, and others happen slowly.

Visit the question board to identify questions that have been answered, and discuss the questions that remain unanswered.

Tie to the Anchoring Phenomenon

In this final lesson of the unit, students follow Logan and his family as they spend the day at the beach. Students have learned about sand landforms and how they form and change over the years.

Know the Standards

TEACHER DEVELOPMENT

5. PE 2-ESS2-1: The activities in this segment contribute to the Performance Expectation by having students compare three solutions that are designed to address the problem of sand erosion of dunes and shorelines. Erosion can take place over a long amount of time, after years of weathering and erosion from water or wind. However, it can also take place over a short amount of time, such as in the instance of hurricanes.

Exploring Land and Water

Big Question: How can things that happen on Earth change the land?

Tie to the Anchoring Phenomenon: Students use what they learned throughout the unit about landforms and water to complete an activity that reinforces understanding of how things that happen on Earth can change the landscape.

AT A GLANCE

Learning Objectives

- ✓ Combine information about Earth events from multiple sources.
- ✓ Compare the times over which various Earth processes occur.
- ✓ Classify Earth events as those that occur quickly or slowly.
- ✓ Compare solutions.

Instructional Activities

- drawing

NGSS References

Performance Expectations: 2-ESS1-1; 2-ESS2-1

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

Science and Engineering Practices: 6 Constructing Explanations and Designing Solutions; 4 Analyzing and Interpreting Data

Crosscutting Concept: 7 Stability and Change

Students put together a class mural based on all the landforms they learned about throughout the unit. Students identify those landforms that form quickly or slowly and how they change.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

land

prevent

solution

water

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change compare design

Materials and Equipment

- tape
- construction paper (assorted colors)
- marker
- question board

Advance Preparation

- Prepare an area on the wall in the classroom for students to tape their scrapbook pages from the unit. Each student will have six pages to tape up on the wall.
- Make six labels out of construction paper using the marker, one for each of the places where Logan visited on his journey around America. Hang the labels up on the wall, in the following order: Mount Rushmore National Memorial, Glacier National Park, Yellowstone National Park, Yosemite National Park, Arches National Park, and Cape Cod National Seashore. Students will hang their scrapbook pages beneath each label to make a mural of the trip around the United States.

UNIT CAPSTONE

1. Refocus student attention.

- Bring student attention to the labels on the wall. Explain that each label represents a place where Logan visited with his family over the summer. They started at Mount Rushmore National Memorial and ended at Cape Cod National Seashore.
- Tell students that they will all work together in the class to make a wall mural.

2. Make a mural.

NGSS Elements



PE 2-ESS1-1
DCI ESS2.A

- Prompt students to take out their scrapbook Activity Pages from all six lessons in the unit.
- Invite students to come up to the wall to tape their scrapbook pages from Lesson 1 under the label for Mount Rushmore National Memorial. Make sure students do not cover each other's pages, but they should be taped closely together and not spread too far apart.

- Then have students do the same thing for Glacier National Park. Repeat this for each of the places Logan visited.
- Once all of the scrapbook pages have been taped up to the wall, have the class stand back and look at their work. Point out the pictures that all of the students drew on the scrapbook pages and how they document where Logan traveled with this family.

3. Play a mural game.

NGSS Elements



PE 2-ESS1-1
DCI ESS2.A

- Tell the class that they are going to play a game where you ask them to find certain things on the scrapbook mural.
- Place students into six groups of mixed ability.
- Invite the first group up to the mural. **Ask the group to find one place where Logan visited that had examples of fast or slow changes to the land.** (See **Know the Standards 1.**)
- When the group finds the one example on the mural, prompt them to talk about what three pieces of evidence they have from this unit that show the change happens quickly or slowly. Students should be able to recall evidence from their investigations, the chapters in the Student Book, and the various picture slideshows and video clips they saw throughout the unit.
- Then ask students to discuss the results of the events that happen quickly or slowly. **Ask,** What impact does this have on the landscape or the things around it? (See **Know the Science.**)
- Finally, **ask students to talk about the relative amount of time they think it takes for the change to happen, such as hours, days, months, or years.**
- If students in the group are stumped, open up the questions and discussion to the rest of the class so everyone can participate in answering the questions.

Know the Standards

TEACHER DEVELOPMENT

1. PE 2-ESS1-1: This activity, in combination with the students' activities throughout the unit, satisfies the Performance Expectation by having students articulate statements about the fact that Earth events can happen quickly or slowly and citing evidence to support their claims. Students can cite their investigations, Student Book chapters, in-class demonstrations, picture slideshows, and video clips and talk about the relative amount of time in which the events happen.

Know the Science

TEACHER DEVELOPMENT

Fast and Slow Events: Guide students to understand that some events and their changes can be directly observed, such as in the case with landslides, volcanic eruptions, or the erosion of sand dunes caused by hurricanes. Therefore, these events happen quickly. On the other hand, sometimes changes happen so slowly over thousands of years that they cannot be directly observed. Use guiding questions to help students make these connections.

- Repeat this activity with the rest of the groups so that each group has a chance to go up to the mural and find and discuss a change that happens slowly or quickly. Each group should have an opportunity to find and discuss a new example, as long as each group only talks about one example at a time.

4. Play a problems-and-solutions game.

NGSS Elements



PE 2-ESS2-1

DCI ESS2.A

SEP 6

- Remind students that throughout the unit they learned about problems related to changing landscapes.
- **Ask students to recall the ways in which wind and water can change landscapes.**
 - » Water can wet the land and cause landslides or mudslides. Wind can blow against rock and change the way it looks over time. Wind can blow away sand dunes. Water can wash away sand dunes and beaches. Water can carve out rock. Even frozen water—glaciers—can carve rock.
- Explain that students also learned about some of the ways that people try to solve these problems. These are called solutions.
- Prompt students to take out their Solution Scorecards that they used with Lessons 4 and 6.
- Play a game called problems and solutions, where you call out a problem (such as sand erosion or landslides that affect people or harm landscapes or living things) and students name a solution (sometimes there will be more than one solution, so limit each student to only talking about one solution at a time). Tell students they can use their scorecards to remind themselves of the types of solutions there were (e.g., fences, jetties, walls, bolts, nets, vegetation, etc.). However, remind students that they did not use their scorecards for all of the lessons in the unit. Students will also need to recall the types of solutions they learned about from Lessons 1 through 4. (See **Know the Standards 2.**)
- End with a discussion about the best solutions for different problems, based on certain features/criteria.

NGSS Elements



DCI ETS1.C

Know the Standards

TEACHER DEVELOPMENT

2. PE 2-ESS2-1: This activity, in combination with the students' activities throughout the unit, satisfies the Performance Expectation by having students talk about multiple solutions that are designed to slow or prevent wind and water from changing the shape of the land. Throughout the unit, students identified specific criteria and scored different solutions to compare them to one another. Here, students have a cumulative review of the solutions and discuss what is similar or different about them.

5. Check for understanding.

Monitor Progress

Formative Assessment

Gauge student understanding of concepts covered throughout the unit based on their ability to discuss the relative amount of time in which certain changes take place and the multiple solutions that can be used to address problems related to wind and water erosion. Students should be able to demonstrate knowledge of what they learned from each lesson.

Listen for student responses during the mural game and the problems-and-solutions game to ensure proper understanding of the following concepts:

- Some changes to Earth happen quickly, such as in the case of volcanic eruptions, earthquakes, landslides/mudslides, and hurricanes.
- Some changes to Earth happen over a long period of time, such as in the case of wind and water erosion to rock, sandstone, and sand.
- Water in its liquid and solid forms can change the shape of the land.
- Different solutions have been identified to address problems with wind and water erosion. Some solutions may be better than others. Students can identify the best solutions based on criteria.

Visit the question board to identify questions that have been answered and discuss how to research the questions that remain unanswered.

Tie to the Anchoring Phenomenon

The games in this capstone help finalize the work that students have been doing throughout the unit. Students kept scrapbook pages for each of the places that Logan visited in his tour around America. Students also worked on identifying problems and solutions and comparing different solutions based on sets of criteria that they came up with.

Science in Action: Mapping the Ocean Floor

Tie to the Anchoring Phenomenon: Students join Logan as he and his class learn more about what kinds of landforms are covered by ocean water.

AT A GLANCE

Learning Objectives

- ✓ Read about underwater land features.
- ✓ Make models and maps of the ocean floor.

Instructional Activities (2 Days)

- teacher Read Aloud
- modeling

NGSS References

Science and Engineering Practice: 2 Developing and Using Models

Understandings About the Nature of Science: Scientific Knowledge Is Open to Revision in Light of New Evidence; Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena; Science Is a Way of Knowing; Science Is a Human Endeavor

Connection to Engineering, Technology, and Applications of Science:

Interdependence of Science, Engineering, and Technology

Students read about why people map the ocean floor and the development of technology related to that mapping. Students then make models of the ocean floor.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Language of Instruction

The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

depth

globe

model

seafloor

sonar

virtual

Instructional Resources

Student Book



Ch. 11

Student Book, Chapter 11
“Science in Action: Mapping the Ocean Floor”

Materials and Equipment

- paper (1 large sheet per group)
- pencils (1 per student)
- aluminum baking pans (deep) (1 per group)
- modeling clay (enough for all groups to make models)
- sand (2 cups per group)

1. Day 1: Introduce the topic.

Remind students that they read about Logan who took a trip around America and saw lots of different landforms. Review with students some of the landforms Logan saw, including glaciers, mountains, valleys, rivers, sand dunes, and rock arches. Explain that today they will read more about landforms that are found in the ocean.

2. Read together: “Science in Action: Mapping the Ocean Floor.”

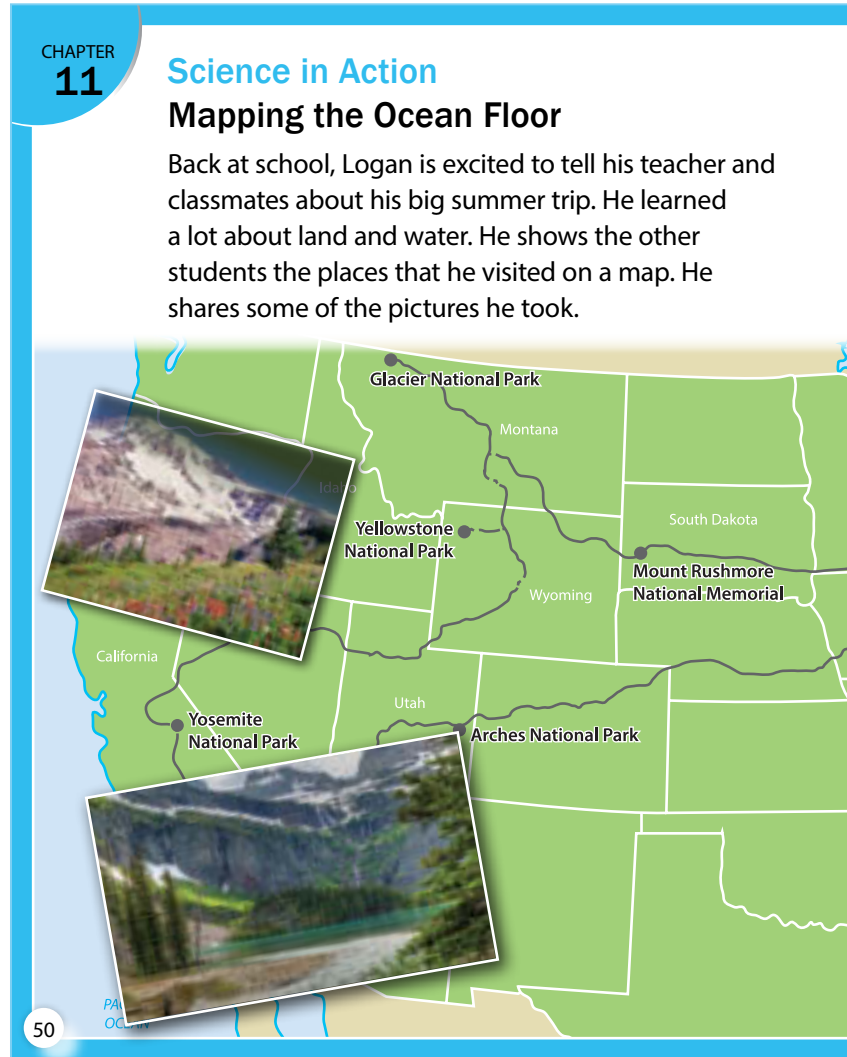
Student Book



Ch. 11

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Ask students to turn to page 50 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Science in Action: Mapping the Ocean Floor,” and tell them to pay special attention to the landforms that they see as you read.



Ask students to look at the picture on pages 50 and 51. Talk about the collage of images they see. Explain that these are all places where Logan visited.

SUPPORT—Remind students that a map is a drawing of an area. There are different kinds of maps. Remind students that they worked with topographic maps, which are maps that have to do with landforms.

LITERAL—Which landforms do you see in the photographs?

» mountains and valleys, a glacial lake, rock fins, and a landslide

Today Mr. Clark has a surprise planned for his students. They will have a video call with a scientist over the internet. Mr. Clark says to the class, "Remember the mountains, valleys, and volcanoes that Logan described from his trip? And how he showed us where they are on a map? Think about those things when we are talking with our guest, Dr. Ross."



51

NGSS Elements



Interdependence of
Science, Engineering,
and Technology

SUPPORT—Explain that because their meeting with the scientist is over the internet, it is a virtual meeting. The scientist could be far away, but they still get to meet.

Explain that **virtual** means when someone or something is not physically there with you but it looks like they are there.

INFERENTIAL—Why is technology important for this meeting to take place? (See **Know the Standards 1.**)

» It lets the class meet with the scientist from far away.

