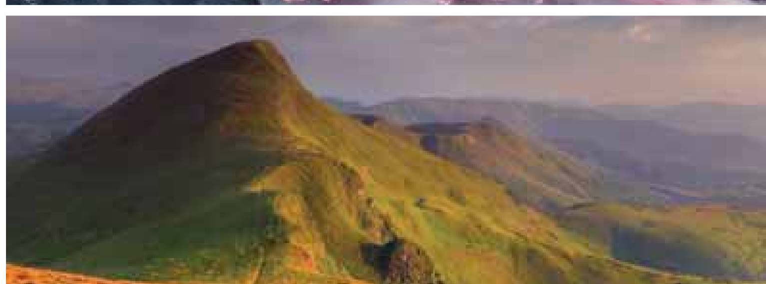
GRADE 4

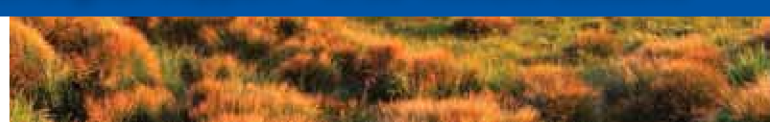
Building Blocks OF SCIENCE™ | 3D

Changing Earth

Program Highlights and Lesson Sampler



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



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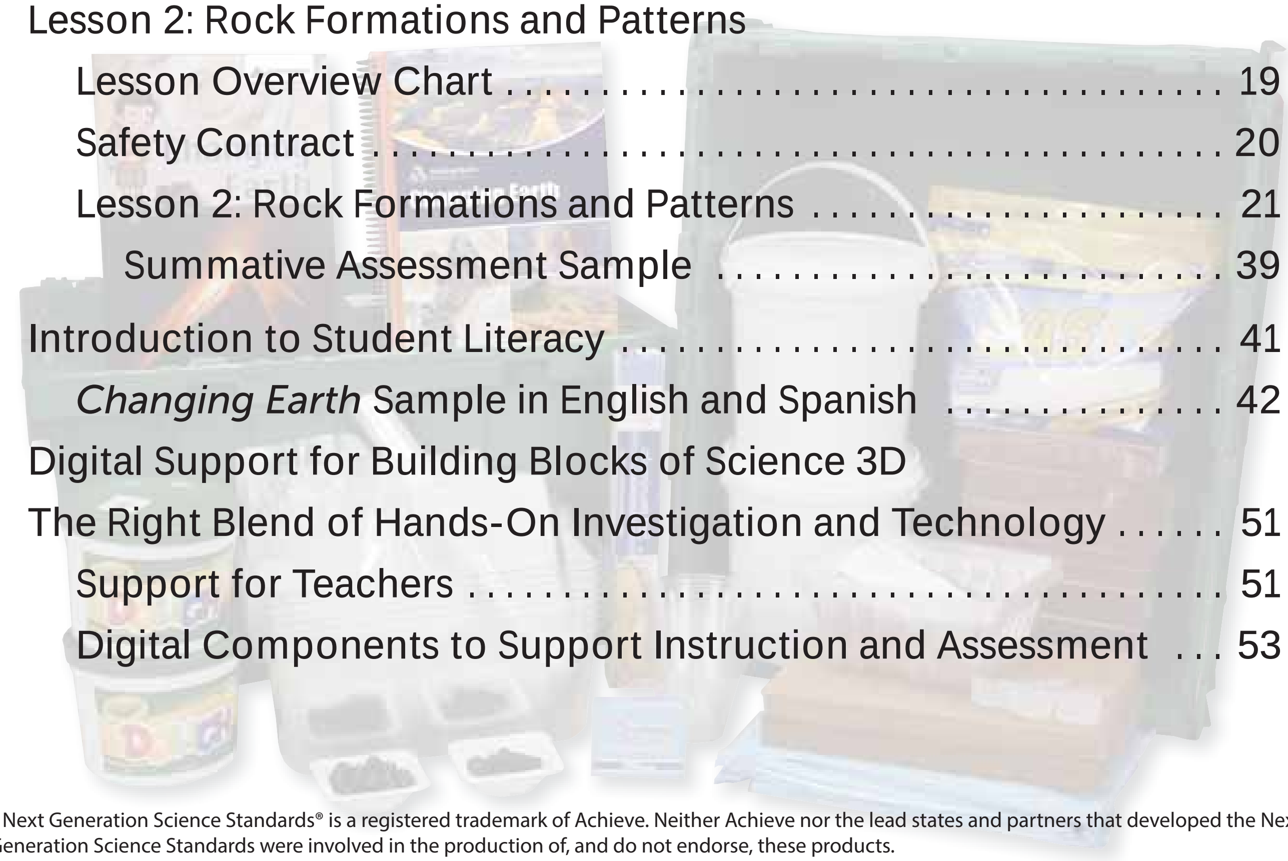

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Changing Earth

Teacher's Guide

3rd Edition

Building Blocks OF SCIENCE™ | 3D

Kit Materials

Material	Quantity Needed From Kit	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Clay				■			
Craft dough		■					
Fluted catch pan	8			■	■	■	■
Large resealable plastic bag	8			■			
Literacy Reader: *Changing Earth* (below grade level)	1	■	■	■	■		
Literacy Reader: *Changing Earth* (on grade level)	1	■	■	■	■		
Marble	30	■					
PerfectCast™ casting powder†						■	
Plastic bowl	8		■				
Plastic knife	30	■	■				
Plastic spoon	16					■	
Plastic tank with drain hole	8			■	■	■	■
Pour cup, 9 oz	8			■	■	■	■
Rock Study Kit	8		■			■	
Roll of aluminum foil	1		■				■
Rubber stopper	8			■	■	■	■
Sand				■			
Scoop	2					■	
Sheet of cardboard	8						■
Small absorbent pad	16			■	■	■	■
Soil		■					
Stream cup with hole, 9 oz	8			■	■	■	■
Toothpick				■	■		■
Velcro				■			

† A Safety Data Sheet (SDS) for this item is available at www.carolina.com/SDS

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

Needed But Not Supplied Materials

Material	Quantity Needed	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
3D relief map of the U.S.	1			■	■		
Art supplies			■				
Blue maker, crayon, or colored pencil	30				■		
Bottle of blue food coloring	1					■	
Chart paper or whiteboard		■		■		■	
Climate map of the U.S.	1				■		
Crayons (four different colors)	32		■				
Crayons or colored pencils					■		
Glue or tape	8		■				
Glue stick	30	■					
Hot pot or thermos	1		■				
Image of the Grand Canyon				■			
Internet access and/or research materials related to rocks			■				
Marker		■		■		■	
Materials for building a model							■
Measuring cup, ½ cup	1			■			
Pair of scissors	30	■	■	■			■
Paper plate	15	■					
Plastic bottle, 1 L	8			■	■		■
Presentation materials (including poster board, markers, and video equipment as available)							■
Projection system (optional)	1			■	■		
Red marker	30	■					
Science notebook	30	■	■	■	■	■	■
Small, flat object	8					■	
Tape			■	■			
Textbook	8			■	■		
Topographic map of the U.S.	1				■		
Water	32.5 L		■	■	■	■	■

† A Safety Data Sheet (SDS) for this item is available at www.carolina.com/SDS

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NOTES

Unit Overview: *Changing Earth*

Earth is made up of mountain ranges, lakes, volcanoes, rivers, canyons, and many other landforms and waterways, all of which are continually changing. Most of these changes are not noticeable in a single lifetime; for example, it takes rivers thousands—even millions—of years to form canyons. Other changes are more drastic and immediate, such as those resulting from an earthquake or a volcanic eruption. *Changing Earth* provides hands-on, inquiry based investigations that focus on phenomena related to the history of Earth and its landforms. Through a series of six lesson, students learn about tectonic plates, make connections to the rock cycle, model erosion using stream tables, and consider how Earth's changes can impact on human activity.

At the beginning of the unit, students learn about the layers of Earth by building a model. They construct a puzzle of Earth's plates and compare maps to draw connections between earthquakes, volcanic eruptions, and the locations of tectonic plates. Volcanic eruptions become the focus as students think about the process of lava cooling to form rock. Students observe samples in a Rock Study Kit and compare different types of rocks. In addition, students simulate the rock cycle to see firsthand how rock types can change from one to the other depending on the conditions. Stream tables are used to model erosion, weathering, and deposition. By adjusting the elevation of the stream table and by adding "vegetation," students learn that the structures of landforms depend on the amount of erosion that occurs. Students explore the value of mapping Earth by comparing different types of maps to draw conclusions about the location of landforms and waterways. This concept is supported by drawing attention to the existence of rock layers. The formation of fossils acts as a strong model to introduce the idea that rocks form layers over time, allowing scientists to provide a relative date for the existence of certain organisms. At the end of the unit, students consider how Earth's changes impact human activity. Soil erosion is identified as a problem for farmers, and students are challenged to develop several models to solve the problem of soil erosion. Students test their solutions, analyze the results, and present their findings to the class.

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Next Generation Science Standards

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

Performance Expectations

- **4-ESS1-1:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- **4-ESS2-1:** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.
- **4-ESS3-2:** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
- **3-5-ETS1-2:** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Disciplinary Core Ideas

- **ESS1.C:** The History of Planet Earth
- **ESS2.A:** Earth Materials and Systems
- **ESS2.B:** Plate Tectonics and Large-Scale System Interactions
- **ESS2.E:** Biogeology
- **ESS3.B:** Natural Hazards
- **ETS1.B:** Designing Solutions to Engineering Problems

Science and Engineering Practices

- Developing and Using Models
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Analyzing and Interpreting Data

Crosscutting Concepts

- Patterns
- Cause and Effect

Important Terms Related to Science Instruction

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

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

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

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

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

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

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

The 5E Instructional Model

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

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

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

Incorporating Phenomena

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

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

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

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

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

Anchoring phenomenon videos kick off each unit

The Engineering Cycle

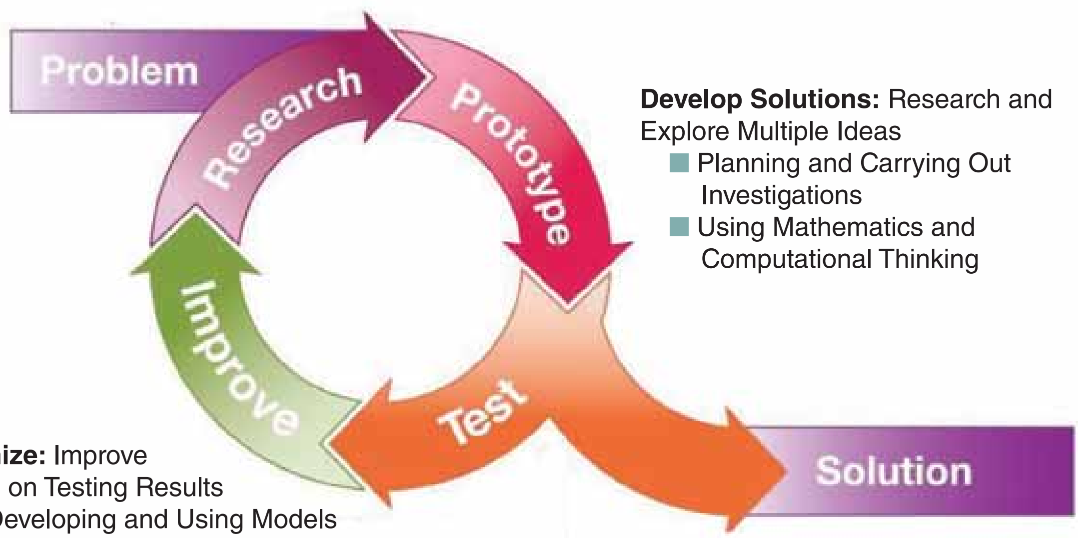
Building Blocks of Science incorporates an engineering design process to support the engineering, technology, and application of science (ETS) core idea outlined in the National Research Council's "A Framework for K–12 Science Education" (NRC, 2012, pp. 201–202). This ETS core idea has been brought into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

