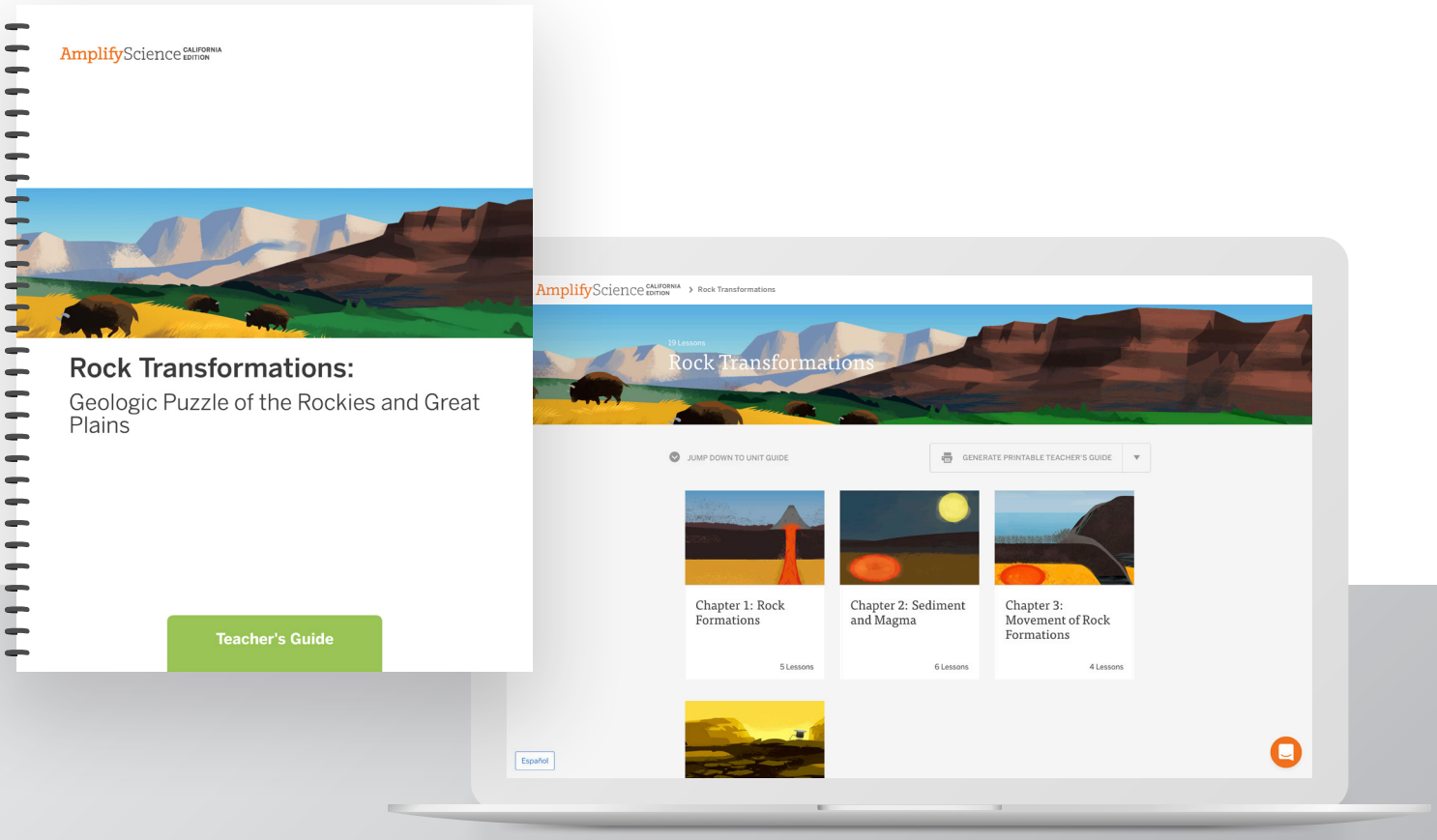
Amplify Science
CALIFORNIA

UNIT GUIDE

Rock Transformations



Amplify.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

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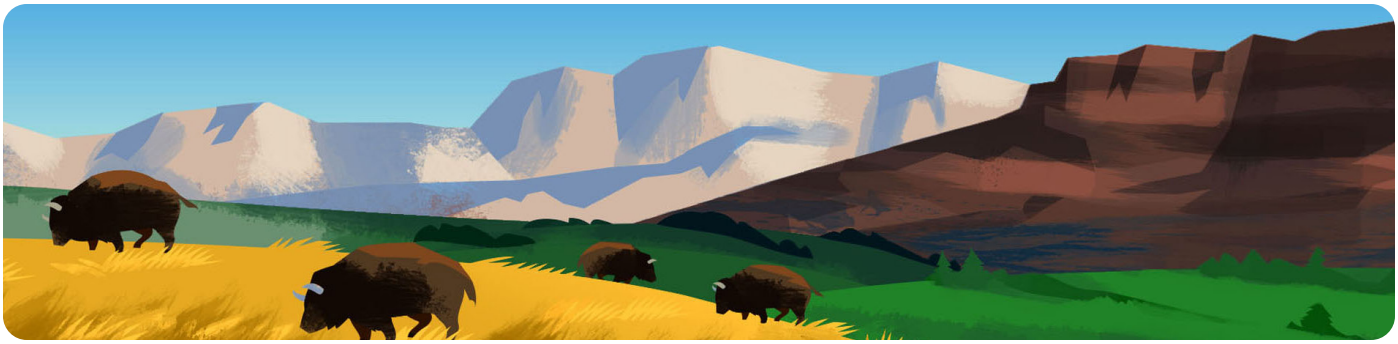


Welcome to Rock Transformations

Understanding the geologic history of specific regions on Earth helps us understand how rock forms and transforms and how matter cycling on Earth is driven by different sources of energy. The Rocky Mountains and Great Plains are two iconic locations in the United States that have a shared geologic history. Interestingly, rocks from the two areas appear very different yet have surprisingly similar mineral compositions. By uncovering and tracing this geologic history throughout this unit, Amplify Science California allows students to explore the characteristics, transformation mechanisms, and related energy sources of sedimentary and igneous rocks. In addition, they figure out many key processes that transform rock material and make important connections between plate motion and those processes.

> Unlike a typical curriculum, Amplify Science California anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of geologists. Their job is to investigate different ways rocks form and change. Working together, students figure out the