Know the Standards

TEACHER DEVELOPMENT

1. Interdependence of Science, Engineering, and Technology: Technology comes in handy and can help us do things, like meet with people over the internet. Talk with students about how engineers and scientists come up with ways to design new technologies, from computers to video equipment to bar code scanners, that help enhance our work and lives.

LITERAL—What does Mr. Clark tell the students to think about when they meet with the scientist, Dr. Ross?

» the mountains, valleys, and volcanoes

SUPPORT—Clarify for students that in this case *Dr.* does not refer to the person who takes care of you when you are sick. *Doctor* is a title that goes in front of a person's name when they have studied in college a long enough time to become an expert at what they do.

Page 52

Ask students to look at the picture on page 52.

The scientist they see on the screen shows them a globe and points out how most of it is blue. "The globe is a model of Earth," he says, "and most of Earth is covered by the ocean. "But land features don't end where the ocean meets the shoreline," he continues. "What is beneath all that water?" he asks. "More land! The land below the ocean's water is called the seafloor."



52

NGSS Elements



Interdependence of
Science, Engineering,
and Technology

Explain that a **globe** is a three-dimensional model of Earth. It is similar to a map. (See **Know the Standards 2.**)

Know the Standards

TEACHER DEVELOPMENT

2. Interdependence of Science, Engineering, and Technology: Discuss with students the tools that are being referred to in the Student Book on page 52. Explain that screens help us view things. Computers have screens, and so do televisions. Then talk about how globes are tools that help people study Earth.

INFERENTIAL—How do you think maps are different from globes?

» Maps are flat. Maps have scales and directions on them.

LITERAL—What covers most of Earth?

» the ocean

LITERAL—What can you find under all that water?

» You can find more land.

Explain that the **seafloor** is the land below the ocean's water.

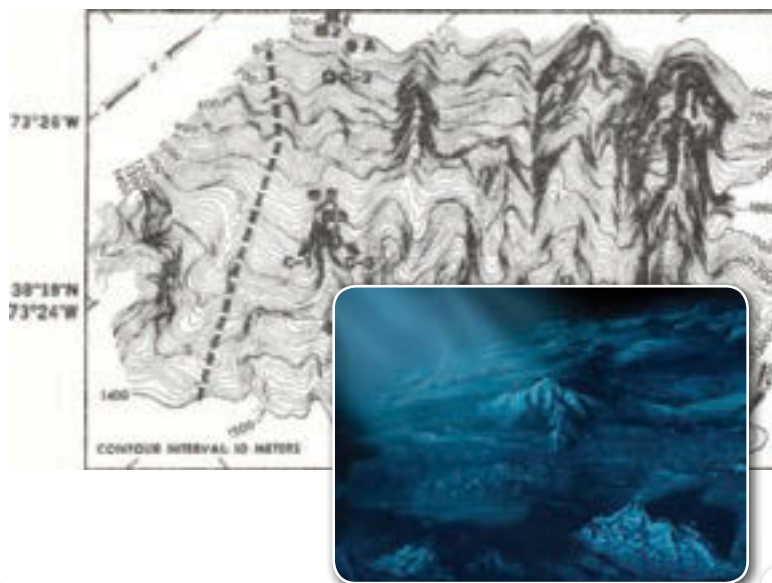
Page 53

Ask students to look at the two pictures on page 53. Talk about what students see in the first picture. Explain that this is a map of the ocean floor. Then discuss the second picture on the page. Explain that this shows different landforms under the ocean. You can follow the shaded areas to tell where mountains or hills might be underwater.

Then Dr. Ross says some words that really catch Logan's attention. "The seafloor has mountains and valleys just like dry land does," he says. "It even has volcanoes."

Dr. Ross is a scientist who makes maps of the seafloor. He shows the students some seafloor maps. The maps show hills and flat places. They show mountain peaks and valleys.

Dr. Ross explains that many areas of the ocean floor still have not been mapped with much detail. He tells students that he is continuing the work of another seafloor mapmaker named Marie Tharp.



INFERENTIAL—What do you think the different squiggle patterns on the map mean? What could these represent?

- » The lines go up and down to show where the land goes up and where it comes down again. These could be mountains and valleys.

LITERAL—What kind of landforms can you find on the seafloor?

- » mountains, valleys, and volcanoes

INFERENTIAL—Why do you think many areas of the ocean floor still have not been mapped with much detail?

- » The ocean is very large and very deep. It is hard to map the bottom of the ocean.



Ask students to look at the picture on page 54. Explain that this is Marie Tharp, a scientist who studied the ocean. Here, in the picture, she is drawing maps. (See **Know the Standards 3.**)

Marie Tharp

For a long time, people thought the ocean floor was flat. But a scientist named Marie Tharp helped prove that it wasn't. She was the first person to map the bottom of the Atlantic Ocean. She proved that it was covered with mountains and canyons, just like Earth's land surface.



54



LITERAL—What did Marie Tharp prove? (See **Know the Standards 4.**)

» that the ocean floor is not flat; that it has mountains and canyons

SUPPORT—Explain that scientists are able to prove things with evidence. Talk about different types of evidence that scientists use, such as data/numbers, pictures, models, observations, and drawings.

Know the Standards

TEACHER DEVELOPMENT

3. Science Is a Human Endeavor: Dr. Ross is a male scientist who studies ocean floors and landforms. Men and women can work as scientists.

4. Scientific Knowledge Is Open to Revision in Light of New Evidence: People used to believe that the ocean floor was flat. Marie Tharp helped disprove this with evidence based on her research.

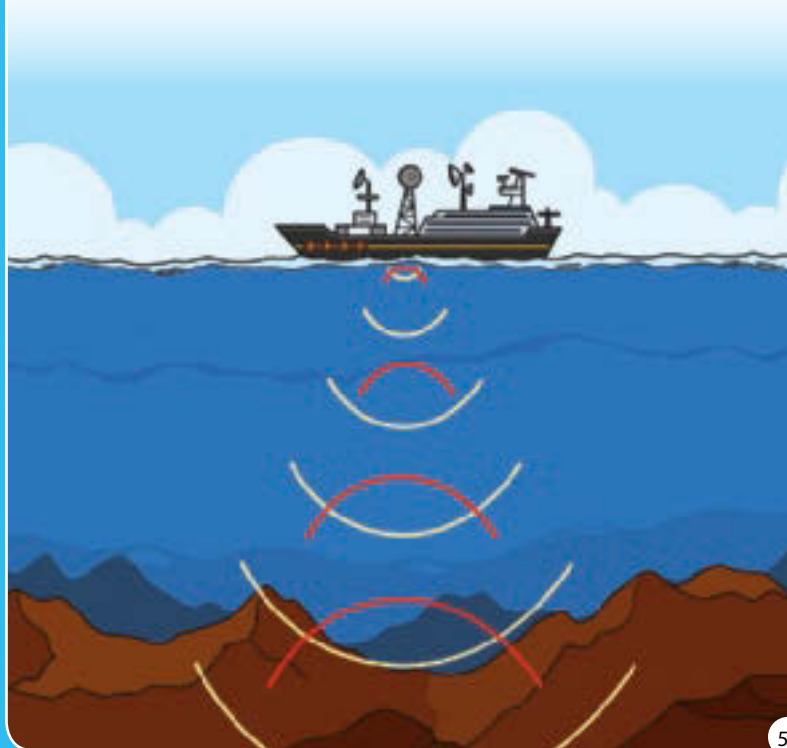
LITERAL—What was Marie Tharp the first person to do?

» map the bottom of the Atlantic Ocean

Page 55

Ask students to look at the picture on page 55. Explain that this is a picture that shows how something called sonar works.

Marie Tharp could not actually see the ocean floor. She used data. Scientists on a boat used a system called sonar to collect the data. Sonar can tell how deep the water is beneath a boat. Marie Tharp combined many, many depth measurements. She used them to draw the high and low places on the seafloor.



NGSS Elements



Science Is a Way
of Knowing

Explain that **sonar** is a system that helps tell how deep the water is beneath a boat.

INFERENTIAL—Why did Marie Tharp have to use sonar? (See **Know the Standards 5.**)

» She could not actually see the ocean floor.

Know the Standards

TEACHER DEVELOPMENT

5. Science Is a Way of Knowing: Learning about landforms on the ocean floor can tell scientists more about the history of Earth and how it formed.

Explain that **depth** is a measure of how deep something is. The ocean does not have one depth. Its depth changes from one place to another.

INFERENTIAL—Why do you think the depth of the ocean floor changes?

» because some areas on the seafloor are taller than other areas

1. Day 2: Facilitate the activity.

NGSS Elements



SEP 2

- Remind students that they previously read about scientists who study the landforms under the ocean's water. Tell them that today they will work on an activity where they get to map the bottom of an ocean! (See **Know the Standards 6.**)
- Have students form small groups, and give each group the following materials: aluminum baking pan, sand, modeling clay, and large sheet paper with pencils.
- Tell students that they are going to use the modeling clay and sand to make landforms on the ocean floor. Students can use the clay to make hills of various heights and sizes and then place them wherever they want into the pan. Students can use the sand to scatter on the ocean floor of their pans and make hills with it as well. (See **Know the Standards 7.**)

NGSS Elements



Science Models,
Laws, Mechanisms,
and Theories Explain
Natural Phenomena

- Circulate around the room, and make sure students are setting up their models with the sand and clay hills inside the pans.
- When all groups have made their models, have them trade their pans with another group. Now, instruct students to use their large sheet of paper and pencils to draw a map of the ocean floor for the pans they got in their trade.
- Remind students that they should find a way to represent when the land goes up and down, to show peaks and valleys of hills and mountains (or volcanoes), on their maps.

Differentiation

SUPPORT—If students have a difficult time figuring out how to indicate where the land goes up and down, allow them to use words or symbols on their maps.

- At the end of class, have groups place the models next to their maps on a long table or counter, and host a gallery walk so all students can look at the models and maps.

Know the Standards

TEACHER DEVELOPMENT

6. SEP 2 Developing and Using Models: Students make models of the ocean floor to reiterate what they learned about landforms underwater and to practice making maps.

7. Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena: Scientists like Marie Tharp used drawings on maps as a model to help explain what the ocean floor looks like. Here, students get to use models to learn what it's like to map the bottom of the ocean.

SUPPORT—Mapping requires visual and spatial skills, which some students may still be developing. Allow these students to make models of the ocean floor without making the maps. Have them talk about the seafloor instead of mapping it.

CHALLENGE—Challenge students to measure the height of the various peaks of the hills/mountains/volcanoes in the ocean floor model and record the information on their maps.

EXTEND—Have students come up with an investigation where they can figure out the depth of their models. They can fill their pans with water and measure the distance between the deepest and shallowest parts of the pan to the surface of the water.

2. Check for understanding.

Review the map drawings to ensure students understand the purpose of maps and what they show.

Teacher Resources

Activity Pages

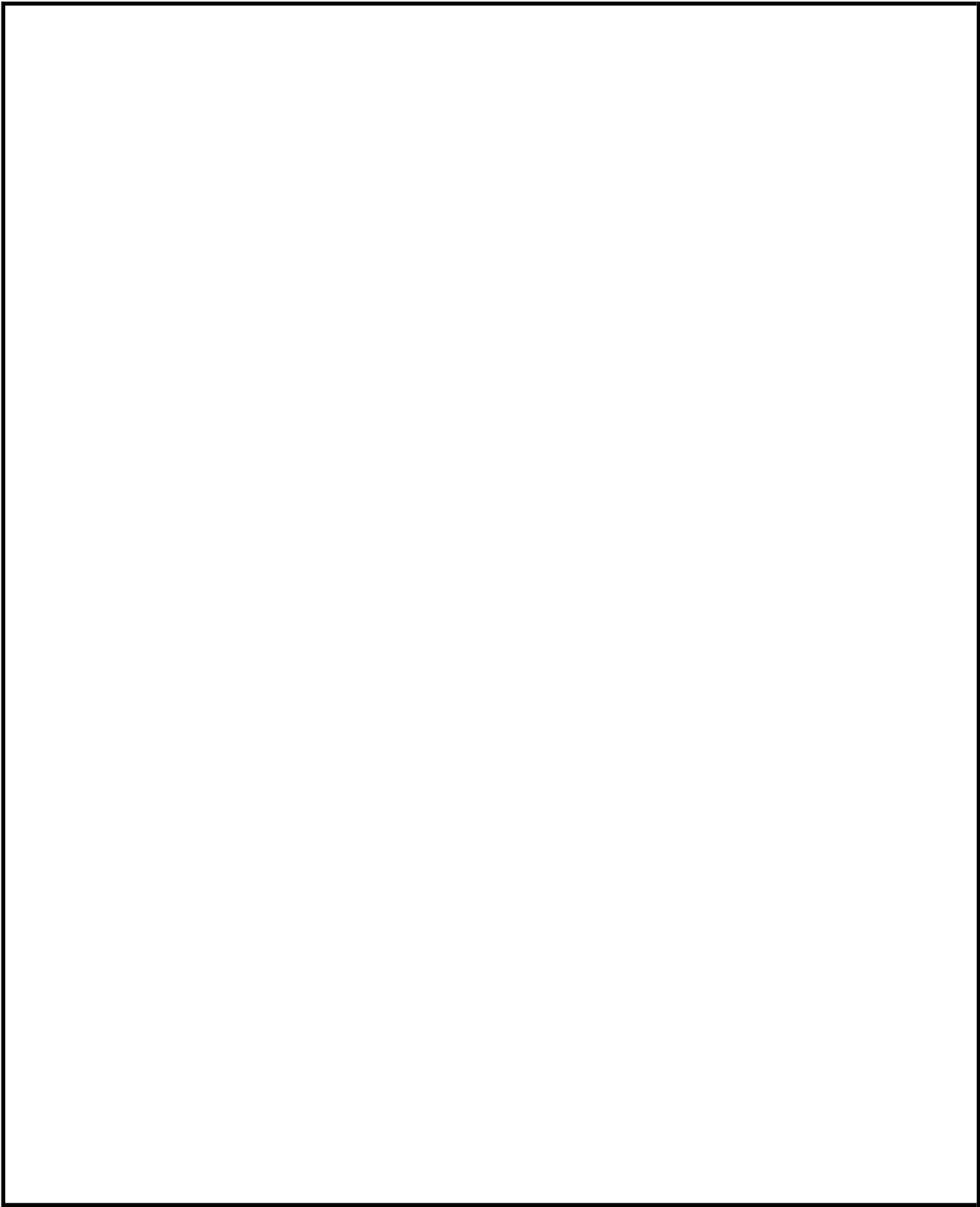
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Activity Pages Answer Key: *Exploring Land and Water* **272–275**

Our Landscape

Draw a landscape that you see on your way to or from school.