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

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

Engineering Design Process

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



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

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

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

Sensemaking: Developing Claims Supported with Evidence and Reasoning

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

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

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

Science Notebooks

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

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

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

Take-Home Science Activities

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

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

Assessment

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

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

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

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

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

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

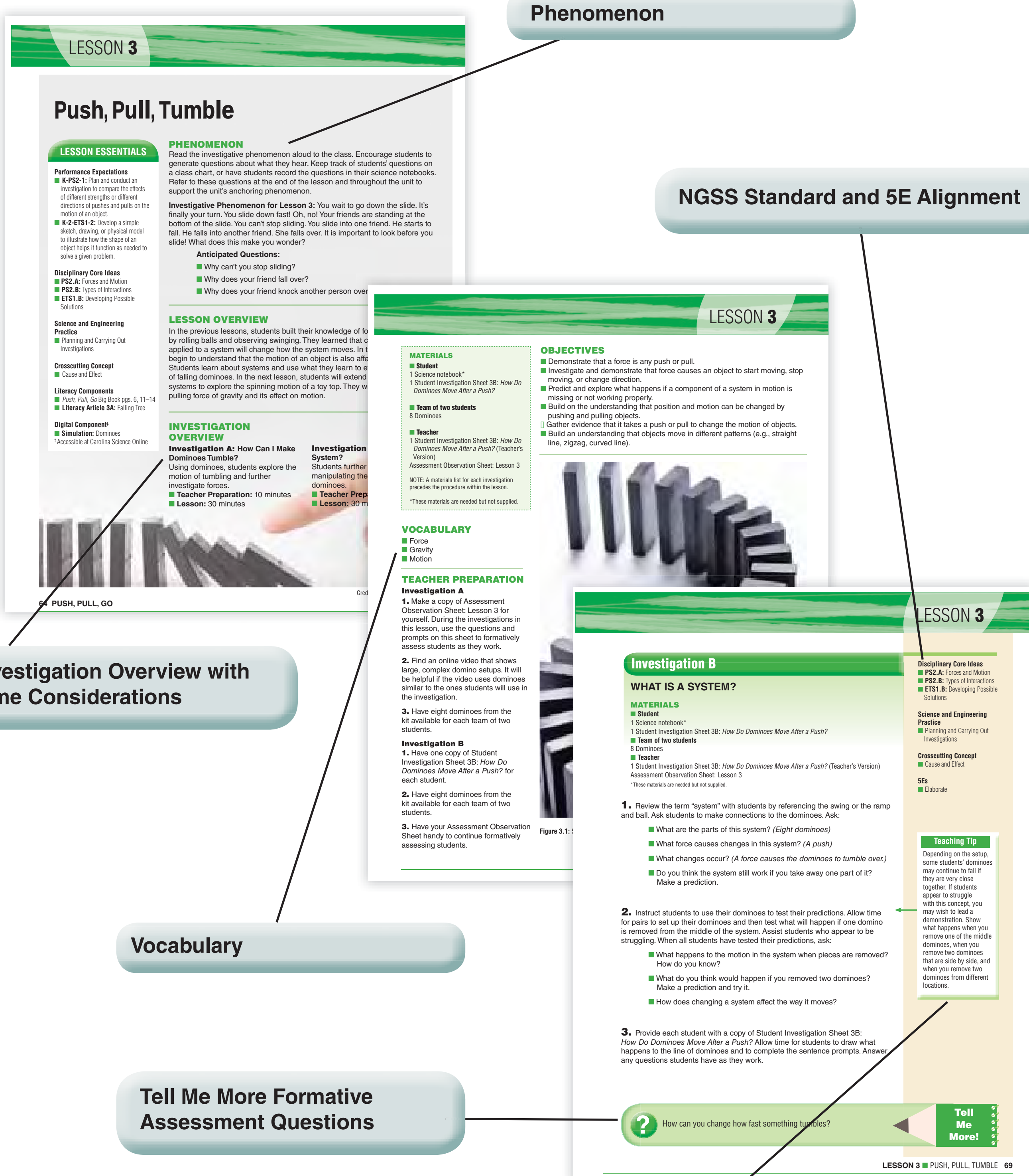
Additionally, there is a second end-of-unit assessment accessible only online. This digital summative assessment is **scenario-based** and touches upon all the standards from the unit. It includes both close-ended and open-ended questions.

Building Blocks of Science 3D—The Total Package

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

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

Navigating the Teacher's Guide



Phenomenon

NGSS Standard and 5E Alignment

Investigation Overview with Time Considerations

Vocabulary

Tell Me More Formative Assessment Questions

Teacher Tips and Differentiation Strategies

Extensions

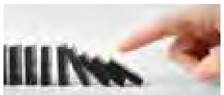
LESSON **3**

EXTENSIONS

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

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

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



Credit: Africa Studio/Shutterstock.com

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

ASSESSMENT STRATEGIES

1. Investigation A

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

2. Investigation B

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

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

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

Additional Features

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

Assessment Strategies

Literacy Article 3A

Name: ____________ Date: ______

Falling Tree

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

It rained hard. The wind blew.

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

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

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

Credit: Patrycja

Literacy Articles

Take-Home Science Activities

Student Investigation Sheet 3B: How Do Domin

Name: ____________ D

This is a line that moves.

Dominoes ____________.

A push ____________.

© Carolina Biological Supply Company Student Investigation Sheet 3B

Student Investigation Sheets

Take-Home Science

Dear Family,

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

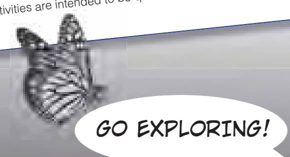
Take-Home Science is an exciting part of our program because it's one way we can better connect home and school. With everyone working together, we can reinforce the science concepts that your student is exploring in the classroom. Here's how Take-Home Science works.

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

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

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

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



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Building Blocks OF SCIENCE™ | 3D

Every unit anchored in phenomena

Changing Earth

Unit Overview

Earth is made up of mountain ranges, lakes, volcanoes, rivers, canyons, and many other landforms and waterways, all of which are continually changing. Most of these changes are not noticeable in a single lifetime; for example, it takes rivers thousands—even millions—of years to form canyons. Other changes are more drastic and immediate, such as those resulting from an earthquake or a volcanic eruption. *Changing Earth* provides hands-on, inquiry based investigations that focus on phenomena related to the history of Earth and its landforms. Through a series of six lesson, students learn about tectonic plates, make connections to the rock cycle, model erosion using stream tables, and consider how Earth's changes can impact on human activity.

Unit Anchoring Phenomenon

Our Earth is constantly changing; however, it occurs at a very slow rate. Changes to landforms or evidence of erosion may not be noticeable in a year or even a lifetime, but we can find evidence of past changes to predict future changes. The anchoring phenomenon for *Changing Earth* is identifying geological events and structures to explain the history of Earth.

	LESSON 1	LESSON 2
INVESTIGATIVE PHENOMENA	Throughout history, the west coast of the United States has experienced many earthquakes. In 1980, a strong earthquake occurred and led to the volcanic eruption of Mount St. Helens in Washington. The earthquake also caused a massive avalanche. What does this make you wonder?	Whether building a skyscraper, a home, or a sand castle, most structures require a deep hole for a foundation. As you dig this hole, you might notice that the color of the soil, sand, or clay changes as you dig deeper. When you're finished digging out your foundation, it has become evident that the land has a layered pattern. What does this make you wonder?
OBJECTIVES	■ Construct a model of three layers of Earth. ■ Assemble a map of Earth's tectonic plates and make predictions about the effects of their movement. ■ Recognize patterns within the Ring of Fire to draw conclusions about volcanic activity and earthquakes.	■ Compare the characteristics of different types of rocks. ■ Use a model to simulate the rock cycle. ■ Classify rocks by the way they are formed. ■ Research different types of rocks and make connections between their characteristics and where they are found.
SCAFFOLDING Students should know:	↓ Earth is composed of three layers: crust, mantle, and core. ↓ The mantle is made of liquid rock (magma), which convects and results in movement of the crust. ↓ Volcanic activity and earthquakes are common along the boundaries between tectonic plates. ↓ The movement of tectonic plates can cause magma to rise from Earth's mantle and flow from volcanoes as lava.	↓ Lava that flows from volcanoes can cool and form rock. ↓ There are three types of rocks: igneous, metamorphic, and sedimentary. ↓ Each type of rock is formed differently, and rocks can change into different types depending on the conditions to which they are exposed. ↓ We can examine patterns in rocks to learn about Earth's history and landforms. ↓ Humans use rocks in multiple applications.

Concepts build from one lesson to the next

LESSON 3	LESSON 4	LESSON 5	LESSON 6
If you drive through hills or mountain ranges, you might notice warning signs about rockslides, landslides or mudslides. It is particularly important to exercise caution around these regions during periods of high rainfall. In fact, some national parks might even close roads. What does this make you wonder?	When examining a map of the United States, you might notice shading in different regions. Thin blue lines are scattered throughout the map. Some of these lines are wavy; some are straight. Some maps, like globes, are three-dimensional. They might even have textures or appear raised in different areas. What does this make you wonder?	Paleontologists search all over the world for fossils. Most fossils are found in regions that used to be covered in water. As paleontologists dig, they tend to find fossils of water-dwelling organisms. What does this make you wonder?	One year in North Carolina, scientists found that many ponds and streams were very unhealthy, causing many of the plants and animals that lived in those areas to die. This was observed after a summer with a lot rainfall. The unhealthy ponds and streams were all near farms. What does this make you wonder?
■ Differentiate between weathering and erosion. ■ Make a connection between water erosion and the rock cycle. ■ Use a water table to simulate how water erosion creates landforms. ■ Make predictions about the structures of Earth based on the locations of rivers and streams.	■ Use different maps to draw conclusions about the impact of water erosion on landforms. ■ Determine the importance of maps in exploring the history of Earth. ■ Develop maps of river systems to identify patterns of movement.	■ Model deposition using a stream table to explain how sedimentary rock forms. ■ Simulate fossil formation by creating layers of sediment in the stream table. ■ Estimate the relative ages of rock layers based on the fossils found within them.	■ Describe soil erosion and predict its impact on humans. ■ Develop a solution for soil erosion and use the stream table to test the model. ■ Analyze results to determine the effectiveness of models to prevent soil erosion and make connections to real-life solutions to scientific problems.
↓ Sediment forms from rock as a result of weathering and erosion. ↓ Water, ice, wind, and gravity can cause rock to break down into smaller pieces. ↓ Landforms, such as valleys, canyons, and deltas, are formed by the process of erosion. ↓ The presence of vegetation and the speed of water impacts the rate of erosion and the formation of sediment.	↓ Maps can be used to observe patterns of erosion and weathering on Earth. ↓ Geologists use maps as tools to describe the history of Earth. ↓ River systems are responsible for shaping many of Earth's landforms. ↓ The flow of water, related to speed and elevation, affects erosion.	↓ Erosion moves sediment and eventually deposits it (deposition). ↓ Deposited sediment can form in layers and harden, forming sedimentary rock. ↓ Layers of rock form over time, and scientists use these layers to estimate the relative age of Earth. ↓ Fossils form in sedimentary rock and are exposed after erosion. ↓ We can learn about Earth's history using fossils and rock layers.	↓ Soil erosion changes the shape of the land and can have negative effects on human activities. ↓ To prevent soil erosion, scientists have developed solutions to limit the breakdown of sediment as water moves through an area. ↓ Soil erosion can be prevented by directing water through a specific path and preventing it from overflowing onto land.