cycling of matter (rock material) on Earth and how energy from the sun and from Earth's interior drive different rock transformation processes. The unit concludes with a Science Seminar in which students use what they have learned to consider competing claims about which rock transformation processes can happen, and, therefore, which types of rocks might be found by a future lander on Venus.

Unit Type: Core

Student Role: Geologists

Phenomenon: Rock samples from the Great Plains and from the Rocky Mountains—regions hundreds of miles apart—look very different, but have surprisingly similar mineral compositions.

Core Concept: Understanding of how rocks form and transform

Target Performance Expectations:

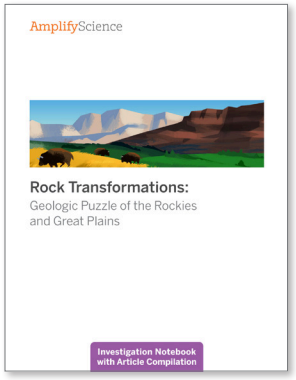
- ESS2-1: Earth's Materials
- ESS2-2: Geoscience Processes
- ESS3-1: Distribution of Natural Resources

Related Performance Expectations:

- ESS1-3: Scale in the Solar System
- ESS2-3: Evidence for Plate Motion

Students figure out the unit phenomenon through the use of a variety of resources.

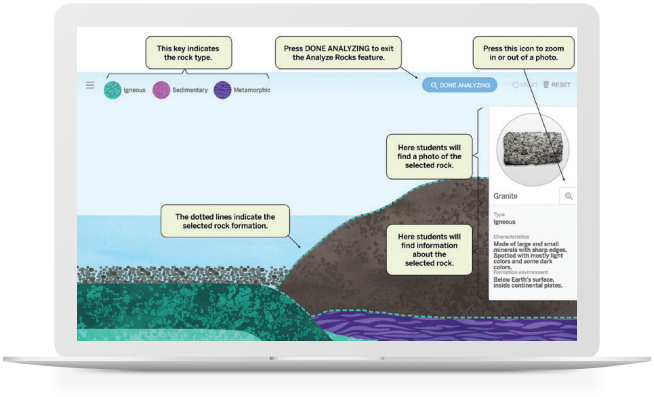
Student Investigation Notebook



Hands-On Kit

Videos

Digital Simulations



About technology in this unit:
All Amplify Science California lessons were designed with device sharing in mind, and never assume that every student has a separate device.