Name _____

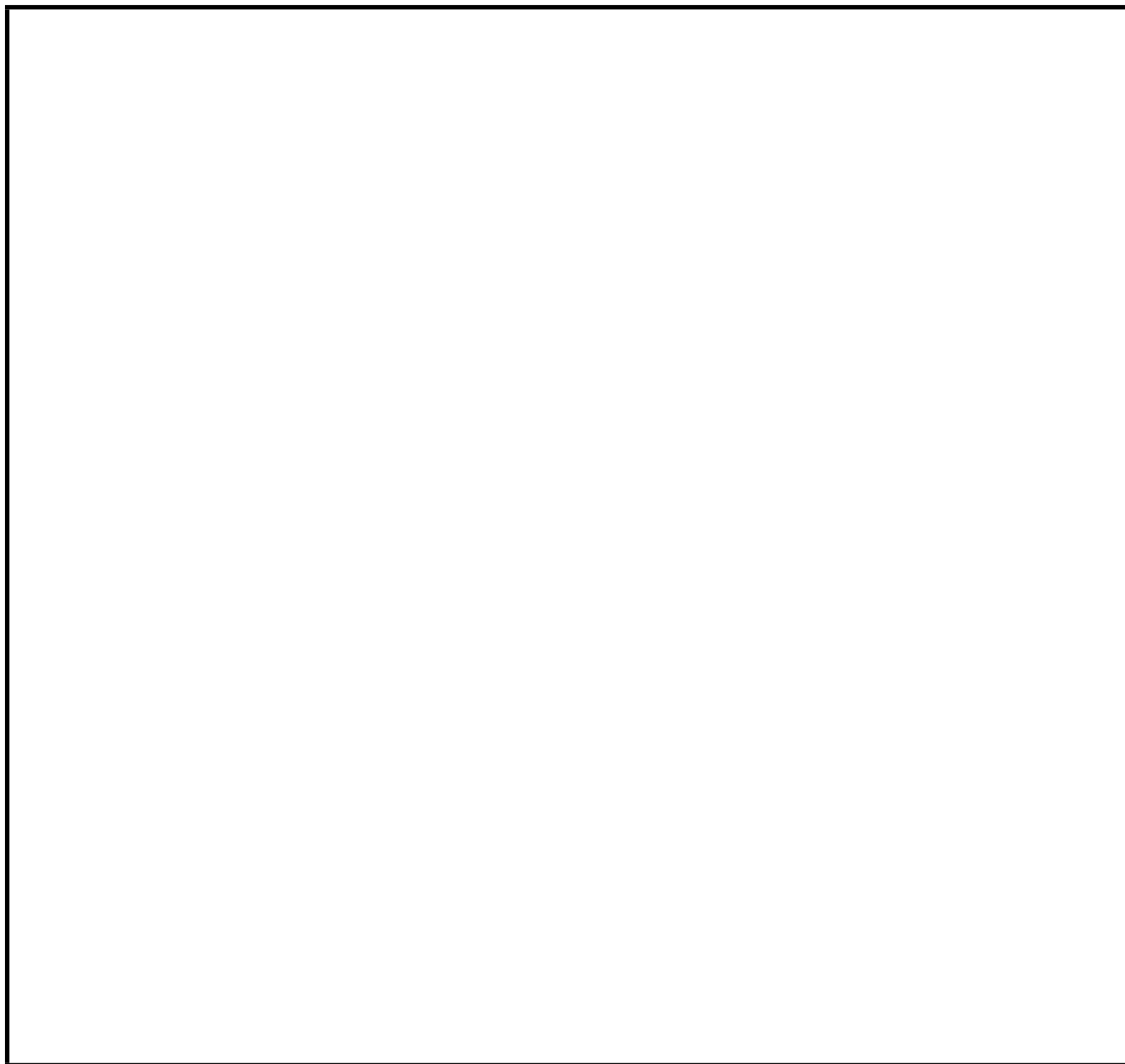
Date _____

Activity Page 1.1.1

Use with Lesson 1.1

The Rock

Draw what you saw in one rock when you used the hand lens.

A large, empty rectangular box with a black border, intended for a student to draw what they saw in a rock when using a hand lens.

Write a question you would like to ask about rocks.

Name _____

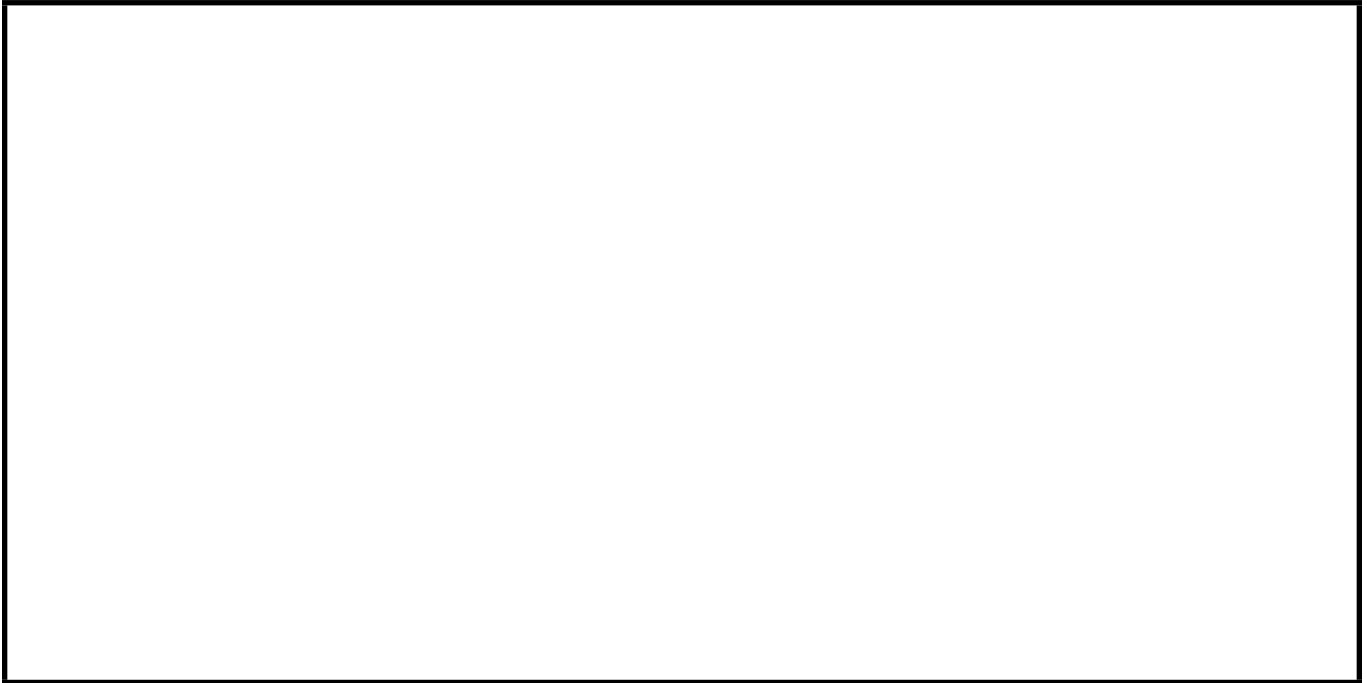
Date _____

Activity Page 1.2.1

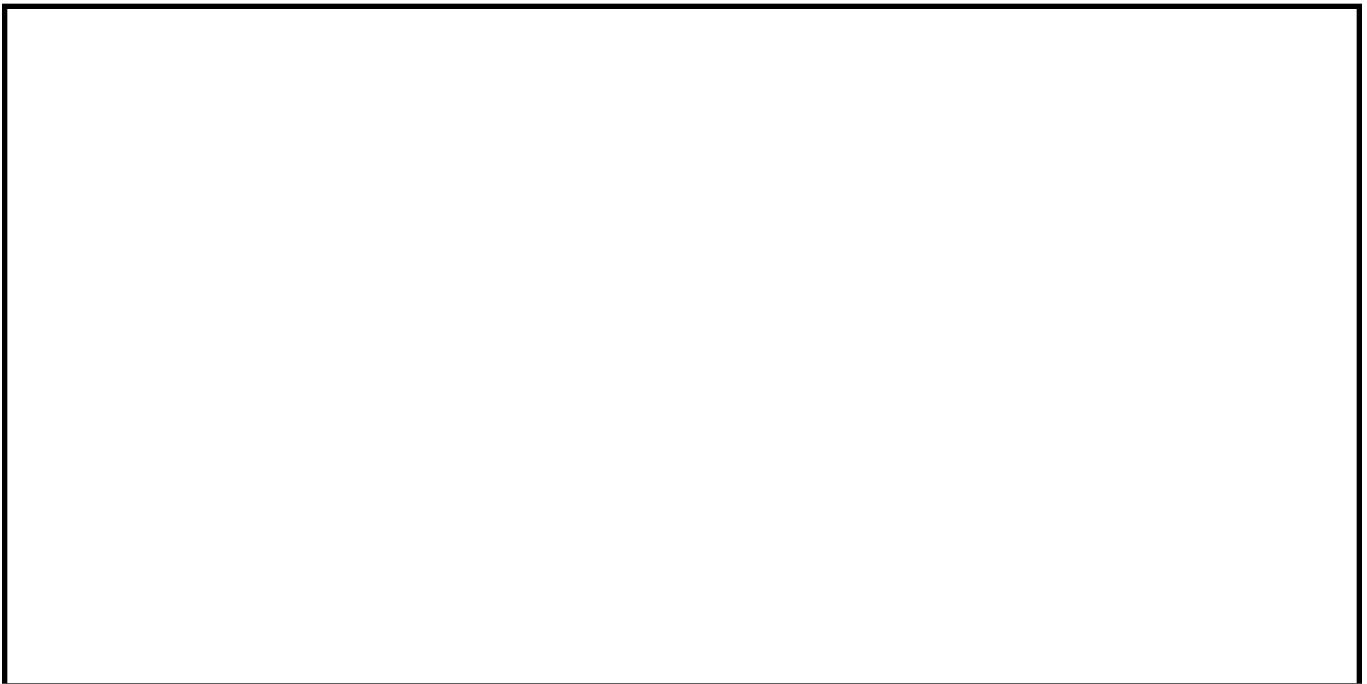
Use with Lesson 1.2

How Does Freezing Water Affect Rocks?

Draw what the cartons look like before they are frozen.

A large, empty rectangular box with a black border, intended for a student to draw what the cartons look like before they are frozen.

Draw what the cartons look like after they are frozen.

A large, empty rectangular box with a black border, intended for a student to draw what the cartons look like after they are frozen.

Name _____

Date _____

Activity Page 1.3.1

Use with Lesson 1.3

Problem and Solution: Water

Fill in the blanks to complete the sentences. Use the word bank below.

change	preserve	short	long
--------	----------	-------	------

The Problem

Water can _____ stone monuments. It can wash away soil or sand.

This happens over a _____ period of time.

fill it with silicone	fill it with ice	over	underneath
put a covering	blow wind		

Solution #1

If a rock has cracks in it, we can _____.

Solution #2

We can prevent rocks from being weathered by water if we _____ the stone monument.

Name _____

Date _____

Activity Page 1.4.1

Use with Lesson 1.4

Did the Sealing Tests Work?

Write your answers on the lines.

Describe the two solutions you tested:

1. _____

2. _____

Which test worked better?

Why did that test work better?

Name _____

Date _____

Activity Page 1.4.2

Use with Lesson 1.4

Scrapbook—Lesson 1

Log the journey you take with Logan around the United States!

Where did Logan visit?

What kind of land feature is this?

What can water do to rock?

Does this happen quickly or slowly?

How can you prevent water from changing rock?

Draw a picture of what Logan saw on his trip.



Name _____

Date _____

Water and Land

List the land and water features.

Land Features	Water Features

Write a question you would like to ask about how landforms are made.