NGSS correlations by lesson

Lesson 2: Rock Formations and Patterns

<table>
<tr><th>Investigation Overview</th><th>Standards</th><th>Resources</th></tr>
<tr>
<td>

Investigation A: What's Your Type?
5Es: Explore
Students use a Rock Study Kit to make observations and then record their data in a table.
■ **Teacher Preparation:** 5 minutes
■ **Lesson:** 30 minutes
Tell Me More! Where would you expect to find igneous rock? Sedimentary rock? Metamorphic rock?

Investigation B: What Is the Rock Cycle?
5Es: Explore, Explain, Elaborate
Students examine the rock cycle by completing a flow chart and creating a model using crayon shavings.
■ **Teacher Preparation:** 10 minutes
■ **Lesson:** 30–45 minutes
Tell Me More! How can metamorphic rock form from igneous rock?

Investigation C: How Do We Use Different Types of Rocks?
5Es: Elaborate
Students choose a rock from the Rock Study Kit and conduct research to develop a flyer about their rock.
■ **Teacher Preparation:** 5 minutes
■ **Lesson:** 90–120 minutes
Tell Me More! Wind can help form sedimentary rock. Explain how.

</td>
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Next Generation Science Standards Performance Expectations
■ **4-ESS1-1:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
■ **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.

Disciplinary Core Ideas
■ **ESS1.C:** The History of Planet Earth
■ **ESS2.A:** Earth Materials and Systems
■ **ESS2.B:** Plate Tectonics and Large-Scale System Interactions

Science and Engineering Practices
■ Developing and Using Models
■ Constructing Explanations and Designing Solutions
■ Analyzing and Interpreting Data

Crosscutting Concepts
■ Patterns
■ Cause and Effect

Language Arts and Math Standards
Language Arts
■ **L.4.6:** Vocabulary Acquisition and Use
■ **RI.4.3:** Key Ideas and Details
■ **RI.4.5:** Craft and Structure
■ **RI.4.7:** Integration of Knowledge and Ideas
■ **RI.4.9:** Integration of Knowledge and Ideas
■ **RL.4.4:** Craft and Structure
■ **SL.4.1:** Comprehension and Collaboration
■ **W.4.1:** Text Type and Purposes
■ **W.4.2:** Text Type and Purposes

Math
■ **4.NF.B.3.A:** Building fractions from unit fractions.

</td>
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Student Investigation Sheets
■ Student Investigation Sheet 2A: *What Types of Rocks Exist?*
■ Student Investigation Sheet 2B: *What Is the Rock Cycle?*
■ Student Investigation Sheet 2C: *Will I Rock at Research?*

Literacy Components
■ *Changing Earth* Literacy Reader, pgs. 16–21
■ Literacy Article 2A: Cool Rocks

Digital Components
■ Simulation: Formation of Rock Types
■ Simulation: Rock Cycle

Vocabulary
■ Igneous rock
■ Lava
■ Metamorphic rock
■ Sediment
■ Sedimentary rock

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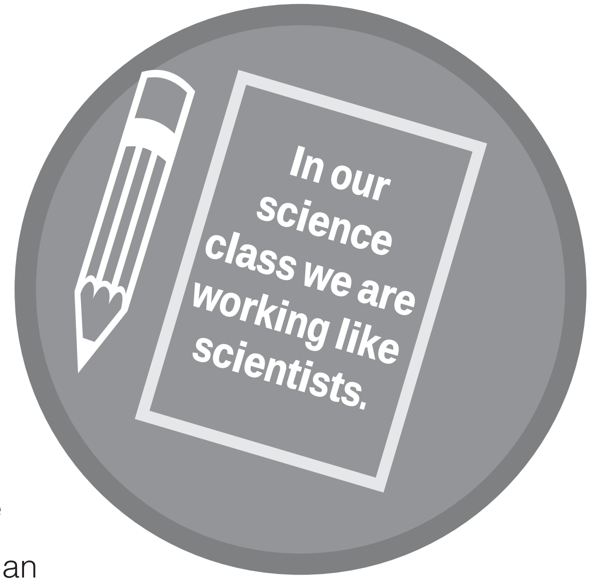
30-minute investigations fit into your busy day

Integrated ELA and math

Safety Contract



In science class, I will:

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

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

Student's signature ______________________________

Date ______________________________

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

Parent/Guardian's signature ______________________________

Date ______________________________

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

All lessons are anchored in phenomena

Rock Formations and Patterns

LESSON ESSENTIALS

Performance Expectations
- **4-ESS1-1:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.

Disciplinary Core Ideas
- **ESS1.C:** The History of Planet Earth
- **ESS2.A:** Earth Materials and Systems
- **ESS2.B:** Plate Tectonics and Large-Scale System Interactions

Science and Engineering Practices
- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Analyzing and Interpreting Data

Crosscutting Concepts
- Patterns
- Cause and Effect

Literacy Components
- *Changing Earth* Literacy Reader, pgs. 16–21
- **Literacy Article 2A:** Cool Rocks

Digital Components‡
- **Simulation:** Formation of Rock Types
- **Simulation:** Rock Cycle

‡ Accessible at Carolina Science Online

PHENOMENON

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

Investigative Phenomenon for Lesson 2: Whether building a skyscraper, a home, or a sand castle, most structures require a deep hole for a foundation. As you dig this hole, you might notice that the color of the soil, sand, or clay changes as you dig deeper. When you're finished digging out your foundation, it has become evident that the land has a layered pattern. What does this make you wonder?

Anticipated Questions:
- What causes the layers of sand, soil, or clay to form?
- Why are the layers different colors?
- Are there differences between soil, sand, and clay?

LESSON OVERVIEW

In the previous lesson, students examined Earth's layers and tectonic plates. Students made connections between the locations of the plates and events like earthquakes and volcanic eruptions. In this lesson, students apply what they have learned about Earth's moving plates to the formation of rocks during the rock cycle. Students observe samples from a Rock Study Kit and learn about the three types of rocks: igneous, metamorphic, and sedimentary. Students simulate the rock cycle using crayons and construct a flow chart to describe the process. At the end of the lesson, students choose one rock from the Rock Study Kit to research and develop a flyer about to share with the class. In their research, students make observations about where their selected rock type is typically formed. In the next lesson, students will think about how erosion and weathering shape Earth's crust and use a steam table to model these processes.

INVESTIGATION OVERVIEW

Investigation A: What's Your Type?
Students use a Rock Study Kit to make observations and then record their data in a table.
- **Teacher Preparation:** 5 minutes
- **Lesson:** 30 minutes

Investigation B: What Is the Rock Cycle?
Students examine the rock cycle by completing a flow chart and creating a model using crayon shavings.
- **Teacher Preparation:** 10 minutes
- **Lesson:** 30–45 minutes

Investigation C: How Do We Use Different Types of Rocks?
Students choose a rock from the Rock Study Kit and conduct research to develop a flyer about their rock.
- **Teacher Preparation:** 5 minutes
- **Lesson:** 90–120 minutes

Credit: sirtravelalot/Shutterstock.com

MATERIALS

Student

1 Science notebook*
1 Student Investigation Sheet 2A: *What Types of Rocks Exist?*
1 Student Investigation Sheet 2B: *What Is the Rock Cycle?*
1 Student Investigation Sheet 2C: *Will I Rock at Research?*

Team of four students

4 Different color crayons*
1 Pair of scissors*
1 Piece of aluminum foil, 5 x 5 inches*
1 Plastic bowl
1 Plastic knife
1 Rock Study Kit
Glue or tape*
Hot water*

Class

Art supplies*
Internet access and/or research materials related to rocks*

Teacher

1 Student Investigation Sheet 2B: *What Is the Rock Cycle?* (Teacher's Version)
1 Gneiss rock (sample #14 in Rock Study Kit)
1 Granite rock (sample #2 in Rock Study Kit)
1 Hot pot or thermos*
1 Pair of scissors*
1 Roll of aluminum foil
1 Sandstone rock (sample #8 in Rock Study Kit)
Tape*
Water*

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

*These materials are needed but not supplied.

OBJECTIVES

- Compare the characteristics of different types of rocks.
- Use a model to simulate the rock cycle.
- Classify rocks by the way they are formed.
- Research different types of rocks and make connections between their characteristics and where they are found.

VOCABULARY

- Igneous rock
- Lava
- Metamorphic rock
- Sediment
- Sedimentary rock

TEACHER PREPARATION

Investigation A

1. Make one copy of Student Investigation Sheet 2A: *What Types of Rocks Exist?* for each student.

2. Each group of four students will need a Rock Study Kit.

Investigation B

1. For each student, make a copy of Student Investigation Sheet 2B: *What Is the Rock Cycle?*

2. Cut one 5-inch x 5-inch square of aluminum foil for each group of four students.

3. Each group will need four different-color crayons to shave for a rock cycle simulation. It is recommended to use colors commonly found in rocks, such as black, brown, red, white, grey, orange, and yellow.

4. Each group of four students will need a piece of foil, a plastic bowl, and a plastic knife.

5. Have about 400 mL of hot water available to fill each group's bowl about halfway (25 mL) two times. Bring hot water to class in a thermos, or you can heat water in a hot pot in the classroom. This water will need to be hot enough to melt wax.

6. You will use Figure 2.1 to draw the rock cycle. Have a piece of chart paper or access to a whiteboard and a marker.

Investigation C

1. Make a copy of Student Investigation Sheet 2C: *Will I Rock at Research?* for each student.

2. Have a Rock Study Kit available for each group.

3. Provide literature, data, and Internet access for students to learn more about their selected rocks. Make arrangements with your school's library technology center to have these resources available. Plan to allow 1–2 class sessions for students to conduct research.

4. Have available art supplies to create a flyer. Consider providing construction paper, markers, and colored pencils.

5. Have tape available to display the flyers around the classroom.

Just-in-time background information

BACKGROUND INFORMATION

Rocks compose Earth's crust and are continuously changing from one form to another as Earth's forces bring them to the surface and cycle them back into the mantle. There are three types of rocks: igneous, sedimentary, and metamorphic. Each type of rock can be changed into either of the other two types of rock (and even into a different form of the same type of rock) as a result of the rock cycle.

- **Igneous rocks** are formed when melted rock cools. The melted rock is called magma if it is inside Earth; it is called **lava** if it is above Earth's surface.
- On Earth's surface, rocks are eroded into **sediment** that is then carried away and deposited, compacted, and cemented to eventually form **sedimentary rock**.
- As rock is squeezed and heated by the forces of the moving plates, it deforms and can become a new type of rock called **metamorphic rock**. Usually, metamorphic rock is found deep within Earth, as it tends to be close the mantle. However, some metamorphic rock is found in lakes or mountains, providing evidence in changes of Earth's surface over time.

Apart from providing insight about Earth's history, rocks have many functions. Humans use rocks for the construction of structures, like buildings or fireplaces, or objects, like jewelry and makeup. Each type of rock has unique characteristics that help determine its applications. For example, some rocks are soft and can be easily broken down for use in medicines. Other types of rocks are very hard and difficult to scratch, making them beneficial for countertops.

Investigation A

3-dimensional learning

WHAT'S YOUR TYPE?