In this grade, student-facing technology includes Practice Tools and digital Simulations. When the use of a digital tool is called for in a lesson, teachers have several implementation options:

If limited student devices are available—teachers can have students do activities in pairs or small groups.

If no student devices are available—teachers can project the digital tool to the class and either "drive" the digital tool themself or invite students to "drive" by using their device.

If internet access is unavailable—teachers can "pre-load" the digital tool on their device for use offline.

Chapter 1:
The storyline begins

What students investigate:

How did the rock of the Great Plains and the rock of the Rocky Mountains form?

What students figure out:

The rock of the Great Plains is sedimentary rock and the rock of the Rocky Mountains is igneous rock. They formed in different ways so they must not have formed together. Rocks can form in different ways. This causes them to be different types. When sediment is compacted and cemented together, it forms sedimentary rock. When magma cools, it hardens to form igneous rock.

How they figure it out:

- Observing rock samples
- Finding different ways to make rocks form using the Sim
- Modeling the formation of sedimentary rocks using hard candy
- Watching a video showing igneous rock formation as magma cools
- Creating a visual model showing two different ways rocks can form
- Evaluating evidence based on how detailed observations are

KEY


CLASS


HANDS-ON


HOMEWORK


MODELING


READING


SIM


SORTING


STUDENT-TO-STUDENT DISCUSSION


TEACHER


TEACHER-LED DISCUSSION


WARM-UP


WRITING

DAY 1 | LESSON 1.1

Pre-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2

Studying Rock Formations and Samples

- Warm-Up (10 min)
- Video: Geology 101 (5 min)
- Thinking Like a Geologist (10 min)
- Observing Hand Samples of Rock (20 min)

DAY 3 | LESSON 1.3

Investigating How Rocks Are Formed

- Warm-Up (10 min)
- Forming Rocks in the Simulation (25 min)
- Considering How Rocks Form (10 min)
- Family Homework Experience (Optional)

On-the-Fly Assessment

DAY 4 | LESSON 1.4

Modeling How Rocks Are Formed

- Warm-Up (5 min)
- Modeling How Sediment Forms Rock (15 min)
- Playing Cooling Magma (2 min)
- Discussing How Magma Forms Rock (8 min)
- Rock Types and How They Form (15 min)
- Homework

DAY 5 | LESSON 1.5

Examining Evidence About Rocks

- Warm-Up (5 min)
- Modeling How Rocks Form (15 min)
- Evaluating Rock Observations (17 min)
- Discussing How the Rocks Formed (8 min)
- Homework
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 2:
The storyline builds

What students investigate:

Where did the magma and sediment that formed the rock of the Great Plains and the rock of the Rocky Mountains come from?

What students figure out:

It is possible that the rock of the Great Plains formed from sediment that eroded off the Rocky Mountains. It might also be possible that the rock of the Rocky Mountains formed from the rock of the Great Plains if the Great Plains rock were somehow carried underground to where energy from Earth's interior could melt it into magma. Matter gets transformed by energy, but the same matter is still present. Sediment forms when any type of rock is weathered, a process driven by energy from the sun. Magma forms when any type of rock is melted, a process driven by energy from Earth's interior.