Name _____

Date _____

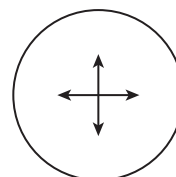
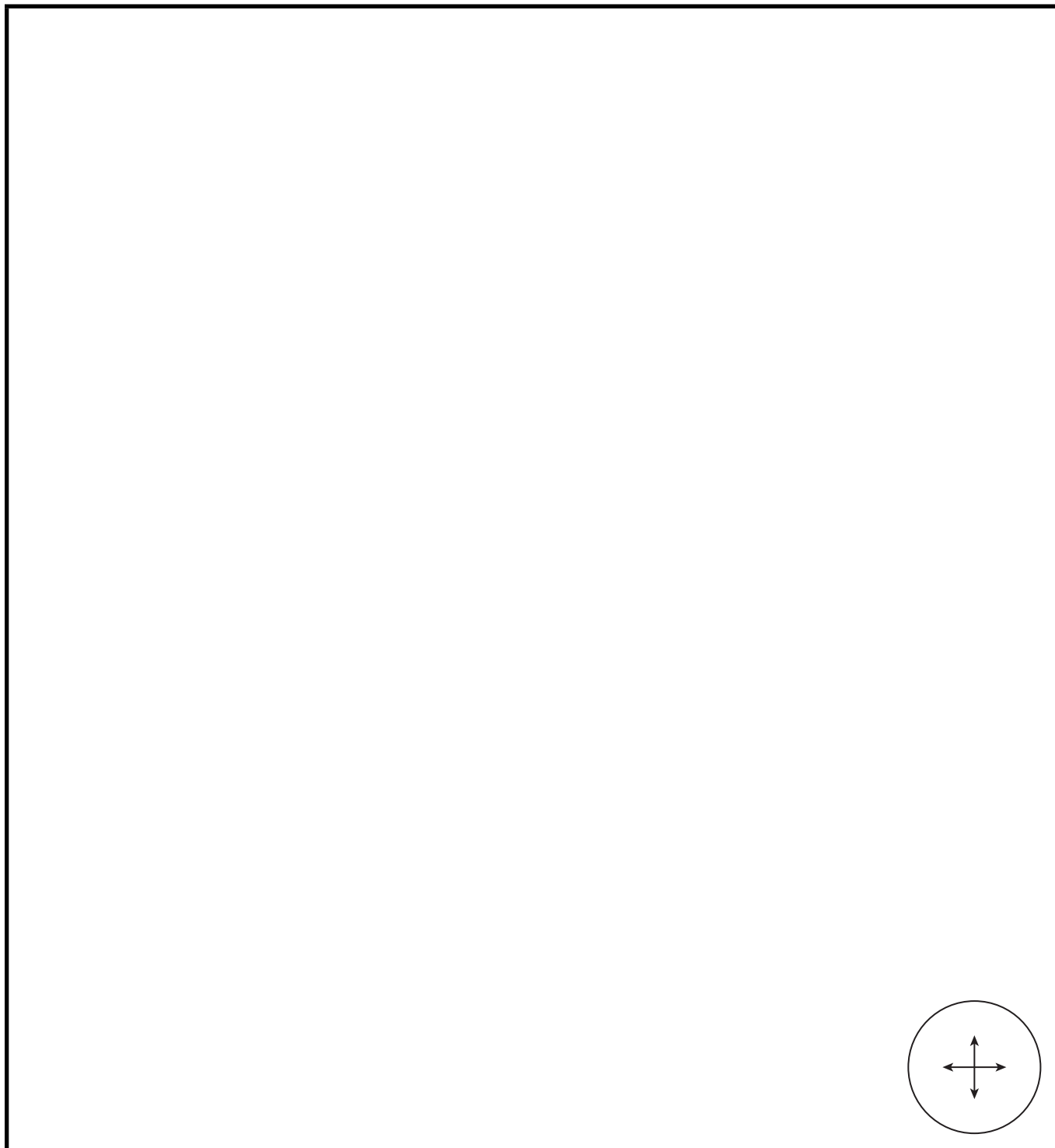
Activity Page 2.2.1 (Page 1 of 2)

Use with Lesson 2.2

Map It!

Draw your map.

Label the compass with north, east, south, and west.



Name _____

Date _____

Activity Page 2.2.1 (Page 2 of 2)

Use with Lesson 2.2

Map It! continued

Answer the questions below.

Which feature is the tallest? _____

Which feature is the farthest north? _____

Which feature is the farthest east? _____

Which part of the schoolyard do you think has the highest elevation? _____

Which part of the schoolyard do you think has the lowest elevation? _____

Name _____

Date _____

Activity Page 2.3.1

Use with Lesson 2.3

How Water Flows

Fill in the sentences with the correct words.

Water flows (uphill or downhill) _____.

Rocks and other land features can change how water (flows or melts) _____.

When water flows over soil, the soil (moves or stays in place) _____.

Bodies of water that flow are (lakes or streams) _____.

Bodies of water that do not flow are (lakes or rivers) _____.

Flowing water collects at the (top or bottom) _____ of a hill or mountain.

The water (flowed or did not flow) _____ in the same direction each time.

Moving Ice

Draw what the landscape looks like when the glacier starts to move, in the middle, and at the end.

Beginning
Middle
End

Name _____

Date _____

Activity Page 2.5.1

Use with Lesson 2.5

Solve a Riddle

Read the riddles. Then circle the word that answers the riddle.

Riddle 1

I am water that likes to flow.
Into larger bodies of water I go.
I am somewhat small and usually shallow.
I'm not very wide; I'm usually narrow.

I am a lake/river/stream.

Riddle 2

I'm very large, and I flow downhill.
I do not like to stand still.
Into the ocean my water goes.
This is the direction my water flows.

I am a lake/river/stream.

Riddle 3

I am water that does not flow.
I stand quite still; I do not go.
I am surrounded by higher land.
This is where I like to stand.

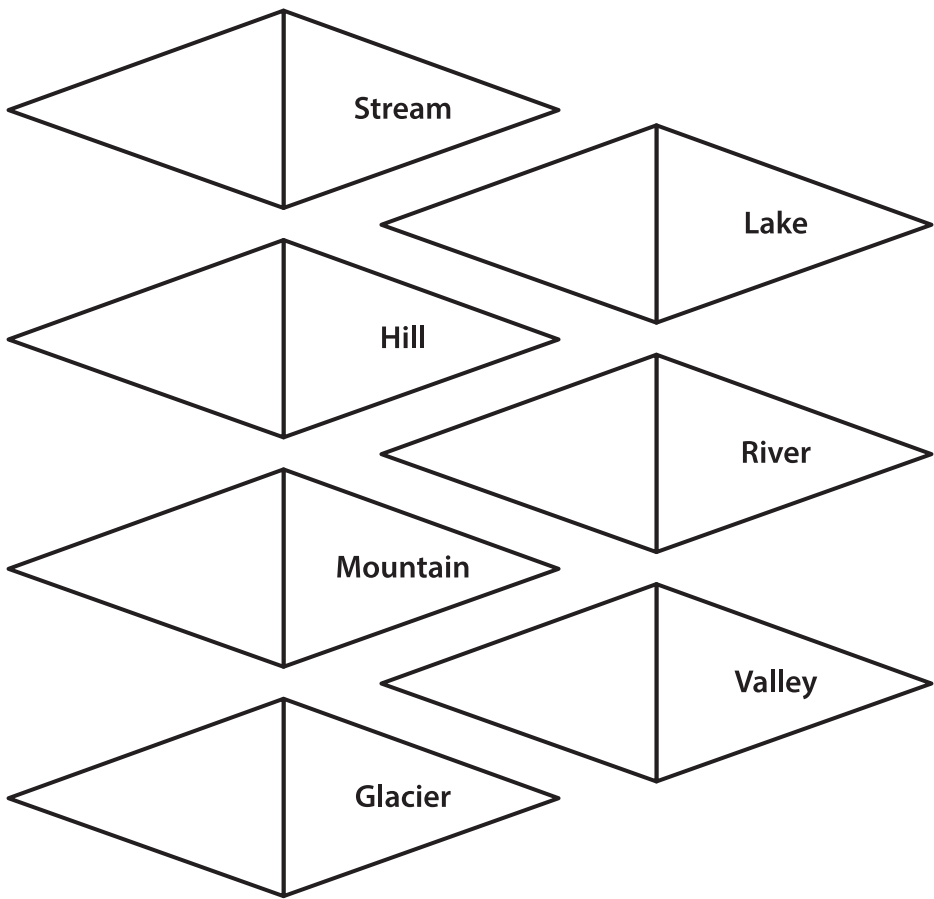
I am a lake/river/stream.

Riddle 4

I am frozen, and I move downhill.
I can break mountains, or I can make hills.
I leave rocks and sand where I go,
But I don't flow fast. I flow kind of slow.

I am a rock/glacier/mountain.

Land and Water Flags



Name _____

Date _____

Activity Page 2.6.2

Use with Lesson 2.6

Scrapbook—Lesson 2

Log the journey you take with Logan around the United States!

The second stop on Logan's trip was _____.

There, Logan saw _____.

Write down everything you know about glaciers.

Logan and his family used a _____ to find their way around the park.

The elevation of a valley is (higher or lower) _____ than the elevation of a mountain.

The elevation of a mountain is (higher or lower) _____ than the elevation of a hill.

Draw a picture that represents what Logan saw at Glacier National Park.



Name _____

Date _____

Activity Page 3.1.1

Use with Lesson 3.1

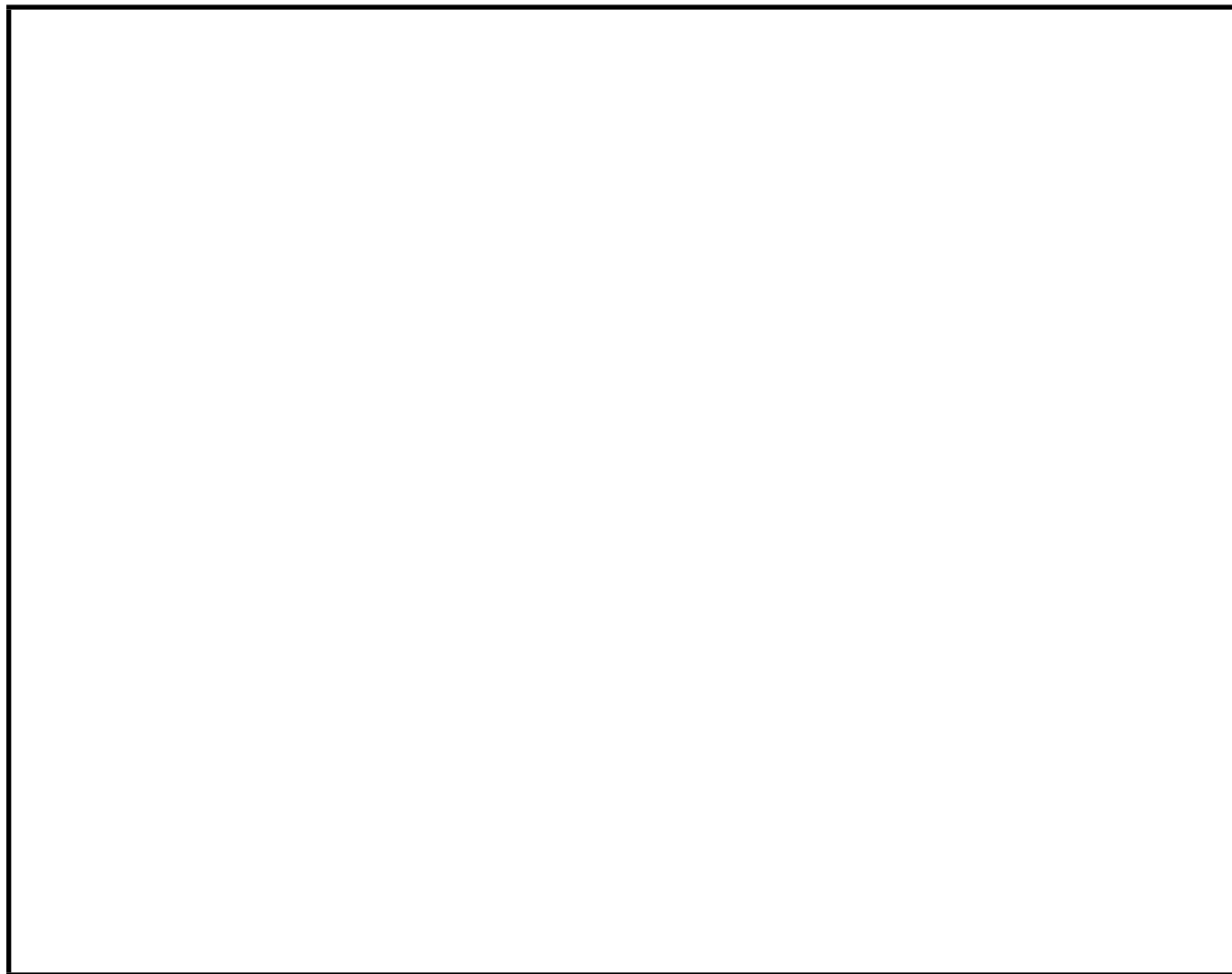
Yellowstone National Park

Circle the correct answer to complete the sentence.

Logan saw (plains or beaches) at Yellowstone National Park.

He also saw (glaciers or geysers).

Draw a picture of what Logan saw at Yellowstone National Park.



Write a question you would like to ask about the land and water features at Yellowstone National Park.

Modeling Groundwater

Use the drawing boxes below to show what happens to your model.

<p>Draw how your model looks when you start.</p>	<p>Draw what happens when it rains.</p>
<p>Draw how your model looks after you pump the water out.</p>	<p>Draw what happens when it rains again.</p>

Name _____

Date _____

Activity Page 3.2.2

Use with Lesson 3.2

Geyser Go!