MATERIALS

- **Student**

1 Science notebook*
1 Student Investigation Sheet 2A: *What Types of Rocks Exist?*

- **Team of four students**

1 Rock Study Kit

1. Prompt students to think about how rocks form. Ask:

- When a volcano erupts, the magma from the mantle is released as liquid lava. This lava flows down the sides of the volcano. What happens to this lava over time? *(The lava will eventually cool and become solid rock.)*

Explain that hot lava cools to form igneous rock, one of the three rock types.

2. Clarify that there are three types of rocks: igneous, metamorphic, and sedimentary. Introduce the investigation by displaying one Rock Study Kit and explaining that students will make observations of and comparisons between the different rocks.

3. Distribute a copy of Student Investigation Sheet 2A: *What Types of Rocks Exist?* to each student. Briefly review the investigation sheet, and explain that students will fill in the color and texture columns for each rock.

4. Divide the class into groups of four students, and provide a Rock Study Kit to each group. Draw attention to the numbers on the bottom of each rock sample and explain that these numbers correspond to the numbers in the first column of the chart on Student Investigation Sheet 2A.

5. Allow time for students to observe each rock in the kit and fill in the chart on the investigation sheet.

6. After students have completed the table, facilitate a class discussion about what students observed using the following questions:

- Do you notice any patterns between rock type and color or texture? *(Answers will vary. Listen for students to make connections between a rock type and its appearance.)*

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

Science and Engineering Practice
- Analyzing and Interpreting Data

Crosscutting Concept
- Patterns

5Es
- Explore

Literacy Components
- *Changing Earth* Literacy Reader, pgs. 16–19
- **Literacy Article 2A:** Cool Rocks

Digital Component
- **Simulation:** Formation of Rock Types

ELA connection SL.4.1

ELA connection
RI.4.3, RI.4.5, L.4.6, RL.4.4, SL.4.1

Literacy Tip

Ask students to read Literacy Article 2A: Cool Rocks as a review of the different rock types.

Digital Tip

Use the Formation of Rock Types simulation to introduce the rock cycle and describe how each rock type is formed.

Digital simulations to enrich concepts

- We know that igneous rock is formed by cooling lava or magma. Does the appearance of these rocks suggest they were once hot liquid? *(Answers will vary. Students may cite the dark color of obsidian, scoria, and basalt as evidence of this.)*

- Based on the appearance of the sedimentary and metamorphic rocks, can you make a prediction about how they are formed? *(Answers will vary. Students might suggest that sedimentary rocks are formed by many smaller pieces coming together in some way, or that metamorphic rock appears to form in layers.)*

7. After students have shared their ideas, introduce the rock cycle. Explain that students will further investigate the rock cycle in the next investigation.

- Igneous rock: formed from cooling magma from the mantle or from cooling lava from a volcanic eruption.
- Metamorphic rock: formed when rock is buried and experiences a great deal of heat and pressure over time.
- Sedimentary rock: formed when rock breaks down into smaller pieces, called sediment, which compacts into layers.

Tell Me More!

Where would you expect to find igneous rock? Sedimentary rock? Metamorphic rock?

NOTES

Investigation B

WHAT IS THE ROCK CYCLE?

MATERIALS

Student

1 Science notebook*
1 Student Investigation Sheet 2B: *What Is the Rock Cycle?*

Team of four students

4 Different color crayons*
1 Pair of scissors*
1 Piece of aluminum foil, 5 x 5 inches
1 Plastic bowl
1 Plastic knife
Hot water*

Teacher

1 Student Investigation Sheet 2B: *What Is the Rock Cycle?* (Teacher's Version)
1 Gneiss rock (sample #14 in Rock Study Kit)
1 Granite rock (sample #2 in Rock Study Kit)
1 Hot pot or thermos*
1 Pair of scissors*
1 Roll of aluminum foil
1 Sandstone rock (sample #8 in Rock Study Kit)
Chart paper or whiteboard*
Marker*
Water*

* These materials are needed but not supplied.

1. Facilitate a brief review about the rock types and how each is formed. Ask:

- What are the characteristics of igneous rocks? *(Answers will vary.)*
- How are igneous rocks formed? *(Igneous rocks are formed when liquid rock [lava or magma] cools.)*
- What are the characteristics of metamorphic rocks? *(Answers will vary.)*
- How is metamorphic rock formed? *(Metamorphic rock is formed when rock is buried and experiences heat and pressure over a long period of time.)*
- What are the characteristics of sedimentary rocks? *(Answers will vary.)*
- How is sedimentary rock formed? *(Sedimentary rock is formed when rock breaks down into smaller pieces and compacts into layers.)*

2. Display the gneiss (metamorphic), sandstone (sedimentary), and granite (igneous) rocks from the Rock Study Kit. Tell students what type of rock each of the samples is.

3. Discuss the rock cycle. Remind students that rocks cycle through all three types due to the heating, cooling, pressure, erosion, and weathering that occur in and on Earth. Explain that a rock can cycle from one type to another.

Disciplinary Core Ideas

- **ESS1.C:** The History of Planet Earth
- **ESS2.A:** Earth Materials and Systems

Science and Engineering Practices

- Developing and Using Models
- Analyzing and Interpreting Data

Crosscutting Concepts

- Patterns
- Cause and Effect

5Es

- Explore
- Explain
- Elaborate

Literacy Component

- *Changing Earth* Literacy Reader, pgs. 20–21

Digital Component

- **Simulation:** Rock Cycle

ELA connection RI.4.6, RI.4.5, RI.4.7, L.4.6, RL.4.4

Digital Tip

Use the Rock Cycle simulation to support the introduction of this process.

Digital simulations to enrich concepts

ELA connection SL.4.1

4. Divide the class into groups of four students. Ask each of the following questions one at a time. After you ask each question, allow time for students to briefly discuss their ideas with their group members, and then discuss students' ideas as a class. During the discussion, develop a diagram like Figure 2.1 on the board. After all the questions have been discussed and the diagram is complete, instruct students to copy the diagram into their science notebooks.

- Gneiss (metamorphic) can turn into granite (igneous). What needs to happen for this to occur? *(The gneiss must melt into liquid magma and eventually cool to form granite.)*
- Granite (igneous) on Earth's surface can turn into sandstone (sedimentary). What needs to happen for this to occur? *(The granite must be broken down into smaller pieces through erosion or weathering and then compacted to form sandstone.)*
- Sandstone (sedimentary) can turn into gneiss (metamorphic). What needs to happen for this to occur? *(The sandstone must experience heat and pressure over time to change into gneiss.)*
- Why do we call this process the "rock cycle"? *(Rocks can change from one type to another and back again, or cycle through each type, depending on the conditions.)*

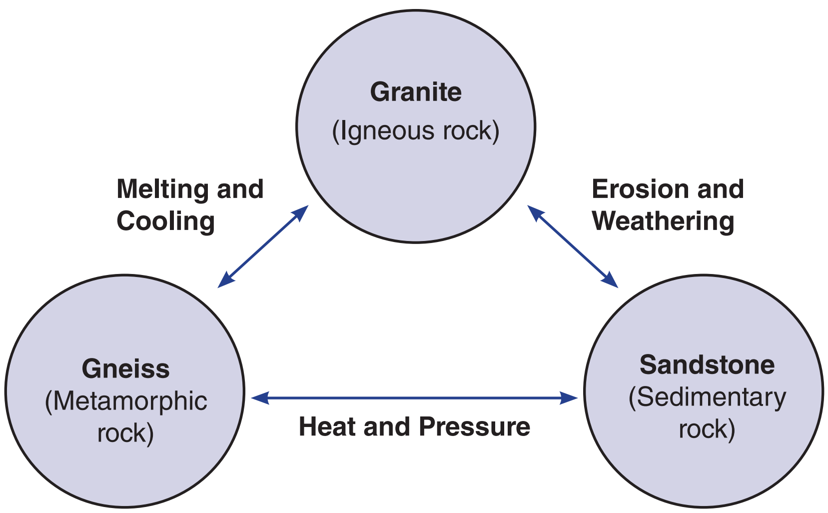


Figure 2.1: The rock cycle

5. Distribute a square of aluminum foil, a plastic knife, a plastic bowl, and four different-color crayons to each group.

Teaching Tip

As an option, obtain a set of materials for yourself so you can model steps of the procedure throughout the investigation.

6. Model how to use the knife to shave wax off a crayon onto the center of a square of foil. Direct students to take turns shaving crayons onto the foil until they have a small pile of wax about the size of a quarter.

7. Guide students to make connections between the crayon shavings and rocks. Ask:

- Imagine the crayon is the side of a mountain or volcano. What does shaving the crayon simulate, or represent? *(Shaving the crayon represents the creation of sediment by weathering.)*
- Little particles that crumble off the side of a mountain or volcano are called sediment. What structures are these shavings similar to in nature? *(Sand, pebbles, or dirt)*

8. Instruct students to condense their pile of crayon shavings (sediment) in the middle of one half of the foil square. Instruct them to fold the opposite side of the foil over on top of the shavings and press down on the pile as hard as they can. Each student in the group should get an opportunity to press down on the foil to ensure that the shavings become compacted.

9. Have students unwrap the foil and observe what happened. Ask:

- What did you simulate by pressing down firmly on the crayon shavings? *(Students should realize that pushing on the crayon "sediment" simulated how rock sediment is cemented together due to pressure from within Earth.)*
- What rock type have you created? *(Sedimentary rock)*

Teaching Tip

This "sedimentary rock" of crayon shavings will be delicate but should stay packed together in layers.

Tips for teaching in every lesson

10. Instruct students to form the aluminum foil square into a "boat." Tell them that the bottom of the boat must be a single layer of foil to allow the heat from the water to pass through. Instruct students to place their crayon rock inside the boat. While students prepare their boats, pour hot water halfway into each group's bowl.

Safety Tip
Tell students to exercise caution when handling hot water. Students should handle the aluminum foil and avoid contact with the water.

11. Instruct students to place the foil boat with their sedimentary rock in the hot water and observe what happens. When students notice the wax beginning to soften and swirl together, direct students to remove the boat from the water. They should fold the foil and squeeze the soft wax together. Caution students to avoid touching the wax directly. Ask:

- How did the crayon wax compare before and after heating? *(The colors are the same, but the new rock has a different shape and consistency.)*
- What have you simulated by heating and pressing the crayon wax? *(Students should realize that they simulated the heat and pressure that rock experiences within Earth that causes rocks to soften and change shape.)*
- Which rock type have you created? *(Metamorphic rock)*

Teaching Tip

Make sure students do not let the wax blend and make the individual colors indistinguishable. This is important because it will help students recognize the distinction between metamorphic and igneous rock.

12. Instruct students to dispose of the water in their bowls. Refill each group's bowl with fresh hot water. Instruct students to put the crayon rock back in the foil boat in the hot water and to keep it there until the crayon has completely melted and the colors have blended. Ask:

- How did the crayon wax change during this second stage of heating? *(The colors blended more, and the wax became liquid.)*
- What have you simulated by heating the wax again? *(The metamorphic rock melted due to the heat of the mantle.)*
- Remove the aluminum boat from the water. In time, the crayon wax will cool. What rock type will be created? *(Igneous rock.)*

ELA connection SL.4.1

13. Distribute a copy of Student Investigation Sheet 2B: *What Is the Rock Cycle?* to each student. Review the directions with the class, and instruct students to complete the flow chart using their experience with the crayon rock cycle to support their answers. Allow time for students to work individually or with their group members.