How they figure it out:

- Finding ways to cause magma and sediment to form using the Sim, and then observing which of these processes are driven by energy from the Sun and which are driven by energy from Earth's interior
- Watching two videos: one that illustrates the processes of weathering and erosion, and another of a hard candy model of magma formation
- Reading an article about the geologic history of Devils Tower
- Modeling the formation of sediment using hard candy
- Writing about ways that different energy sources affect rock
- Creating new visual models
- Conducting Sim missions related to rocks in Hawaii in order to review chapter content

KEY


CLASS


HANDS-ON


HOMEWORK


MODELING


READING


SIM


SORTING


STUDENT-TO-STUDENT DISCUSSION


TEACHER


TEACHER-LED DISCUSSION


WARM-UP


WRITING

DAY 6 | LESSON 2.1

Exploring How Magma and Sediment Form

- Warm-Up (5 min)
- Exploring How Magma and Sediment Form (20 min)
- Playing Understanding Weathering (10 min)
- Sorting Rock Processes (10 min)
- Homework

Optional Flextension: *Identifying Minerals*

DAY 7 | LESSON 2.2

"Devils Tower"

- Warm-Up (5 min)
- Reading "Devils Tower" (25 min)
- Discussing Annotations (10 min)
- Reflecting on Magma and Sediment (5 min)

On-the-Fly Assessment

DAY 8 | LESSON 2.3

Energy's Role in Forming Rocks

- Warm-Up (5 min)
- Making Sediment with Hard Candy (15 min)
- Playing Making Candy Magma (5 min)
- Rereading "Devils Tower" (20 min)
- Homework

On-the-Fly Assessment

DAY 9 | LESSON 2.4

Explaining How Energy Affects Rocks

- Warm-Up (5 min)
- Write and Share: Energy Transforming Rocks (20 min)
- Modeling How Rocks Form, Part 2 (15 min)
- Reflecting on the Claims (5 min)

On-the-Fly Assessment

DAY 10 | LESSON 2.5

Critical Juncture Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Critical Juncture Assessment

DAY 11 | LESSON 2.6

Investigating Hawaiian Rocks

- Warm-Up (10 min)
- Making Rock Materials in Hawaii (30 min)
- Explaining How Rock Materials Formed (5 min)
- Self-Assessment (Optional)

Self-Assessment

Chapter 3:
The storyline gets more complex

What students investigate:

How could rock from one of the regions have transformed into a different type of rock in the other region?

What students figure out:

The plate motion that occurred near the Great Plains and Rocky Mountains uplifted igneous rock that formed underground. This rock eventually eroded and its sediment formed sedimentary rock in the Great Plains. Plate motion moves rock formations. Subduction moves rock down, below Earth's outer layer. Uplift moves rock upward, toward Earth's surface. Uplift and subduction can expose rock formations to different energy sources, which can transform them. Any type of rock can transform into any type of rock because of plate motion.

How they figure it out:

- Reading an article about the oldest rocks on Earth and how plate motion affects rock transformations
- Conducting Sim missions attempting to transform certain types of rock to other types
- Engaging in a classroom model that illustrates the many possible transformations that rock material may undergo
- Writing about how rock material may come to be exposed to different types of energy, and therefore undergo different types of transformations
- Creating their final visual model

KEY


CLASS


HANDS-ON


HOMEWORK


MODELING


READING


SIM


SORTING


STUDENT-TO-STUDENT DISCUSSION


TEACHER


TEACHER-LED DISCUSSION


WARM-UP


WRITING

DAY 12 | LESSON 3.1

"The Oldest Rock Formations on Earth"

- Warm-Up (10 min)
- Reading "The Oldest Rock Formations on Earth" (25 min)
- Discussing Annotations (10 min)
- Homework

On-the-Fly Assessment

DAY 13 | LESSON 3.2

Moving Rock Formations

- Warm-Up (10 min)
- Rereading "The Oldest Rock Formations on Earth" (20 min)
- Moving Rock Formations (15 min)
- Homework

DAY 14 | LESSON 3.3

Plate Motion and Rock Transformations

- Warm-Up (5 min)
- Moving Through Rock Transformations (20 min)
- Mapping Rock Transformation Paths (15 min)
- Reflecting on Rock Transformations (5 min)

DAY 15 | LESSON 3.4

Preparing the Final Report

- Warm-Up (5 min)
- Write and Share: Moving Rock Formations (15 min)
- Modeling Rock Transformations (25 min)
- Homework
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 4:
Application to a new context

What students investigate:

The harsh surface environment on Venus has made lander exploration impossible to date. Plus, its thick clouds make it impossible to take the same visible wavelength, high-resolution images we have of other planetary surfaces. So the question is, what type of rocks might be found by a future lander on Venus?