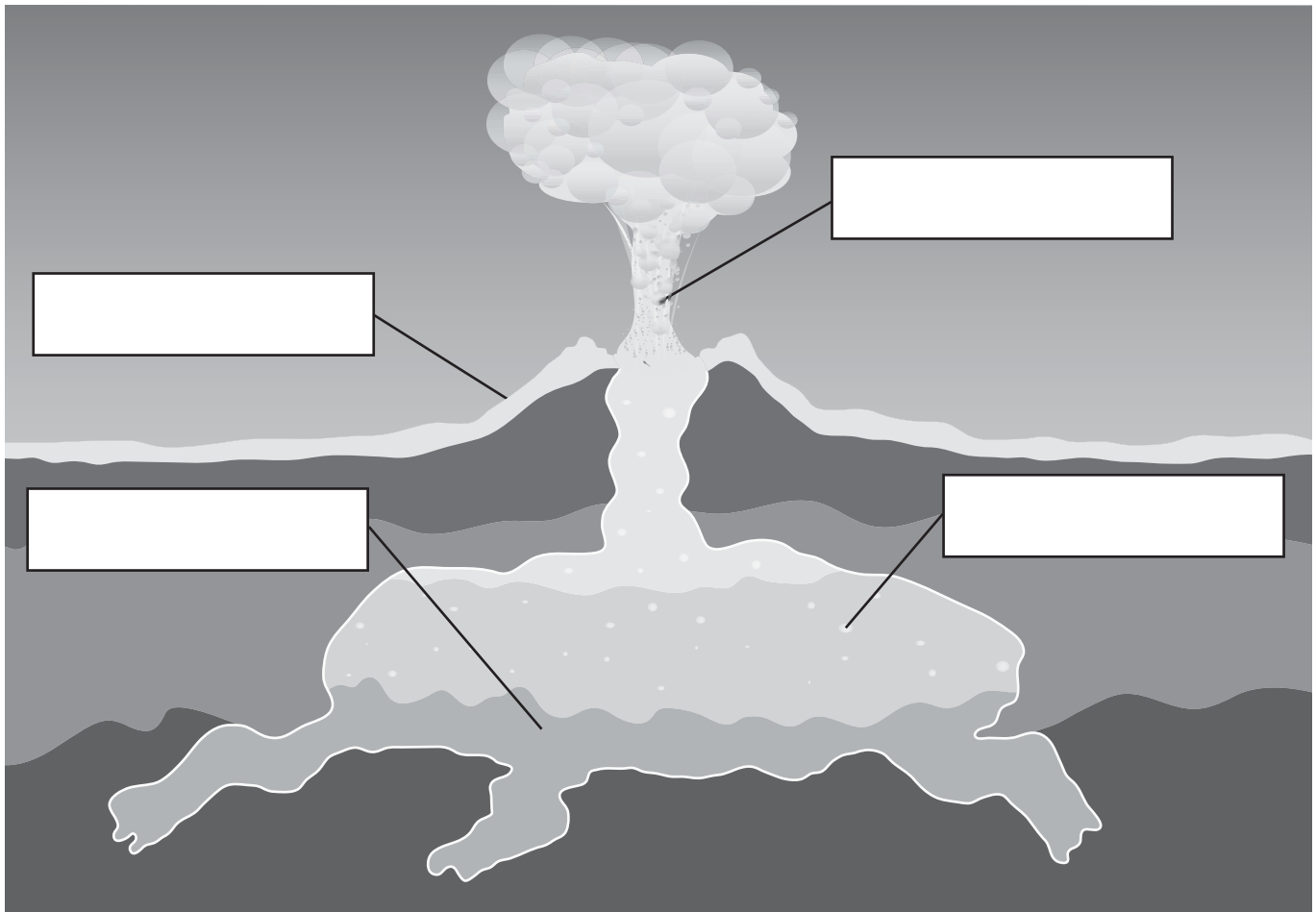
Label the picture.

surface

geyser

water

bubbles



Name _____

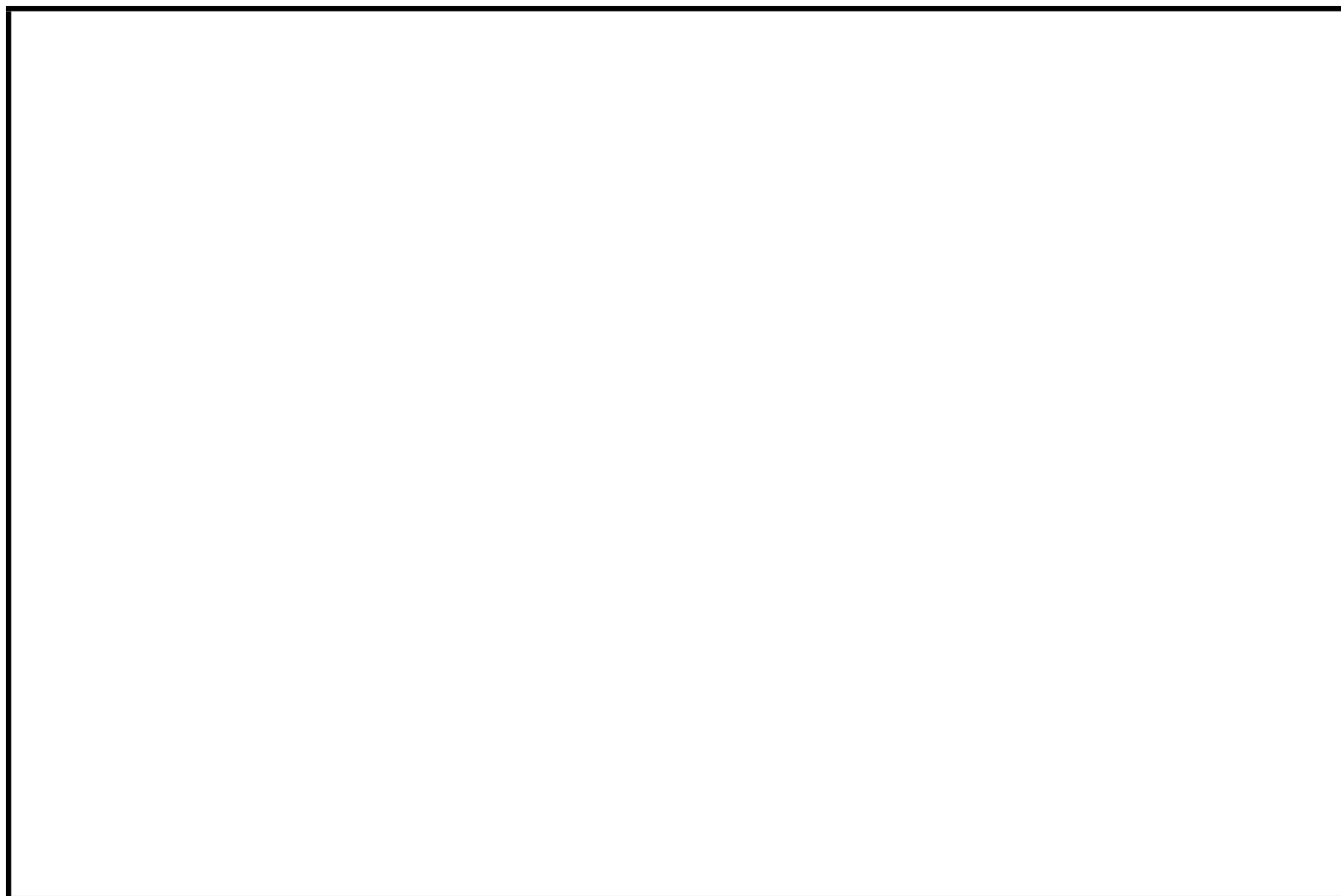
Date _____

Activity Page 3.3.1

Use with Lesson 3.3

About Volcanoes

Draw a picture of a volcano.



Write words or phrases about volcanoes that start with the letters shown.

V: _____

O: _____

L: _____

C: _____

A: _____

N: _____

O: _____

Look at an Earthquake

Use the drawing boxes below to show what happens during earthquakes.

--	--

Name _____

Date _____

Activity Page 3.4.2

Use with Lesson 3.4

Scrapbook—Lesson 3

Log the journey you take with Logan around the United States!

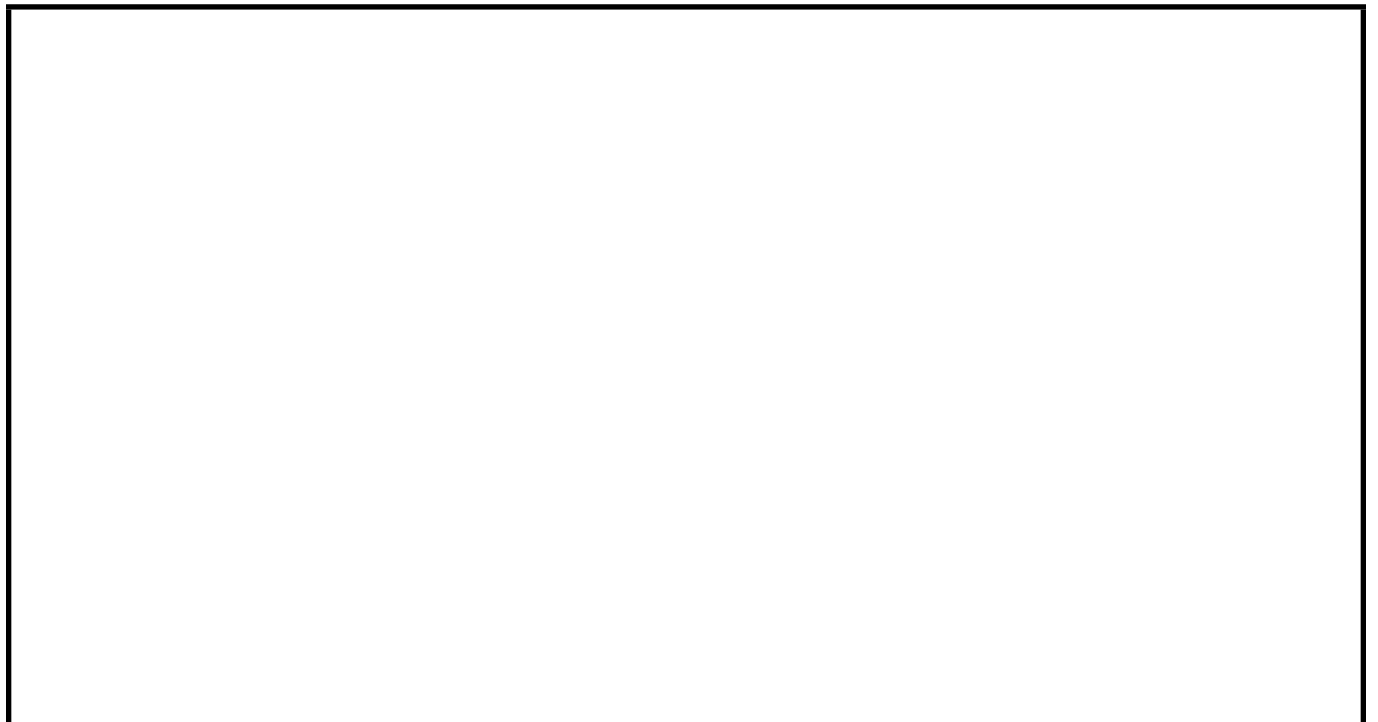
The third stop on Logan's trip was _____.

There, Logan saw _____.

Write down everything you know about geysers.

Write down everything you know about volcanoes.

Draw a picture that represents what Logan saw at Yellowstone National Park.



Name _____

Date _____

Yosemite National Park

What changes happen slowly in Yosemite?	What changes happen quickly in Yosemite?

Name _____

Date _____

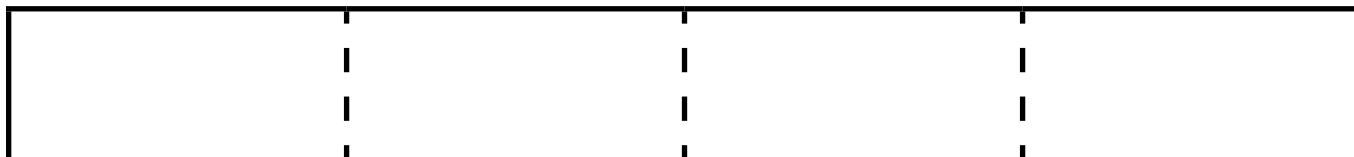
Activity Page 4.2.1

Use with Lesson 4.2

Paper House Template

Cut out the walls and roofs. Fold them along the dotted lines.

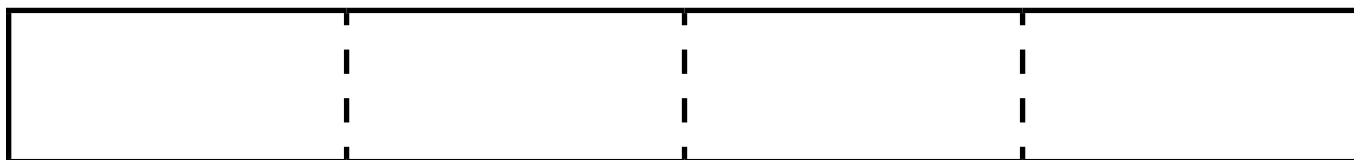
Walls



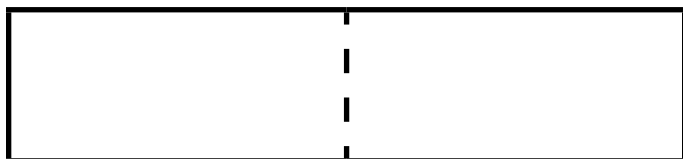
Roof



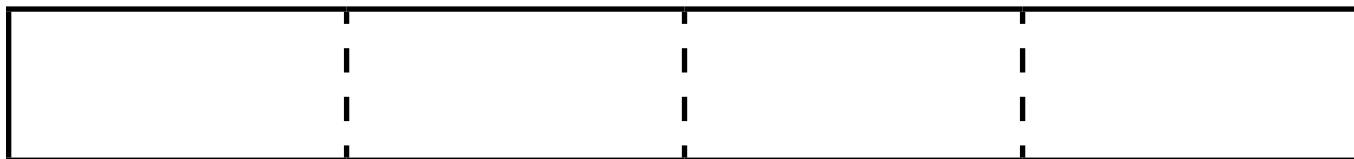
Walls



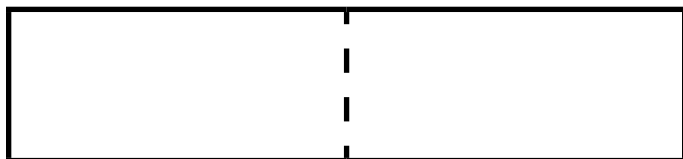
Roof



Walls



Roof



Name _____

Date _____

Landslide Investigation

Investigation 1:

Draw what the houses look like before and after the rockslide.