Teaching Tip

Make sure students understand that the rock cycle goes both ways—that is, that any rock can become any other type of rock if exposed to the right conditions.

14. Have students share their completed diagrams from the investigation sheet with the class to gauge students' understanding and address any misconceptions.

Tell Me More!

How can metamorphic rock form from igneous rock?

Formative assessment

NOTES

Investigation C

HOW DO WE USE DIFFERENT TYPES OF ROCKS?

MATERIALS

- **Student**

1 Science notebook*
1 Student Investigation Sheet 2C: *Will I Rock at Research?*

- **Team of four students**

1 Rock Study Kit

- **Class**

Internet access and/or research materials related to rocks*
Art supplies*

- **Teacher**

Tape*

* These materials are needed but not supplied.

1. Distribute a Rock Study Kit to each group. Provide a few minutes for students to observe the rock samples and choose a rock they find interesting and would like to research.

2. Distribute a copy of Student Investigation Sheet 2C: *Will I Rock at Research?* to each student. Read the directions on the investigation sheet aloud to the class. Explain that students will independently conduct research to learn about the rock they selected. Discuss the requirements of the project and allow students to ask questions.

3. Allow ample time for students to conduct their research and produce their informational flyer. Provide research materials and art supplies for the class to share. Depending on the resources and time allotted, students may need up to two class sessions to complete their research and develop their flyers.

4. When all students have completed their research, provide tape for students to hang their flyers around the classroom.

5. Instruct students to rotate around the classroom and analyze their classmates' flyers in their science notebooks. Students should record the following:

- The rock name and type
- Where it is found
- An interesting fact about the rock

Allow students to spend 1–2 minutes at each flyer.

Disciplinary Core Ideas
- **ESS1.C:** The History of Planet Earth
- **ESS2.A:** Earth Materials and Systems
- **ESS2.B:** Plate Tectonics and Large-Scale System Interactions

Science and Engineering Practices
- Constructing Explanations and Designing Solutions
- Analyzing and Interpreting Data

Crosscutting Concept
- Patterns

5Es
- Elaborate

Teaching Tip

Encourage students to investigate different rocks. You might choose to assign each student a sample.

ELA connection
RI.4.9, RL.4.4

6. Once students have viewed all the flyers, gather the class together. Ask students to share what they learned from this investigation. Challenge students to describe patterns they observed on the maps on the flyers. Draw connections between the locations of Earth's plates and locations in which specific types of rock are commonly found. For example, igneous rocks are commonly found near volcanoes.

Teaching Tip

This series of questions guides students to make a claim supported with evidence and reasoning. For further information about this practice, see "Sensemaking: Developing Claims Supported with Evidence and Reasoning" in the front of this Teacher's Guide.

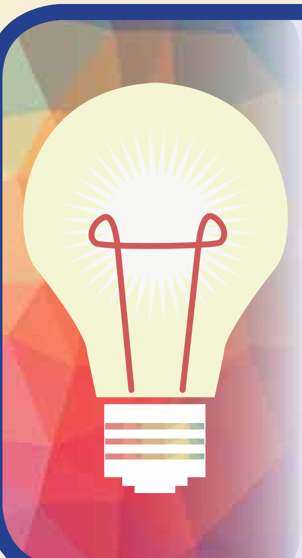
7. Help students summarize what they learned from their research. Ask:

- How can studying rocks reveal information about Earth? *(Answers will vary, but students should explain that rocks can provide information about what landforms have existed in a location in the past.)*
- What rock evidence can we use to support the idea that Earth is very old? *(Answers will vary. Examples include fossils or deep layers of rock.)*
- Why do we depend on rocks? *(Answers will vary. Students are likely to suggest the uses cited in the flyers.)*

Tell Me More!

Wind can help form sedimentary rock. Explain how.

Connecting ideas about phenomena to evidence



Phenomenon

Review students' questions about the investigative phenomenon from the beginning of this lesson. Guide students in applying the concepts explored in this lesson and connecting them to the anchoring phenomenon: identifying geological events and structures to explain the history of Earth. By the end of the lesson, students should be able to explain that:

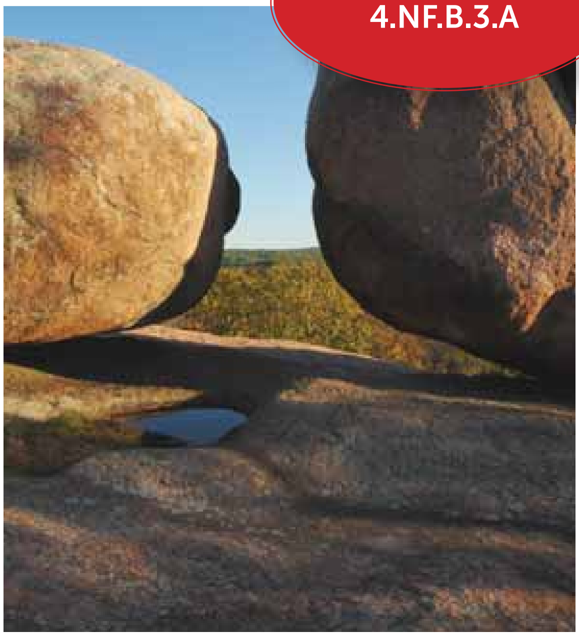
- Earth's crust is made of rocks that have formed over time from the buildup of sediment. This creates a layering pattern.
- Each layer of Earth's crust may be composed of a different type of rock: igneous, sedimentary, or metamorphic.
- The crust in different regions of Earth is made of different kinds of rocks. For example, regions with volcanoes may have crust that contains more igneous rock.

EXTENSIONS

Mountain Math
Challenge students with the following word problem:

- Mount Rock Cycle is made up of three different types of rock. Two-thirds of the mountain is metamorphic rock and one-twelfth is sedimentary rock. What fraction of Mount Rock Cycle is igneous rock? *(One-fourth)*

Math connection
4.NF.B.3.A



Credit: Rusty Dodson/Shutterstock.com

Between a Rock and a Hard Place
An idiom is a phrase that should not be taken in the literal sense but has a meaning of its own, often completely unrelated to the meanings of its individual words. For example, the idiom "A rolling stone gathers no moss" is a phrase that originally meant that people who do not stay in one place will not prosper because a rolling stone does not have time to grow moss if it is moving. In recent times, the same idiom has come to have the opposite meaning—that a person with ambition is more successful than a person not trying to achieve anything. In this understanding, the moss would be slowing the progress of the stone. Invite students to make up an idiom for how it is important it is to work hard and have ambitions using words about landforms.

ASSESSMENT STRATEGIES

1. Investigation A

- Review Student Investigation Sheet 2A: *What Types of Rocks Exist?* to make sure that students have accurately described each rock type.
- Use students' responses to the Tell Me More question to gauge their ability to make connections between a rock's appearance, how it is formed, and where it might be located. Students should recognize that igneous rock is commonly found near volcanoes, that metamorphic rock is commonly found deep in the ground, and that sedimentary rock is commonly found where sediment is present.

2. Investigation B

- Review Student Investigation Sheet 2B: *What Is the Rock Cycle?* to assess students' understanding of the rock cycle. Make sure they can properly describe the transitions between rock types.
- Use students' responses to the Tell Me More question to check their ability to describe changes in rock types. Students should explain that igneous rock would need to be buried and experience great heat and pressure to become metamorphic rock.

3. Investigation C

- Review students' flyers using to make sure students provided accurate information and met the requirements of the project. Review students' notebooks to assess what they have learned about different rock types.
- Use students' responses to the Tell Me More question as a pre-assessment to determine what they know about erosion and weathering. Students should recognize that wind can break down rock into smaller pieces, forming sediments, and therefore forming sedimentary rock when compacted.

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

PLANNING AHEAD

Students will construct stream tables in Lesson 3. To distribute water to groups, obtain eight 16-oz or 1-L plastic soda bottles. Be sure each bottle has a cap.

Name ___________

Date ___________

ELA connection
RI.4.3, RI.4.5, L.4.6

Cool Rocks

Who knew that rocks could be so cool? They have so many characteristics that it is difficult to find two identical rocks. Rocks can be categorized by weight, size, color, hardness, and mineral composition. They can also be characterized by type: igneous, sedimentary, or metamorphic. However, rocks can change type as they move through the rock cycle. For example, a sedimentary rock that is heated and compacted over time can become a metamorphic rock. Rocks aren't so dull after all!

Igneous rocks form when molten rock hardens. Batholiths are large deposits of igneous rocks. They form when large amounts of magma cool and harden underground. Because the magma cools slowly, the crystals in a batholith are large. Batholiths are huge! The smallest ones cover at least 63 square kilometers (39 square miles). Many cover hundreds or thousands of square kilometers. There is a batholith in Idaho that has a surface area of over 24,945 square kilometers (15,500 square miles)! Batholiths also form the core of the Sierra Nevada. When gold was found in these batholiths in 1849, it caused people to rush into California.

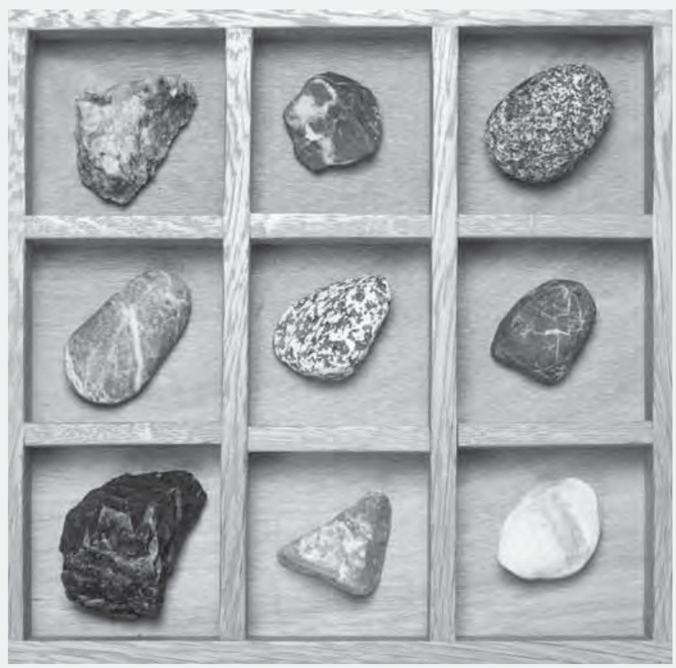
Gold isn't the only precious mineral found in rocks. Some minerals are extremely rare. Tanzanite is one of the rarest minerals on Earth. It can be found only in the African country of Tanzania, near Mount Kilimanjaro. These gemstones were formed when rocks underwent metamorphosis. Tanzanite is usually blue or purple in color, but it can vary in shade. Taaffeite is another rare gem. Only been a handful of these gems have been found in the island nation of Sri Lanka. Taaffeite is so rare that these gems sell for $2,000 a carat.

Questions

1. Igneous rock forms when lava or magma cools. What is the difference between lava and magma?

2. Batholiths are formed underground but eventually reach the surface. How can this happen?

3. Why are precious minerals and gems generally found in rock that forms underground?



Credit: Zigzag Mountain Art/Shutterstock.com

Student Investigation Sheet 2A

What Types of Rocks Exist?