What students figure out:

Scientists must communicate how their claims and evidence are supported with reasoning in a convincing scientific argument. A written scientific argument needs to state a claim, describe specific evidence, and explain how the evidence supports the claim to convince its reader. A claim can sometimes be supported more effectively if you consider the combination of several different pieces of evidence.

How they figure it out:

- Evaluating and analyzing photographic and descriptive evidence, and also analyzing evidence about energy sources on the planet
- Engaging in oral argumentation in a student-led discourse routine called a Science Seminar
- Writing final arguments

KEY

- CLASS
- HANDS-ON
- HOMEWORK
- MODELING
- READING
- SIM
- SORTING
- STUDENT-TO-STUDENT DISCUSSION
- TEACHER
- TEACHER-LED DISCUSSION
- WARM-UP
- WRITING

DAY 16 | LESSON 4.1

Examining Evidence from Venus

- Warm-Up (5 min)
- Rock Transformations on Venus (5 min)
- Evaluating Rock Observations (20 min)
- Comparing Rock on Earth and Venus (15 min)

DAY 17 | LESSON 4.2

More Evidence About Venus

- Warm-Up (5 min)
- Examining Evidence About Venus (25 min)
- Sorting Evidence About Venus (15 min)

On-the-Fly Assessment

DAY 18 | LESSON 4.3

Science Seminar

- Warm-Up (10 min)
- Introducing the Science Seminar (5 min)
- Participating in the Science Seminar (25 min)
- Introducing the Homework Assignment (5 min)
- Homework
- Self-Assessment (Optional)

Self-Assessment

DAY 19 | LESSON 4.4

End-of-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

End-of-Unit Assessment

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science California to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Rock Transformations Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of how rocks form and transform.

Progress Build Level 1:

Rocks that form in different ways are different types of rock.

Progress Build Level 2:

Material for rock formations can come from rock formations that are weathered or melted.

Progress Build Level 3:

Rock formations can move between Earth's surface and its interior, which can lead to their transformation.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science California makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief**.

Below are a few examples of strategies embedded in this unit.

For English learners:

Rereading for a specific purpose (Example from Lesson 2.3)
In Activity 3, students reread the "Devils Tower" article and apply their knowledge of how energy sources contribute to rock transformations. Giving students a second opportunity to work with a text supports their ability to understand the text and integrate the information with their classroom experiences.

For students needing more support:

Graphic organizer (Example from Lesson 1.4)
Many of the vocabulary words in this unit refer to materials or processes having to do with sedimentary or igneous rocks. You may want to provide students with a graphic organizer so they can keep track of which word applies to which type of rock. Later in the unit, students will begin to see the interconnectedness of all of the materials and processes, so you might want to give them time later to revisit their graphic organizer and discuss how all of the words are related.

For students ready for a challenge:

Partners design additional Sim missions (Example from Lesson 3.2)
Have students who need more challenge create (and test solutions for) additional missions in the Sim. These students can then exchange prompts with one another and try to complete the challenges their classmates have designed. Encourage students to consider including specific rock types, locations (e.g., underground, on the continent, or on the seafloor), energy sources, and rock layering (e.g., one specific rock type on top of another) in their missions.

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Rock Transformations 3-D Coverage

SEPs
Science and Engineering Practices

DCIs
Disciplinary Core Ideas

CCCs
Cross-Cutting Concepts

Unit Level

Students obtain information by reading articles and use digital and physical models to investigate how rock transforms from one type to another due to processes driven by energy from the sun and from Earth's interior (energy and matter). They construct explanations about how rock formations of the Rocky Mountains and Great Plains formed.

Chapter Level

Chapter 1: Rock Formations

Students use digital and physical models and conduct investigations observing hand samples of different rocks to discover that the matter that makes up rock formations can have different properties caused by different formation processes (energy and matter).

Chapter 2: Sediment and Magma

Students gather evidence from digital and physical models and obtain information from an article about the different energy sources that drive the geologic processes of rock formation (energy and matter, cause and effect).