Before	After

Investigation 2:

Draw what the houses look like before and after the mudslide.

Before	After

Name _____

Date _____

Solution Scorecard

Use the card to score each solution from 1–3.

Criteria:	Nets	Walls	Bolts	Trees

Name _____

Date _____

Activity Page 4.3.2

Use with Lesson 4.3

Scrapbook—Lesson 4

Log the journey you take with Logan around the United States!

The fourth stop on Logan's trip was _____.

There, Logan saw _____.

Write down everything you know about landslides.

Can water cause landslides? How?

Do landslides make fast or slow changes to Earth?

What are some ways to prevent landslides?

Draw a picture that represents what Logan saw at Yosemite National Park.



Name _____

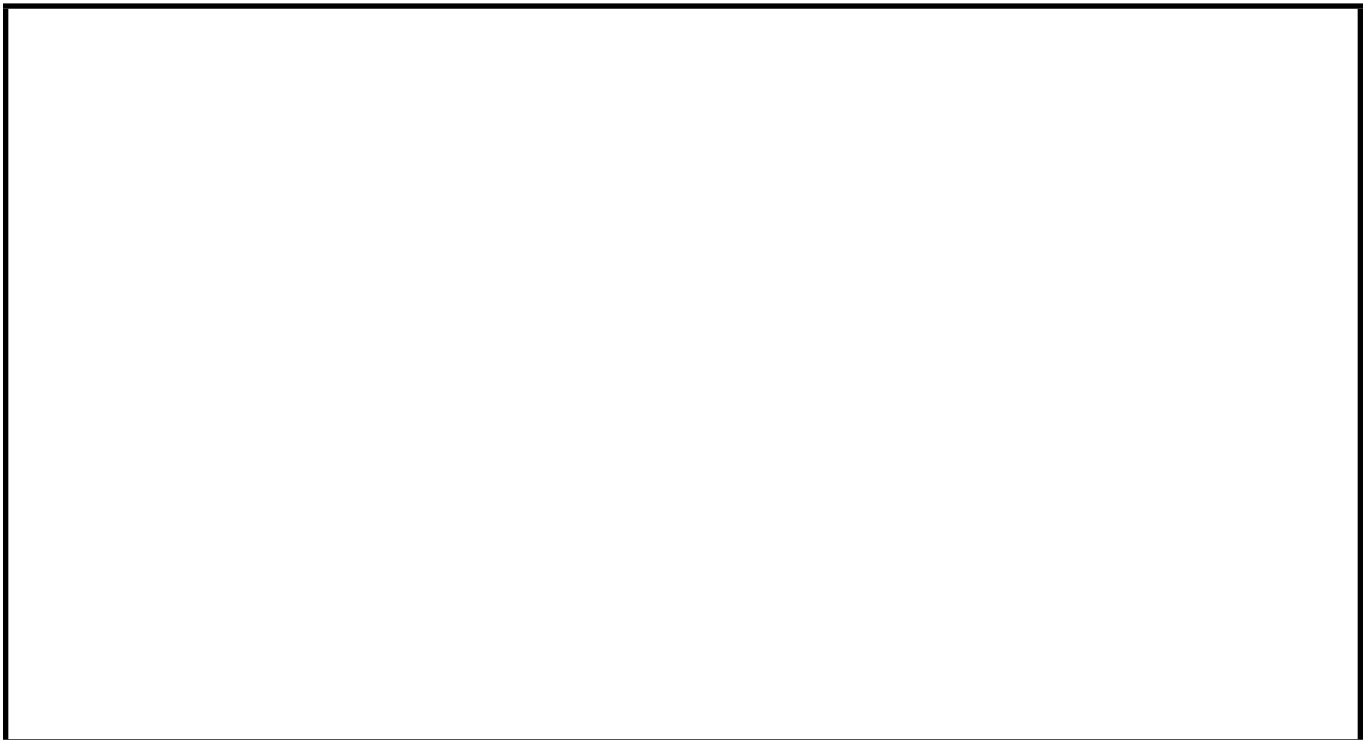
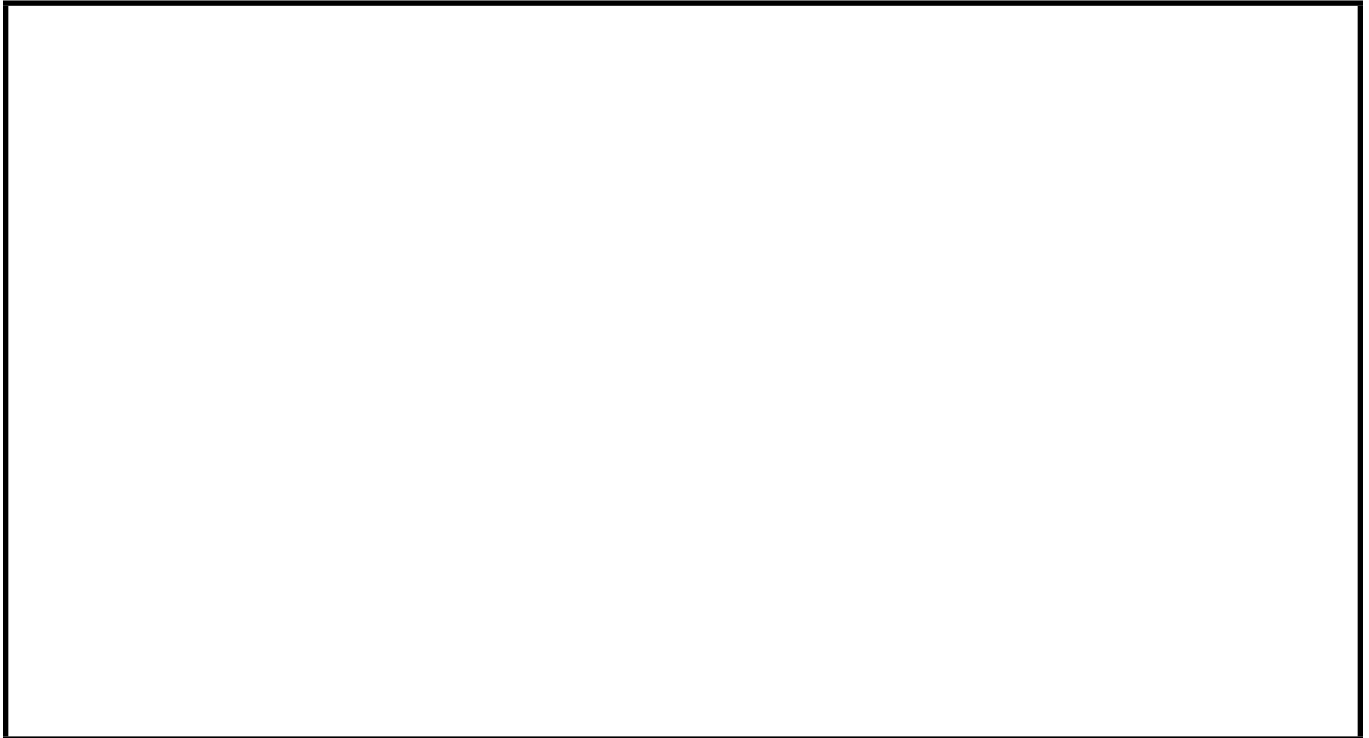
Date _____

Activity Page 5.1.1

Use with Lesson 5.1

Arches National Park

How do rock arches change quickly? How do rock arches change slowly? Draw a picture of a fast change and a slow change below.



Water Changes Rock

Draw what the sandstone looked like before and after the water.

<p>Before</p>		<p>After</p>	
---------------	--	--------------	--

Wind Changes Rock

Draw what the sandstone looked like before and after the wind.

<p>Before</p>		<p>After</p>	
---------------	--	--------------	--

Name _____

Date _____

Activity Page 5.2.3

Use with Lesson 5.2

Scrapbook—Lesson 5

Log the journey you take with Logan around the United States!

The fifth stop on Logan's trip was _____.

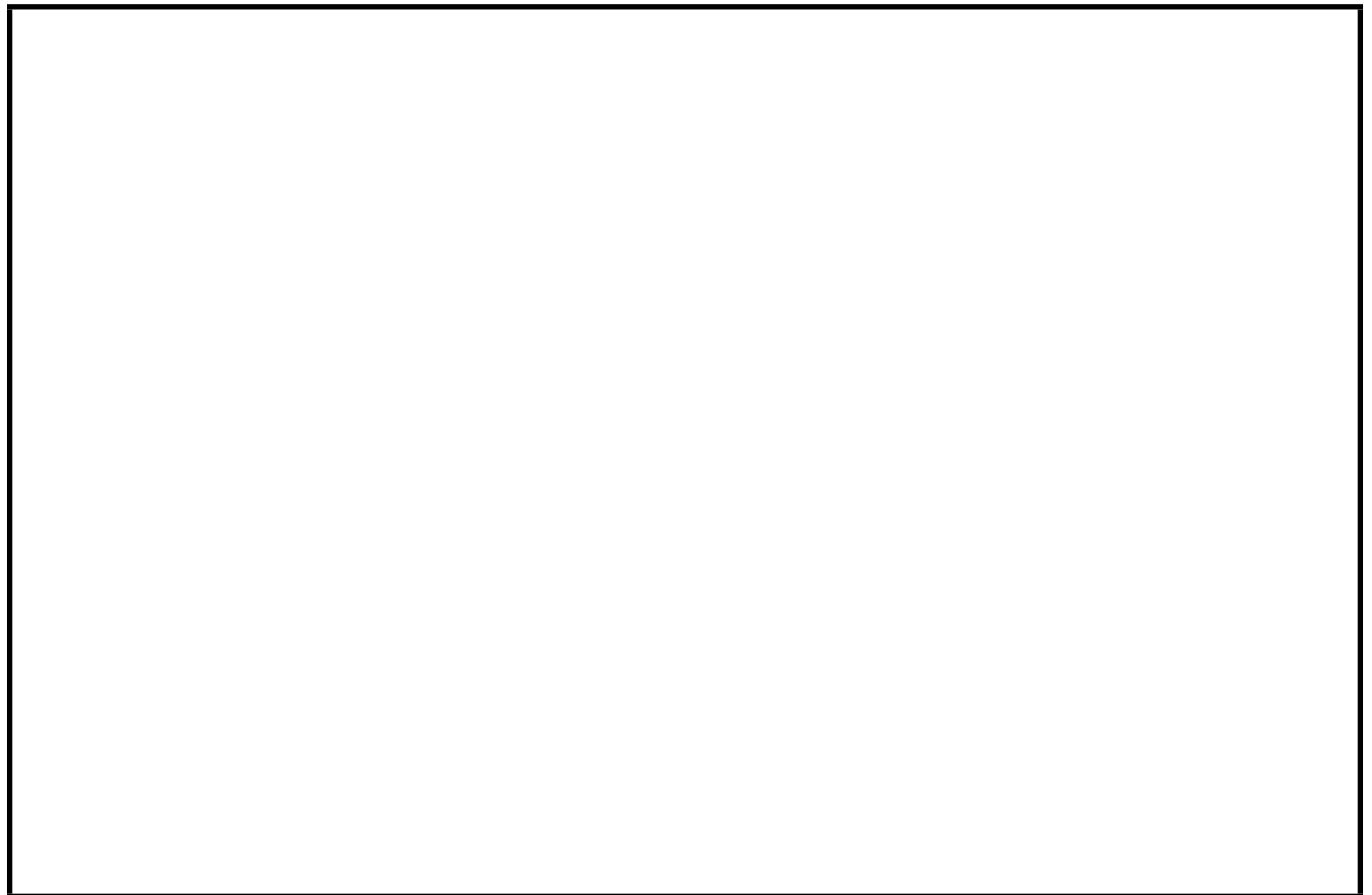
There, Logan saw _____.

Write down everything you know about rock formations.

Do rock arches form quickly or over a long time? _____

When rock arches fall, does this change the landscape quickly or over a long time? _____

Draw a picture that represents what Logan saw at Arches National Park.