Name ______________________

Date ______________________

ELA connection L.4.6

	Name of Rock	Type of Rock	Color	Texture
1	Obsidian	Igneous		
2	Granite	Igneous		
3	Basalt	Igneous		
4	Scoria	Igneous		
5	Rhyolite	Igneous		
6	Shale	Metamorphic		
7	Gypsum Alabaster	Metamorphic		
8	Sandstone	Metamorphic		
9	Conglomerate	Metamorphic		
10	Limestone	Metamorphic		
11	Slate	Sedimentary		
12	Marble	Sedimentary		
13	Quartzite	Sedimentary		
14	Gneiss	Sedimentary		
15	Schist	Sedimentary		

Student Investigation Sheet 2B

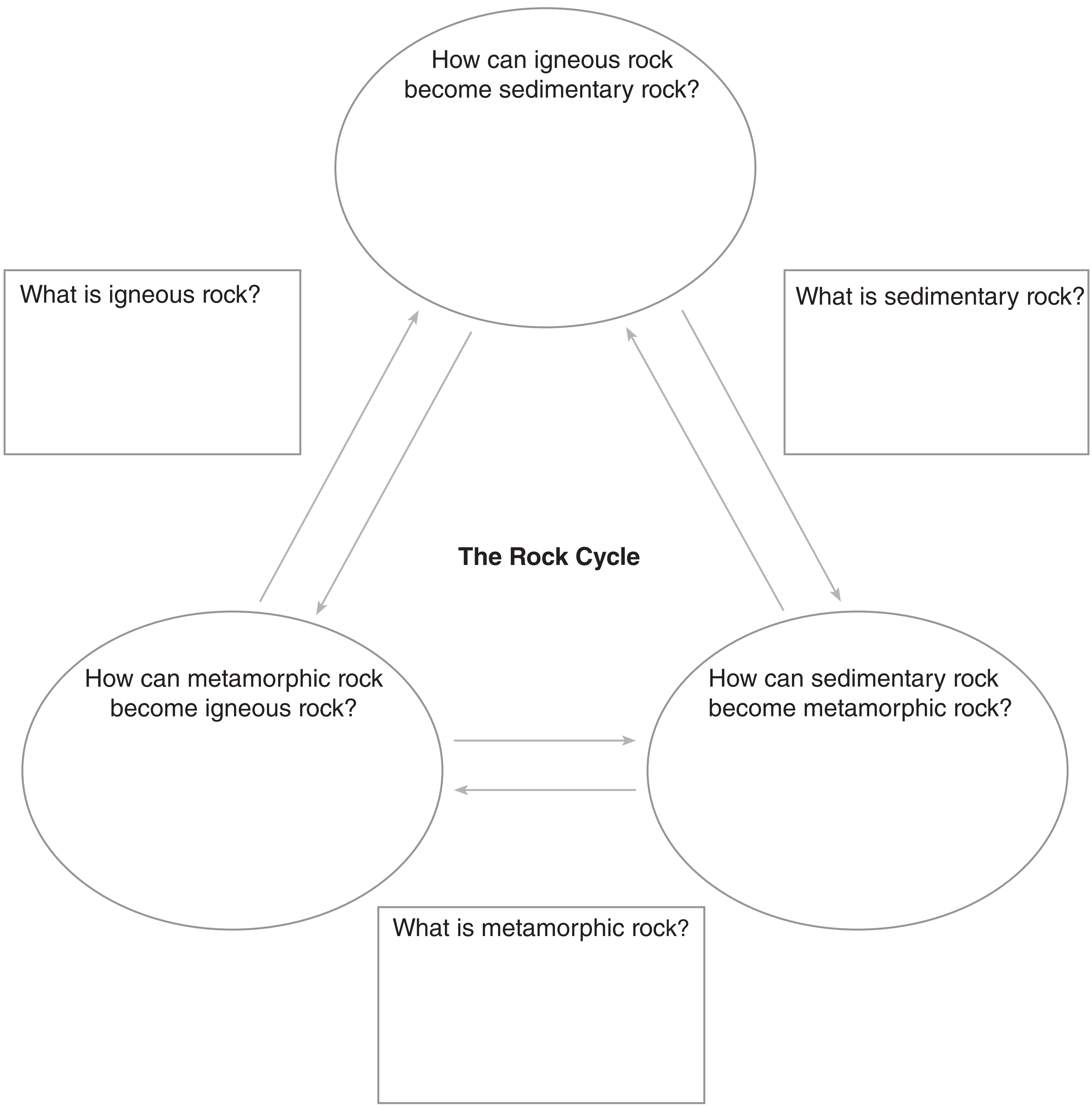
What Is the Rock Cycle?

Name ____________________

Date ____________________

ELA connection
RI.4.3, RI.4.5, RI.4.7, L.4.6

Apply what you have learned about the rock cycle to complete the flow chart below. Fill in the circles by drawing pictures. Fill in the rectangles by writing.



Student Investigation Sheet 2C

Will I Rock at Research?

Name ________________

Date ________________

ELA connection
RI.4.7, RI.4.9, L.4.6, W.4.1

Select a rock that you find interesting from the Rock Study Kit. Use the Internet or printed research materials to find out more about your rock. Use what you find out to design a flyer about your rock to share with the class. Your flyer must include the following information. Use this sheet to take notes as you research.

- Name of rock: ________________
- Type of rock: ________________
- How the rock is formed: ________________
- Unique features of the rock: ________________
- Where on Earth the rock is found (make notes here, but include a hand-drawn or printed map on your flyer): ________________
- What materials the rock is made of: ________________
- What this rock can be used for (how people use this rock): ________________

Cool Rocks

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Questions

1. Igneous rock forms when lava or magma cools. What is the difference between lava and magma? *(Magma is melted rock beneath Earth's surface, and lava is melted rock that has flowed from a volcano onto Earth's surface.)*

2. Batholiths are formed underground but eventually reach the surface. How can this happen? *(Students should realize that the land above the batholith can be weathered and eroded by water, wind, or ice, eventually revealing the batholith at the surface.)*

3. Why are precious minerals and gems generally found in rock that forms underground? *(These rocks form slowly over time as heat changes the rock or magma slowly hardens. It is this time and slow cooling that allow precious minerals and gemstones to form.)*

Credit: Zigzag Mountain Art/Shutterstock.com

Student Investigation Sheet 2B: Teacher's Version

What Is the Rock Cycle?

Apply what you have learned about the rock cycle to complete the flow chart below. Fill in the circles by drawing pictures. Fill in the rectangles by writing.

How can igneous rock become sedimentary rock?
(Igneous rock reaches Earth's surface and is eroded into sediments. Sediments are carried away and deposited, compacted, and cemented.)

What is igneous rock?
(Cooled magma)

What is sedimentary rock?
(Sediments that have been deposited, compacted, and cemented)

The Rock Cycle

How can metamorphic rock become igneous rock?
(Metamorphic rock melts into magma and cools to become igneous rock.)

How can sedimentary rock become metamorphic rock?
(Sedimentary rock experiences heat and pressure from Earth's moving plates.)

What is metamorphic rock?
(Rock that has been squeezed and heated over a long period of time)

Summative Assessment

Name ____________

Date ____________

What have they learned?

1. Earth's inner core is made of iron, which causes ____________.

a. volcanic eruptions
b. tectonic plate movement
c. magnetism
d. convection

Credit: Oscity/Shutterstock.com

2. Half Dome is a granite landform in Yosemite National Park, in California. What caused the flat surface on one side?

a. Tectonic boundaries
b. Lava
c. Weathering
d. Soil erosion

3. A geologist finds a mix of sedimentary and igneous rock at the base of a mountain. What conclusions could she draw from this discovery? ____________

4. How do plants help prevent soil erosion? ____________

NOTES

Building Blocks of Science Student Literacy

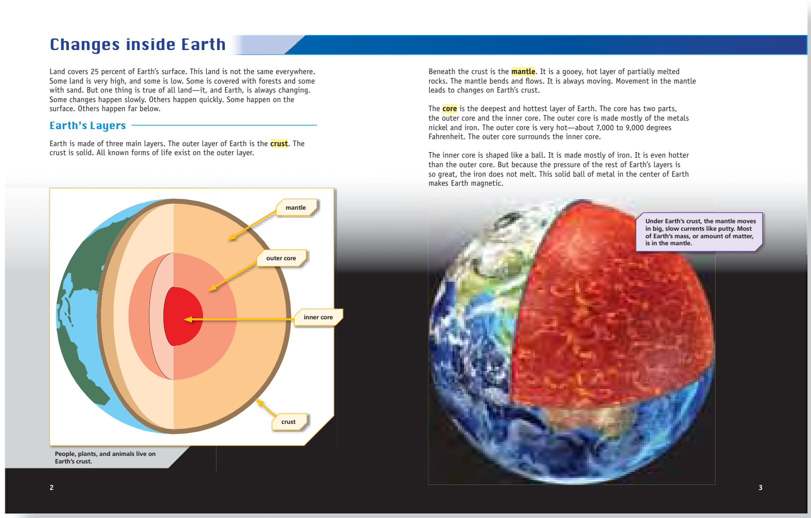
Build students' literacy skills with literacy components found within lessons and Literacy Readers.

Building Blocks of Science Literacy Components can be used to:

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

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

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

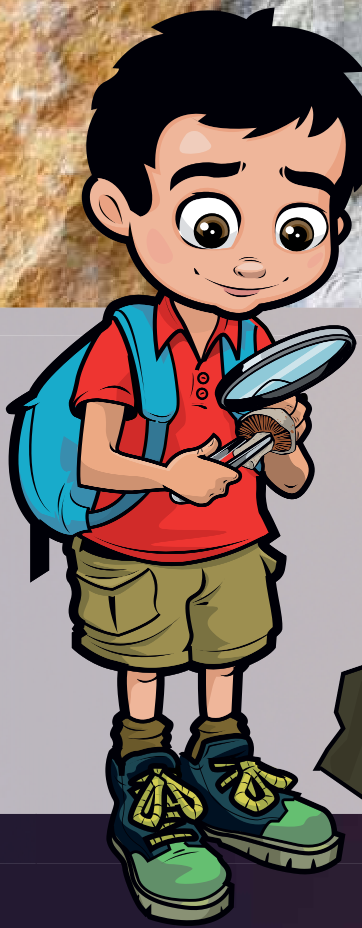


What else to look for?

Literacy Articles—These encourage students to elaborate upon unit topics, discuss real-world applications and phenomena, and ask students to connect this to concepts in the unit. Corresponding questions ask students to access high-level thinking and draw upon previous knowledge. (See page 33 of this sampler for an example.)