Name _____

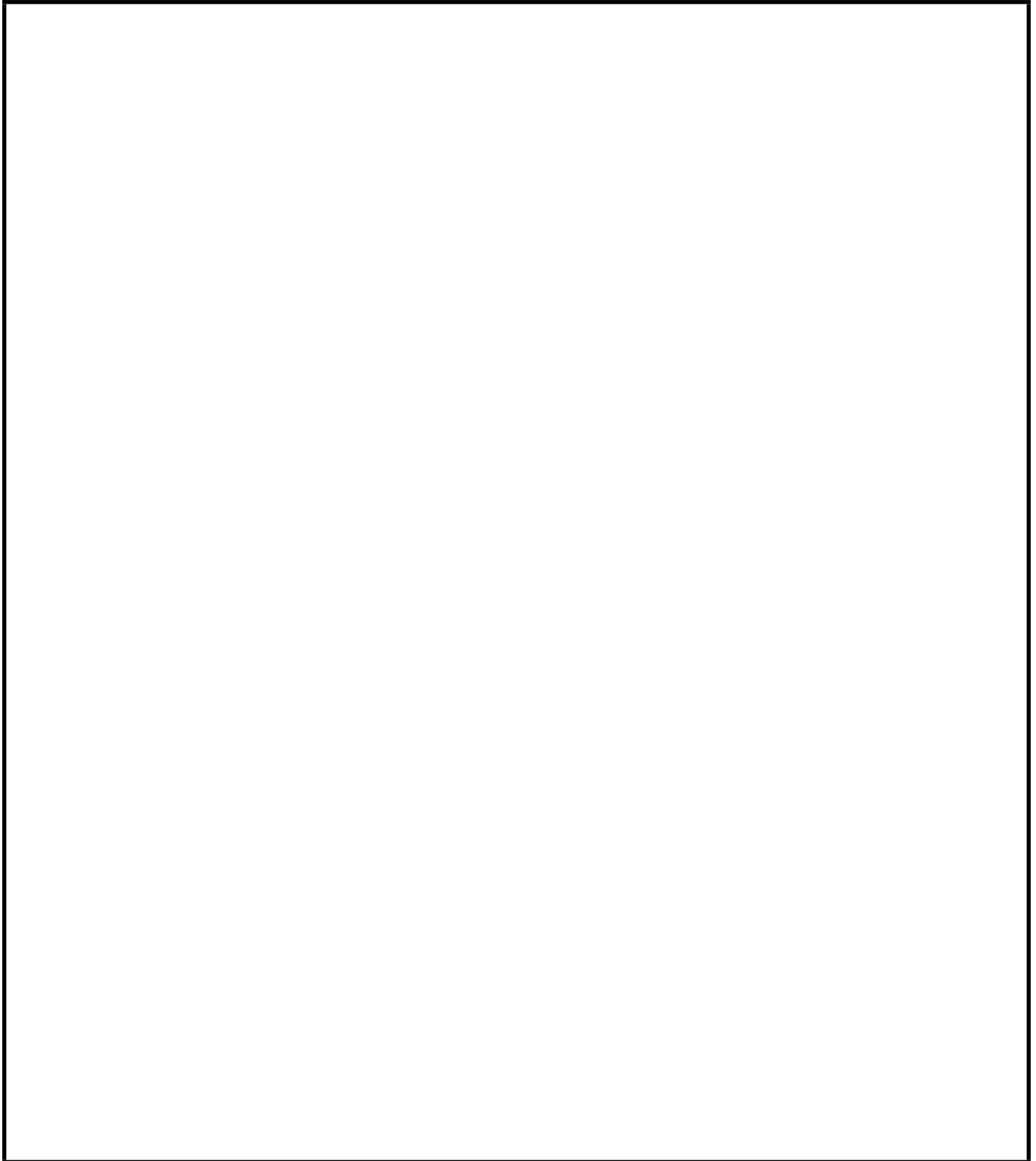
Date _____

Activity Page 6.1.1

Use with Lesson 6.1

Cape Cod National Seashore

Draw the landscape at Cape Cod National Seashore. Label each landform.

A large, empty rectangular box with a black border, intended for a student to draw a landscape of Cape Cod National Seashore. The box is oriented vertically and occupies most of the page below the instructions.

Exploring Sand

Draw how the wind changes the sand.

Before	After

Draw how the water changes the sand.

Before	After

Record the numbers from the ruler.

Starting height of sand: _____

Ending height of sand: _____

Circle the answer.

The sand is higher/is lower than when it started.

Name _____

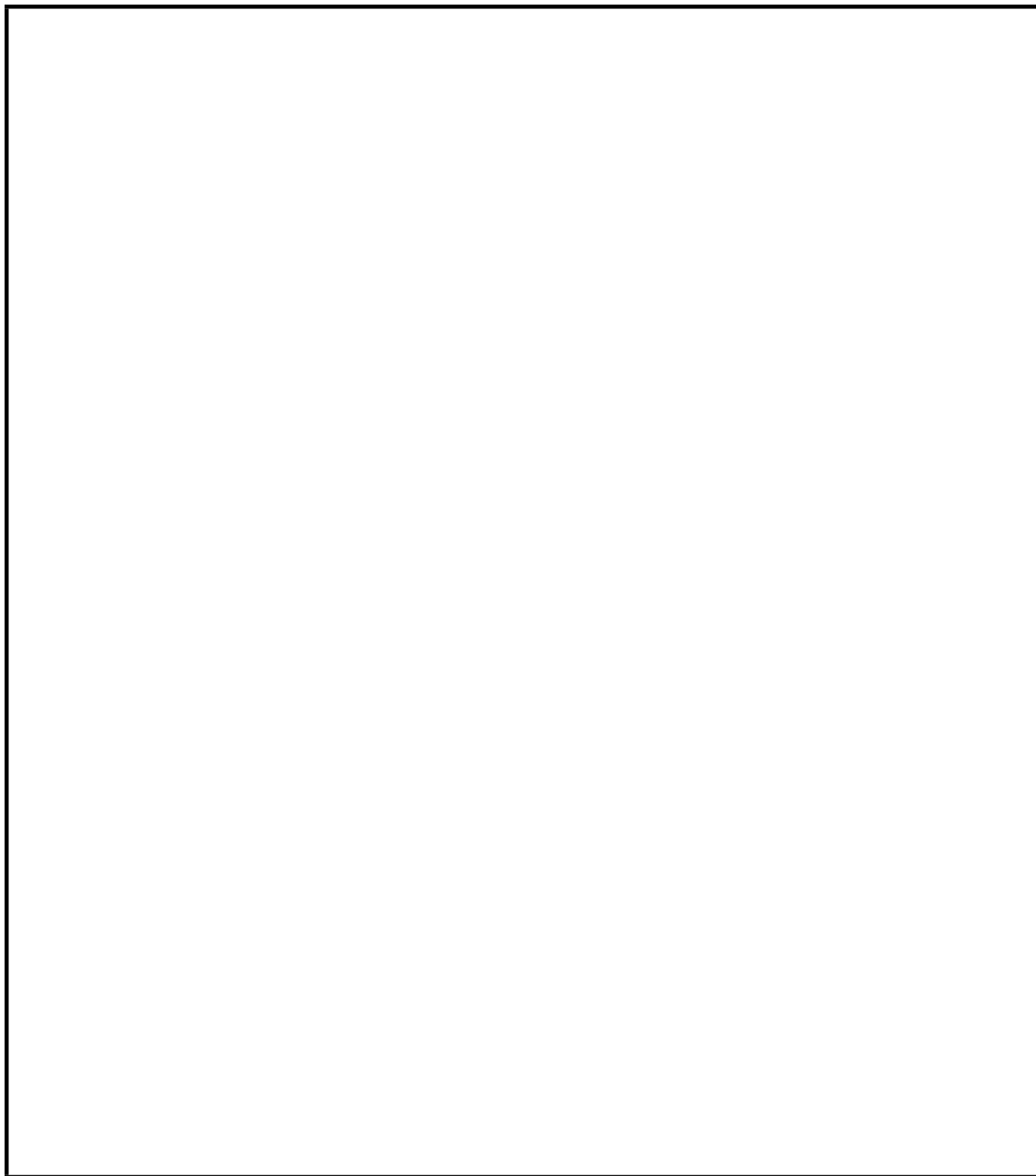
Date _____

Activity Page 6.3.1

Use with Lesson 6.3

Draw a Solution

Draw a solution that helps keep sand in place.

A large, empty rectangular box with a black border, intended for a student to draw a solution that helps keep sand in place.

Name _____

Date _____

Solution Scorecard

Use the card to score each solution from 1 to 3.

Criteria:	Fences	Jetties	Vegetation

Name _____

Date _____

Activity Page 6.4.2

Use with Lesson 6.4

Scrapbook—Lesson 6

Log the journey you take with Logan around the United States!

The last stop on Logan's trip was _____.

There, Logan saw _____.

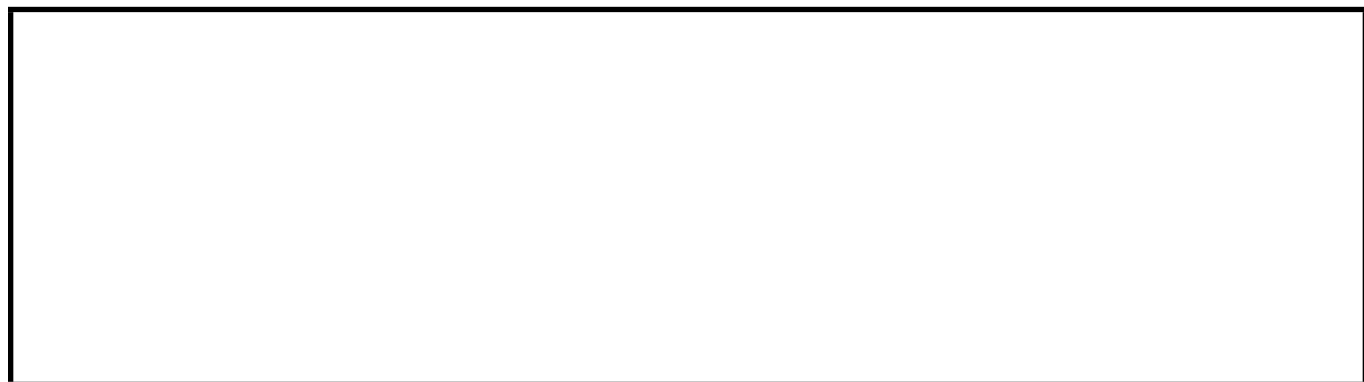
Write down everything you know about sand dunes and shorelines.

Can water cause sand to erode?

Do hurricanes make fast or slow changes to Earth?

What are some ways to prevent sand erosion?

Draw a picture that represents what Logan saw at Cape Code National Seashore.



Activity Pages Answer Key: *Exploring Land and Water*

This answer key offers guidance to help you assess your students' learning progress. Here you will find descriptions of the expected key understandings, correct answers, and desired observations for each Activity Page of this unit. At this grade level, students' written responses are not expected to reflect the specificity shown here, and students should not be evaluated on refined drawing ability. Use the answers below, not as direct models for ideal student responses, but as keys to what to look for in evidence of student learning.

Our Landscape (AP UO.1) (page 238)

Students should demonstrate understanding of what a landscape is by representing a local urban, suburban, rural, or natural landscape, such as a row of houses, city street, park, forest, or field.

The Rock (AP 1.1.1) (page 239)

Student drawings should show a rock shape, color, and texture.

How Does Freezing Water Affect Rocks? (AP 1.2.1) (page 240)

The first drawing should show both cartons with equal levels of plaster (rock). The second drawing should show one carton with the water balloon and cracked plaster. The other should show solid plaster.

Problem and Solution: Water (AP 1.3.1) (page 241)

Water can change stone monuments. This happens over a long period of time.

If a rock has cracks in it, we can fill it with silicone.

We can prevent rocks from being weathered by water if we put a covering over the stone monument.

Did the Sealing Tests Work? (AP 1.4.1) (page 242)

Students should describe two solutions they tested and compare which worked better and why.

Scrapbook—Lesson 1 (AP 1.4.2) (page 243)

Where did Logan visit? Mount Rushmore

What kind of land feature is this? mountain

What can water do to rock? erode or crack rocks

Does this happen quickly or slowly? slowly

How can you prevent water from changing rock? cover it or fill holes

Pictures should show some version of Mount Rushmore.

Water and Land (AP 2.1.1) (page 244)

Land Features: mountains, hills, valleys

Water Features: lakes, streams, glaciers, waterfalls

Map It! (AP 2.2.1) (pages 245–246)

Students should draw a map of the schoolyard with features such as school building, parking lot, playground equipment, and trees colored. Accept reasonable answers to each of the questions.

How Water Flows (AP 2.3.1) (page 247)

Water flows downhill.

Rocks and other land features can change how water flows.

When water flows over soil, the soil moves.

Bodies of water that flow are streams.

Bodies of water that do not flow are lakes.

Flowing water collects at the bottom of a hill or mountain.

The water flowed in the same direction each time.

Moving Ice (AP 2.4.1) **(page 248)**

Students should draw a picture of a smooth slope surface at the beginning of the demonstration. Students' drawings of the middle portion should show the model glacier halfway down the slope with sand disturbed upslope by the glacier. Students' end drawings should show the glacier at the bottom of the slope with the sand disturbed the length of the slope.

Solve a Riddle (AP 2.5.1) **(page 249)**

Riddle 1: stream

Riddle 2: river

Riddle 3: lake

Riddle 4: glacier

Land and Water Flags (AP 2.6.1) **(page 250)**

These flags are used to label student model landforms.

Scrapbook—Lesson 2 (AP 2.6.2) **(page 251)**

The second stop on Logan's trip was Glacier National Park.

There, Logan saw glaciers, lakes, and streams.

Write down everything you know about glaciers.

- Glaciers are made of layers of snow and ice.
- Glaciers are always moving.
- Glaciers can reshape land.
- Melted ice flows into lakes and the ocean.

Logan and his family used a map to find their way around the park.

The elevation of a valley is lower than the elevation of a mountain.

The elevation of a mountain is higher than the elevation of a hill.

Student pictures should represent glaciers, mountains, lakes, and/or streams.

Yellowstone National Park (AP 3.1.1) **(page 252)**

Logan saw plains at Yellowstone National Park.

He also saw geysers.

Student pictures should represent geysers and flat plains.

Students should write a question about land and water features at Yellowstone National Park. For example, "How hot is the water coming out of a geyser?" or "Where does the water in a geyser come from?"