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

Building Blocks OF SCIENCE™ 3D



Changing Earth

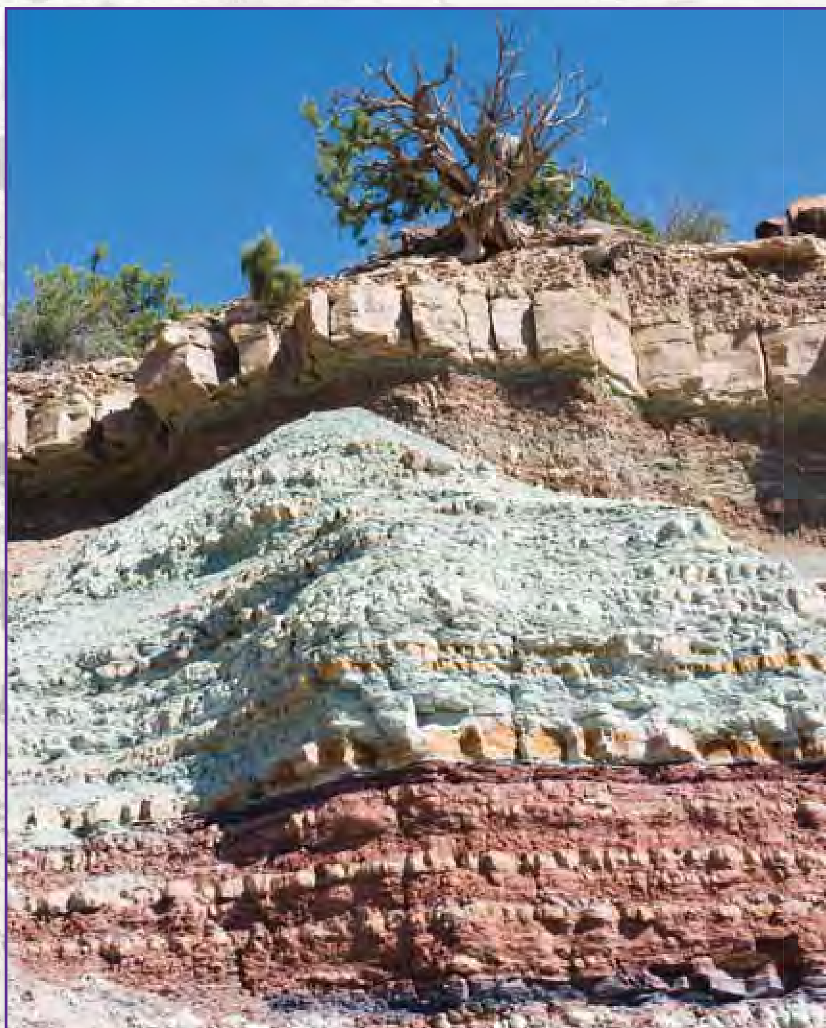
Student literacy–
available in
digital and print

Changing Rocks

Rocks make up Earth's layers and plates. But just what is a rock? A rock is a solid object made up of minerals. A **mineral** is a solid object that forms crystals. Rocks come in many colors, shapes, and sizes. Rocks might seem like they last forever, but they can change. Some changes are slow, and other changes are fast. There are three main types of rocks: sedimentary, igneous, and metamorphic.

Sedimentary Rocks

Remember that weathering breaks rocks into pieces. These pieces of broken rock are sediment. Sediment forms into layers that become **sedimentary rocks**. Sedimentary rocks are found on land and at the bottom of lakes and oceans. They cover about 75 percent of Earth's surface.



Sedimentary rock can form interesting patterns.

Sedimentary rocks form when sediment is deposited, or dropped, by water and wind over many years. It builds up in layers as more sediment drops. The layers slowly get buried under more layers and press together. The sediment becomes stuck together. The cemented mixture hardens to form sedimentary rocks. This change can occur over millions of years. The oldest layers are on the bottom, and the newest layers are on the top. Scientists can learn a lot about changes to Earth's surface over a long time by studying the layers of sedimentary rocks.

Limestone and *shale* are two types of sedimentary rocks. Sometimes these rocks have fossils in them. **Fossils** are the traces or remains of living things that died a long time ago.

This limestone contains fossils.

Igneous Rocks

Temperatures are very hot deep inside Earth. What effect does heat have on rocks inside Earth? It causes them to melt. Melted rock inside Earth is called **magma**. Magma can move up. When a volcano erupts, magma that flows out to the surface is called **lava**. When magma or lava cools, it becomes hard again. Rocks that have cooled and hardened from melted rock are called **igneous rocks**.

New igneous rocks are constantly being added to Earth's crust as magma rises and hardens. They are the source of many important minerals, metals, and building materials. *Granite* and *obsidian* are igneous rocks.

Granite is an igneous rock formed from lava or magma.

Crosscutting Concept

ELA connection RI.4.3, RI.4.7

What patterns do you notice in igneous, metamorphic, and sedimentary rock that might help you recognize them?

Metamorphic Rocks

Pressure is very high deep inside Earth. Pressure squeezes rocks. Pressure and heat together cause rocks to change. To *morph* means to change from one thing into a different thing. **Metamorphic rocks** form when heat and pressure change existing rocks into different rocks. They form new minerals without melting.

Any rock can become metamorphic rock. New metamorphic rocks form from old sedimentary rocks. They form from old igneous rocks. They form from old metamorphic rocks, too. *Gneiss* and *marble* are two kinds of metamorphic rocks. If melting occurs, magma is formed.

The metamorphic rock *gneiss* has wavy bands. It changed from the igneous rock *granite*.

The Rock Cycle

The process in which rocks change is called the **rock cycle**. Rocks can change in different ways in the rock cycle. Look at the diagram on the next page, and follow the arrows along different paths. To start, look for “igneous rock” in the diagram.

Weathering breaks down igneous rocks. It turns big rocks into sediment. Sediment can be moved and slowly buried under more sediment. Then, pressing and cementing change sediment into sedimentary rock. The sedimentary rock can end up deep under the ground where heat and pressure can change it into metamorphic rock.

Heat can also melt the metamorphic rock and change it into magma. Then the magma flows onto the surface as lava. The lava slowly cools and hardens. It forms igneous rock, and the cycle starts over. In this way, rocks can change over and over again in the rock cycle.

Processes in the Rock Cycle

1. Rocks below Earth’s surface melt to form magma. Magma reaches Earth’s surface and becomes lava.
2. Lava cools and hardens into new rock.
3. Weathering and erosion break rocks apart. Weathering forms sediment. Erosion moves sediment to new places.
4. Compacting presses sediment together. When the water between the particles evaporates, the new rock is cemented together.
5. Heat and pressure melt and squeeze existing rocks into new rocks.


The Rock Cycle
Igneous Rock
molten lava
1.
1.
2.
5.
1.
Metamorphic Rock
3.
3.
sediment
3.
Sedimentary Rock
4.
5.
melting
cooling and hardening
weathering and erosion
compacting and cementing
heat and pressure

Careers

Science
in the world

Petrologist

Scientists who study rocks and rock formations are *petrologists*. Petrologists collect and examine rock samples. They remove minerals like gold from rocks. They help find stones such as diamonds. Petrologists also help find natural resources such as petroleum. They use tools to break down rocks to help companies decide where to mine.

Petrologists study all kinds of rocks.

Would I like this career?	You might like this career if • you like to be outdoors. • you like to collect rocks and minerals. • you pay close attention to details.
What would I do?	• You would collect and study rocks. • You would analyze information and solve problems. • You would work for a university, museum, or mining or oil company.
How can I prepare for this career?	• Study science and math. • Develop good research skills. • Start a rock and mineral collection.

Profesiones

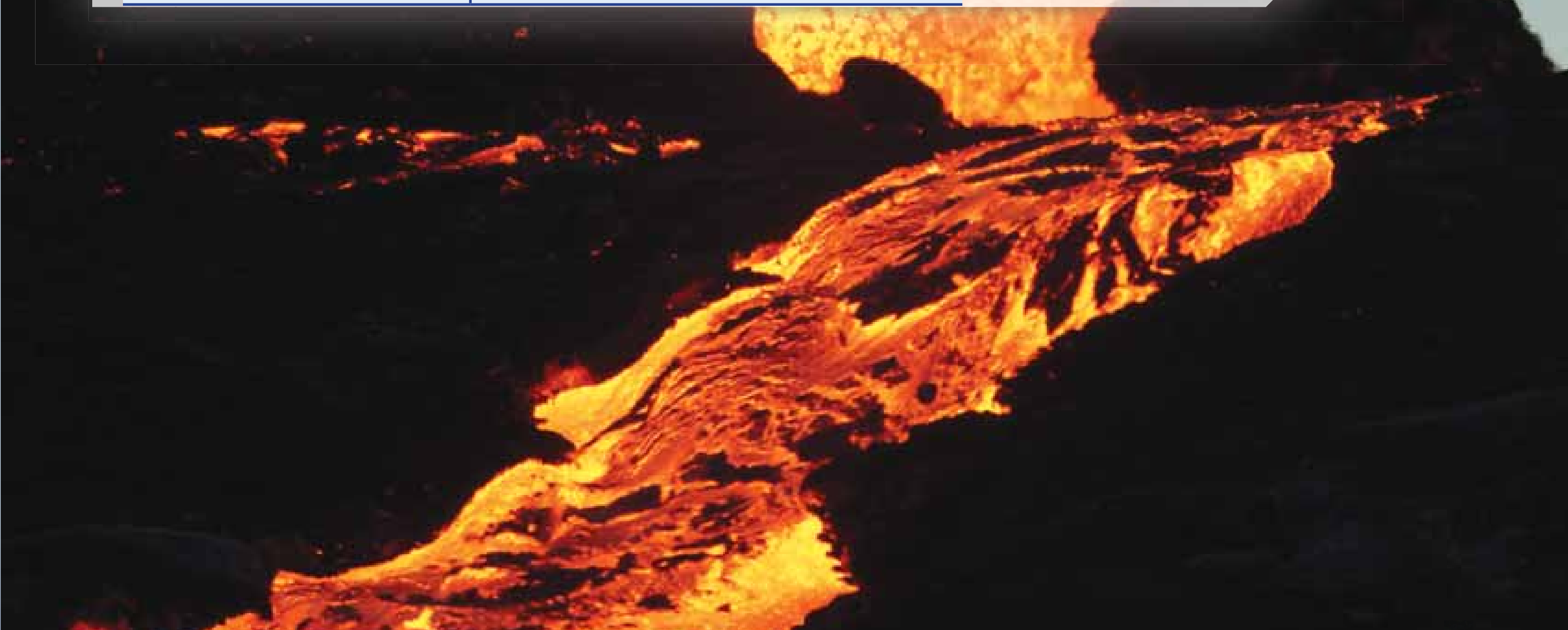
Spanish literacy—
available in digital
and print

Petrólogo

Los *petrólogos* son científicos que estudian las rocas y formaciones rocosas. Recogen y examinan muestras de rocas. Extraen de las rocas minerales como el oro. Ayudan a encontrar piedras como los diamantes. Los petrólogos también ayudan a descubrir recursos naturales como el petróleo. Parten las rocas con herramientas para ayudar a que las compañías decidan donde instalar una mina.

Los petrorólogos estudian todo tipo de rocas.

¿Me gustaría esta profesión?	Te gustaría esta profesión si • te gusta pasar tiempo al aire libre. • te gusta coleccionar rocas y minerales. • prestas mucha atención a los detalles.
¿Qué tendría que hacer?	• Recogerías y estudiarías rocas. • Analizarías información y resolverías problemas. • Trabajarías para una universidad, museo, compañías mineras o petroleras.
¿Cómo puedo prepararme para esta profesión?	• Estudia ciencias y matemáticas. • Desarrolla buenas destrezas de investigación. • Comienza tu propia colección de rocas y minerales.