Modeling Groundwater (AP 3.2.1) **(page 253)**

Students will draw four pictures:

1. the tub with sand and gravel, a cup for a well, a depression for a lake, and animal figures undisturbed
2. the tub with well and depression filled with blue water
3. the tub with the well empty of blue water
4. the tub with the well and depression filled with blue water

Geyser Go! (AP 3.2.2) **(page 254)**

clockwise from top right: geyser, bubbles, water, surface

About Volcanoes (AP 3.3.1) **(page 255)**

Accept all reasonable answers. For example:

V: volcano

O: odor

L: lava

C: crater

A: ash

N: noisy

O: old

Look at an Earthquake (AP 3.4.1) **(page 256)**

To represent what happens in an earthquake, students should draw a picture of graham crackers on whipped cream before they collide and then draw a second picture with the graham crackers folded up in the center and cracked in the middle. Accept all reasonable drawings.

Scrapbook—Lesson 3 (AP 3.4.2) **(page 257)**

The third stop on Logan's trip was Yellowstone National Park.

There, Logan saw geysers and volcanoes.

Accept reasonable answers.

Geysers: underground water that gets heated and shoots water out of the ground

Volcanoes: openings in Earth's surface out of which lava, ash, and hot gases erupt

Students should draw a picture of a geyser.

Yosemite National Park (AP 4.1.1) **(page 258)**

Students should draw two pictures.

Slow Change: erosion of a rock landform like Half Dome

Fast Change: landslide, rockslide, or mudslide

Paper House Template (AP 4.2.1) **(page 259)**

This is a template for paper houses to use in the investigation.

Landslide Investigation (AP 4.2.2) **(page 260)**

Students should draw pictures of paper houses before a rockslide and after a rockslide and then before a mudslide and after a mudslide. The after pictures should show some substantial damage. Accept all reasonable responses.

Solution Scorecard (AP 4.3.1) **(page 261)**

This will be completed as a class. Students score each solution based on the criteria they establish.

Criteria suggestions:

- being strong
- not being in the way (of roads or houses)
- being okay in the sun
- being waterproof
- being fireproof
- looking good

Scrapbook—Lesson 4 (AP 4.3.2) **(page 262)**

The fourth stop on Logan's trip was Yosemite National Park.

There, Logan saw waterfalls, mountains, and streams.

Write down everything you know about landslides.

With the weight of gravity, suddenly a mass of soil and rocks slides off a mountain or cliff.

Can water cause landslides? How? yes, if the extra weight of water causes the mud to slide

Do landslides make fast or slow changes to the Earth? fast

What are some ways to prevent landslides?

planting trees to keep soil in place; building walls or using nets or bolts to hold the land in place

In a picture, students should represent tall mountains, a waterfall, a lake, or a landslide.

Arches National Park (AP 5.1.1) **(page 263)**

Students should draw pictures of a quick change, like a rock falling, and a slow change, like arches caused by wind erosion. Accept all reasonable responses.

Water Changes Rock (AP 5.2.1) **(page 264)**

Students should draw a picture of the rock in the investigation before water is applied. In a second picture, students should show some rock erosion from the water.

Wind Changes Rock (AP 5.2.2) **(page 265)**

Students should draw a picture of the rock in the investigation before wind is applied. In a second picture, students should show some rock erosion from the wind.

Scrapbook—Lesson 5 (AP 5.2.3) **(page 266)**

The fifth stop on Logan's trip was Arches National Park.

There, Logan saw rock formations caused by wind erosion.

Write down everything you know about rock formations.

Over time they are shaped by wind and water erosion.

Do rock arches form quickly or over a long time?
a long time

When rock arches fall, does this change the landscape quickly or over a long time? quickly

Pictures should show various rock formations changed by wind.

Cape Cod National Seashore (AP 6.1.1) **(page 267)**

Student pictures should reflect labeled sand dunes, ocean, shoreline, and beach. Accept all reasonable responses.

Exploring Sand (AP 6.2.1) **(page 268)**

Students should draw a picture of the sand in the investigation before wind is applied. In a second picture, students should show some sand changes from the wind.

Students should draw a picture of the sand in the investigation before water is applied. In a second picture, students should show some sand changes from the water.

Draw a Solution (AP 6.3.1) **(page 269)**

Students should draw a picture of a solution, such as fencing or adding plantings to keep the sand in place.

Solution Scorecard (AP 6.4.1) **(page 270)**

This will be completed as a class. Students score each solution based on the criteria they establish.

Criteria suggestions:

- keeping sand in place as much as possible
- being okay in the sun
- not being able to blow away
- being strong enough to stand up to waves

Scrapbook—Lesson 6 (AP 6.4.2) **(page 271)**

The last stop on Logan's trip was Cape Cod National Seashore.

There, Logan saw beaches, sand dunes, and the ocean.

Write down everything you know about sand dunes and shorelines.

Beaches and shorelines are always changing because of wind and water.

Can water cause sand to erode?

Yes, ocean water and rain reshape sand dunes constantly.

Do hurricanes make fast or slow changes to Earth? fast changes

What are some ways to prevent sand erosion? plant trees, build fencing, build jetties

Students should draw a picture of a shoreline with a beach with sand dunes and the ocean.

Glossary

Blue words and phrases are Core Vocabulary for the unit. **Bold-faced words and phrases** are Language of Instruction, additional vocabulary terms related to the unit that you should model for students during instruction. Vocabulary words are not intended for use in isolated drill or memorization.

A

analyze, v. to examine, study, or look carefully to explain or describe

arch, n. a curved part of a structure above an open space

ash, n. solid, lightweight, flaky material that is left after something is completely burned; the mixture of burnt rock and minerals that is blown out when a volcano erupts

C

change, v. to become different; to make something different (also n. a difference from something's former condition)

compare, v. to examine characteristics of two or more things, particularly looking for similarities

crater, n. the area around the opening of a volcano or geyser that is shaped like a bowl

criteria, n. standards by which something is judged, evaluated, or assessed

D

depth, n. a measure of how deep something is

design, n. a plan to show how something is made or how a process should work (also v. to develop a plan for a device or a solution to a problem)

direction, n. the path along which something moves or the point toward which something is aimed

downhill, adv. toward the bottom of a hill

dune, n. a hill of sand piled up by the wind

E

earthquake, n. shaking of the ground caused by movement of parts of Earth's surface

elevation, n. height above sea level

erosion, n. the process of moving earth material from one place to another

erupt, v. to forcefully push out lava, rocks, and ash from a volcano

eruption, n. the event that occurs when lava, rock, and ash erupt from a volcano

evaluate, v. to examine the details of something and determine the value or effectiveness of it

examine, v. to look at something closely and carefully to learn more about it

example, n. a sample of something that shows what the whole is like

F

friction, n. the resistance of motion when something rubs against something else

G

geyser, n. a natural pool of underground hot water that sometimes erupts and sends steam and hot water into the air

glacier, n. a large area of thick ice made from layers of snow that have never melted

globe, n. a three-dimensional model of Earth

groundwater, n. water found beneath the surface of Earth collected in layers of rock

H

high, adj. elevated considerably above a point of reference; opposite of low

hill, n. a raised land area, higher than surrounding land but smaller than a mountain

horizon, n. the farthest visible place on land, where the outline of the land meets the sky

I

identify, v. to indicate what something is

interpret, v. to explain the meaning of some information

investigate, v. to observe and study something to collect information

L

lake, n. a body of water surrounded by land, larger than a pond

land, n. all the solid parts of Earth's surface

landform, n. a natural feature of Earth's surface, such as a mountain, hill, arch, volcano, and valley

landscape, n. an area of land that includes landforms, plants, and human elements

landslide, n. a sudden movement of a large amount of soil, rock, and other material down a slope

lava, n. hot, liquid rock that flows from a volcano

low, adj. a point or level that is smaller in size, degree, or elevation; opposite of high

M

map, n. a flat representation of an area that shows where things are

model, n. a representation of something that can help people learn about the real thing

mountain, n. a landform that rises high above its surroundings; taller than a hill

mudslide, n. a sudden movement of a large amount of wet soil down a slope

N

national monument, n. a place of importance to the United States that is maintained and protected by the government

notice, v. to see and pay attention to something

O

observe, v. to watch something and notice details about it (observation, n. the process of noticing details or a specific detail that is noticed)

ocean, n. a huge body of salt water that covers most of Earth's surface

P

plains, n. large, flat areas of land with no hills or mountains

pond, n. a small body of water surrounded by land, smaller than a lake

preserve, v. to save from injury, loss, or destruction

prevent, v. to keep something from happening (prevention, n. the act of keeping something from happening)

problem, n. a condition that falls short of satisfying a want or a need

R

represent, v. to display or serve as a sign of something, such as a drawing

river, n. a large, permanent, flowing body of water that flows across land into a lake, another river, or the ocean

rock, n. a natural, solid earth material made of different minerals

rockslide, n. a sudden movement of a large amount of rock down a slope

S

sand, n. tiny, loose pieces of rock, soil, and minerals

sandstone, n. a type of rock made of sand pressed together and hardened

scale, n. the size of a picture, plan, map, or model compared to the real thing

score, v. to evaluate and assign numbers based on rules (also n. the total points achieved in a scoring evaluation)

seafloor, n. the land below the ocean's water

seashore, n. the land bordering the ocean

sediment, n. tiny, broken-down particles of earth material

shape, n. the form or outline of an object

shoreline, n. the line where a body of water and land meet

solution, n. a process, action, or device that fixes a problem

sonar, n. a system that helps tell how deep the water is beneath a boat

steep, adj. describing a slope or hill that rises sharply

stream, n. a body of flowing water smaller than a river

T

topography, n. the physical features of an area of land that includes landforms and their elevations and bodies of water

V

valley, n. a long, large, low place on Earth's surface, usually between mountain ranges or hills

view, n. all that can be seen from a certain place

virtual, adj. occurring through software and technology but not physically present

volcano, n. a landform, usually a mountain, from which molten earth material erupts to the surface

W

water, n. a clear, tasteless, odorless liquid that covers most of Earth's surface and on which living organisms depend

waterfall, n. a place where a river or stream spills over rocks or cliffs

wear away, v. to break something down over time

weathering, n. the process of rock being dissolved, worn, or broken down into smaller pieces

wind, n. the movement of air from one place to another

Classroom Safety for Activities and Demonstrations

In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- Be aware of students who have food allergies, and adjust related activities or make materials substitutions as necessary. Check the ingredients of all food to make sure known allergies are not listed. Students with food allergies can still be affected even if they do not ingest the food item. Some common food allergies are peanuts, tree nuts (e.g., almonds, walnuts, hazelnuts, etc.), and cow's milk (rice milk is a good nut-free alternative).
- Report and treat any injuries immediately.
- Check equipment prior to usage, and make sure everything is clean and ready for use.
- Clean up spills or broken equipment immediately using the appropriate tools.
- Monitor student behavior to ensure they are following proper classroom and activity procedures.
- Do not touch your eyes, ears, face, or mouth while engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page. Have a read-along, and have students agree to the expectations for students when engaged in science activities prior to the start of the first unit.

Online Resources



For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

When doing science activities, I will do the following:

- Report spills, breakages, or injuries to the teacher right away.
- Listen to the teacher for special instructions and safety directions. If I have questions, I will ask the teacher.
- Avoid eating or drinking anything during the activity unless told to by my teacher.
- Review the steps of the activity before I begin. If I have questions, I will ask the teacher.
- Wear safety goggles when working with liquids or things that can fly into my eyes.
- Be careful around electric appliances and unplug them, just by pulling on the plug, when a teacher is supervising.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ / ____ / ____

Student signature and date

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your student and sign this contract. If you have any questions, please feel free to contact me.

_____ / ____ / ____

Parent or guardian signature and date

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned, and will last for more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

Consider some of the following as methods for acquiring the science materials:

- **School Supply Drive**—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- **Open Houses**—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- **Parent-Teacher Organizations**—Reach out to the local PTO for assistance with acquiring materials.
- **Science Fair Drive**—Consider adding a table to your science fair as part of a science materials drive for future units.
- **College or University Service Project**—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- **Local Businesses**—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or for examples of how their sponsorship will benefit students.

Remember: If your school is public, it will be tax exempt, so make sure to have a Tax Identification Number (TIN) when purchasing materials. If your school is private, you may need proof of 501(c)(3) status to gain tax exemption. Check with your school for any required documentation.

Advance Preparation for Activities and Demonstrations

Being properly prepared for classroom activities and demonstrations is the first step to having a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class, do the following:

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues, such as food allergies, that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher's Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

While engaged in the activity or demonstration, do the following:

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration, do the following:

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices, such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

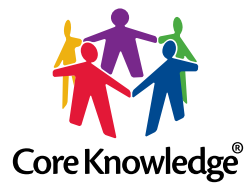
What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and X-rays are just some of the discoveries made when people were practicing science and something did not go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity doesn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence, or they missed a step when performing the activity. Review and provide feedback on students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson segment's guiding question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly; a measurement was made in error, such as a wrong unit of measure or quantity; or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but a teacher guiding them through the problem to figure out why something happened will help them to develop a better sense of how to do science.



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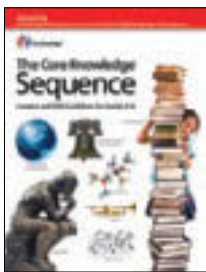
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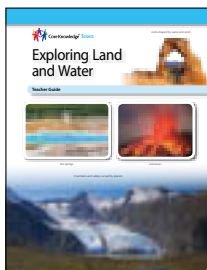
Exploring Land and Water

Core Knowledge Science 2



What is the Core Knowledge Sequence?

The *Core Knowledge Sequence* is a detailed guide to specific content and skills to be taught in Grades K–8 in language arts, history, geography, mathematics, science, and the fine arts. In the domains of science, including Earth and space, physical, and life sciences, the *Core Knowledge Sequence* outlines topics that build systematically grade by grade to support student learning progressions coherently and comprehensively over time.



For which grade levels is this book intended?

In general, the content and presentation are appropriate for students in the early elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 2 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the
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