The Right Blend of Hands-On Investigation and Technology

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

Support for Teachers

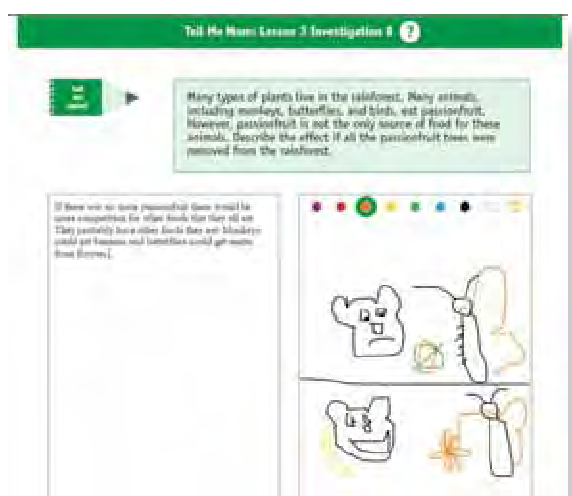
Everything you need to teach the lesson

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

Digital resources by lesson

Everything you need to teach ALL your students

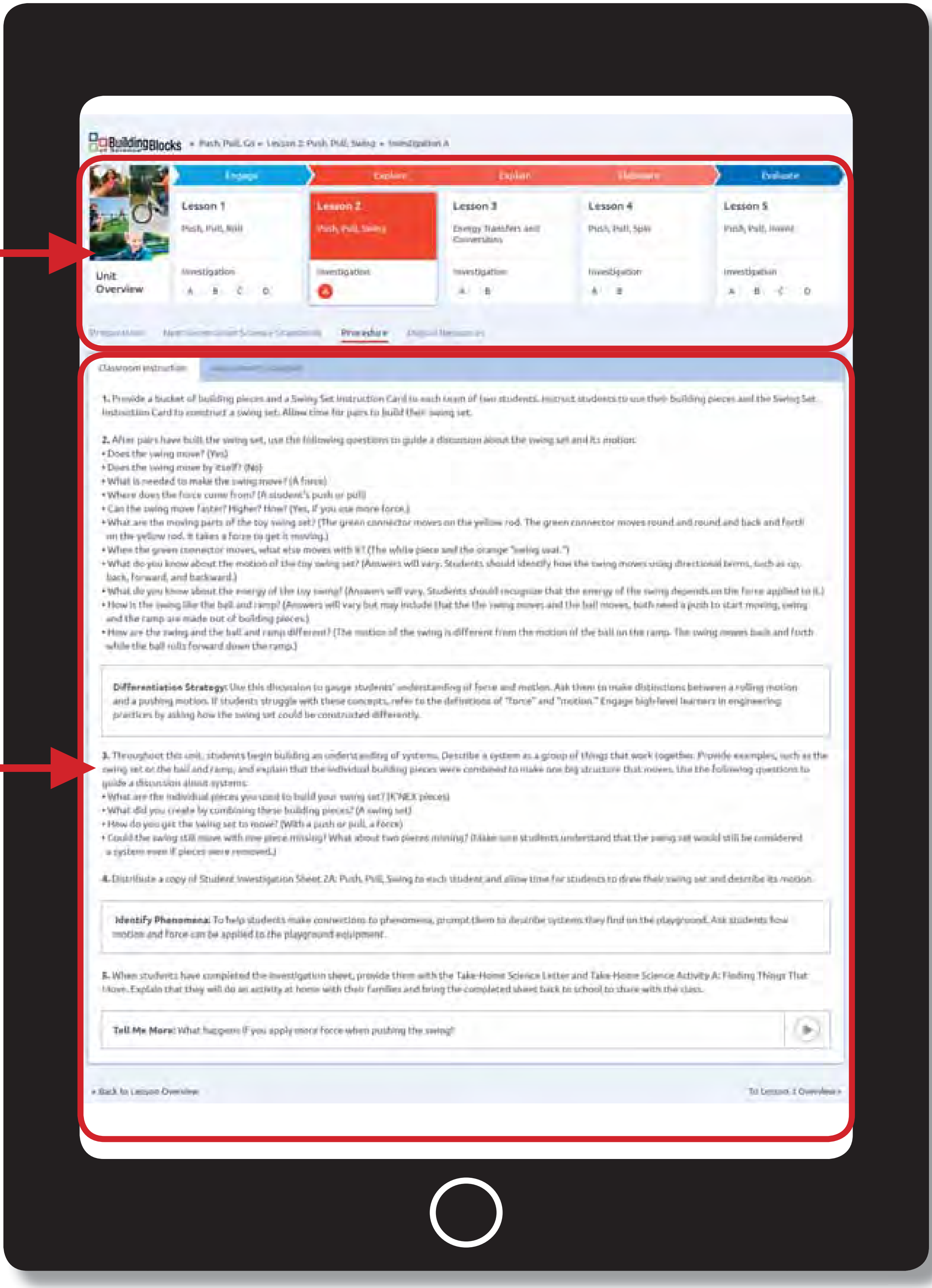
- Step-by-step instruction including guiding questions and anticipated responses
- Differentiation strategies at point of use within each investigation
- **Identify Phenomena** provides teachers with prompts to help students make connections to phenomena addressed within an investigation
- Assessment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



Tell Me More, a formative assessment strategy

For a closer look, visit:

www.carolina.com/bbs3dreview


Lesson 1
Push, Pull, Roll
Lesson 2
Push, Pull, Swing
Lesson 3
Energy Transfers and Conversions
Lesson 4
Push, Pull, Spin
Lesson 5
Unit Overview
Investigation
Procedure
Classroom Instruction
1. Provide a bucket of building pieces and a Swing Set Instruction Card to each team of two students. Instruct students to use their building pieces and the Swing Set Instruction Card to construct a swing set. Allow time for pairs to build their swing set.
2. After pairs have built the swing set, use the following questions to guide a discussion about the swing set and its motion:
• Does the swing move? (Yes)
• Does the swing move by itself? (No)
• What is needed to make the swing move? (A force)
• Where does the force come from? (A student's push or pull)
• Can the swing move faster? Higher? How? (Yes, if you use more force.)
Differentiation Strategy: Use this discussion to gauge students' understanding of force and motion. Ask them to make distinctions between a rolling motion and a pushing motion. If students struggle with these concepts, refer to the definitions of "force" and "motion." Engage high-level learners in engineering practices by asking how the swing set could be constructed differently.
4. Distribute a copy of Student Investigation Sheet 2A: Push, Pull, Swing to each student and allow time for students to draw their swing set and describe its motion.
Identify Phenomena: To help students make connections to phenomena, prompt them to describe systems they find on the playground. Ask students how motion and force can be applied to the playground equipment.
5. When students have completed the investigation sheet, provide them with the Take-Home Science Letter and Take-Home Science Activity A: Finding Things That Move. Explain that they will do an activity at home with their families and bring the completed sheet back to school to share with the class.
Tell Me More: What happens if you apply more force when pushing the swing?

Digital Components to Support Instruction and Assessment

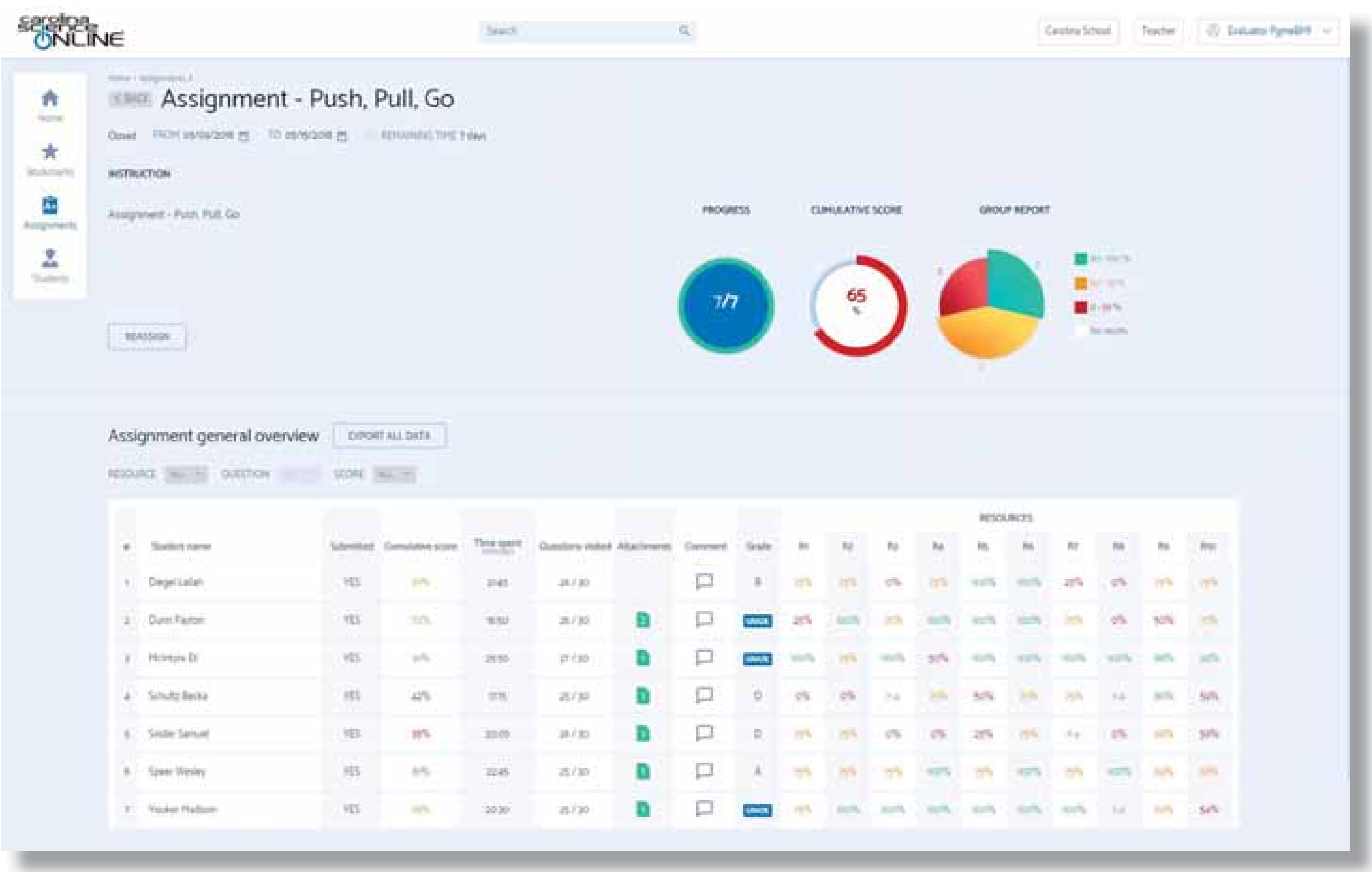
For the Teacher–Customizable Digital Planning at Your Fingertips

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

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

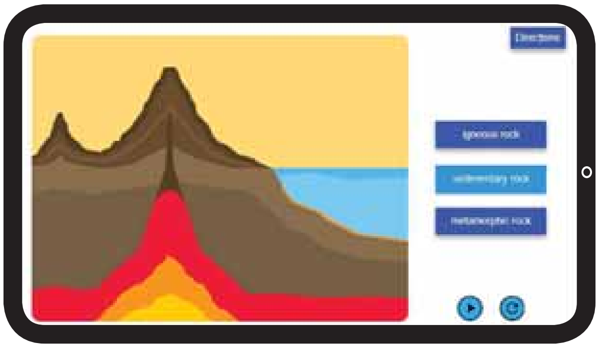
The assignment management system dashboard allows you to:

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



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

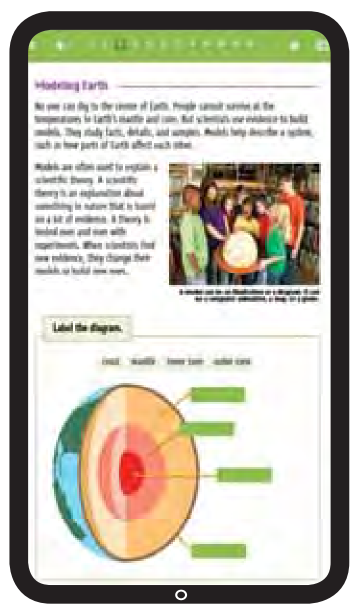
"Digital Tips" take the guesswork out of integrating the following digital resources with hands-on investigations:



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

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

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



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

Building Blocks OF SCIENCE™ | 3D

CAROLINA®
www.carolina.com

Learning Framework

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

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

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