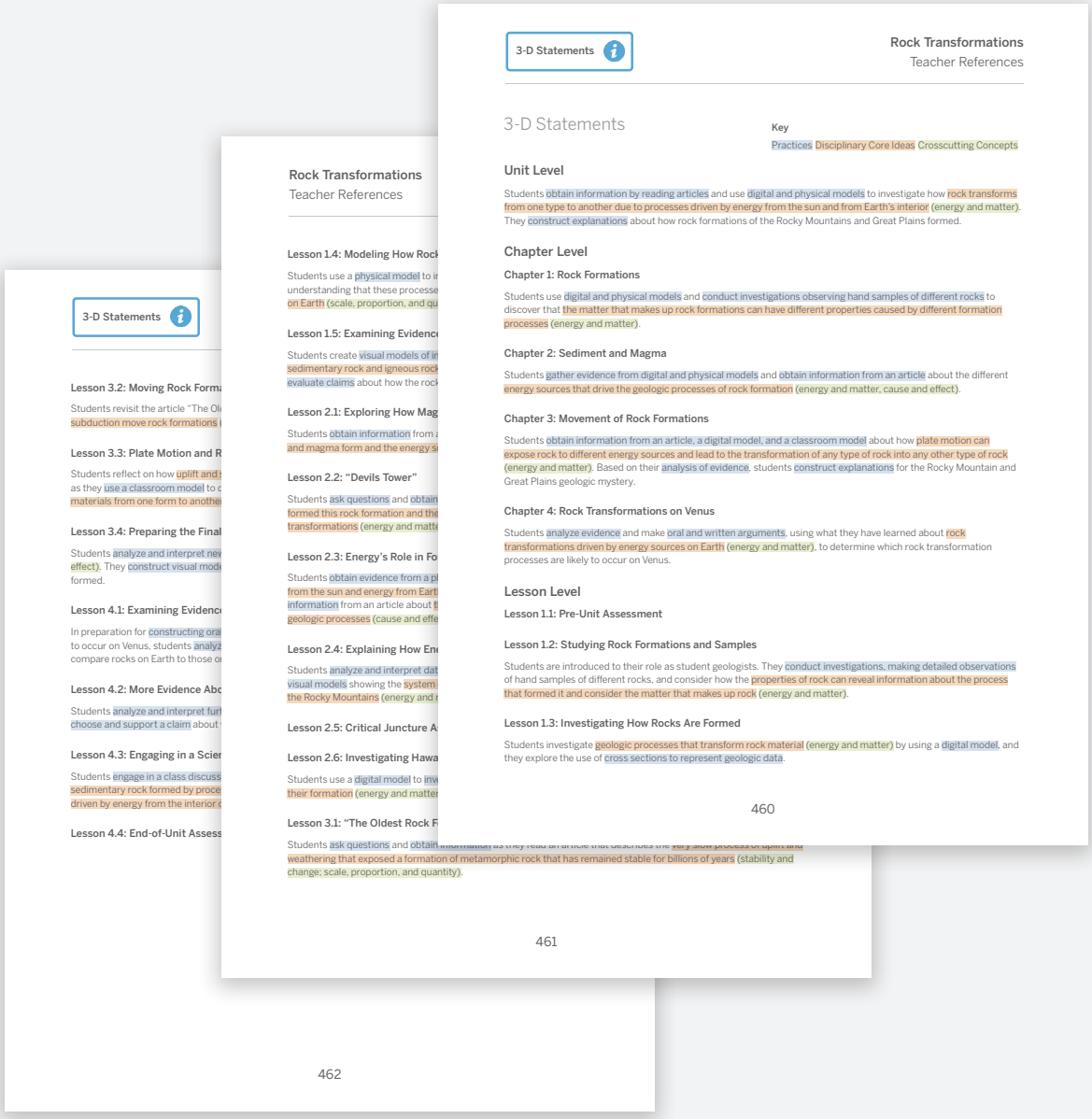
Chapter 3: Movement of Rock Formations

Students obtain information from an article, a digital model, and a classroom model about how plate motion can expose rock to different energy sources and lead to the transformation of any type of rock into any other type of rock (energy and matter). Based on their analysis of evidence, students construct explanations for the Rocky Mountain and Great Plains geologic mystery.

Chapter 4: Rock Transformations on Venus

Students analyze evidence and make oral and written arguments, using what they have learned about rock transformations driven by energy sources on Earth (energy and matter), to determine which rock transformation processes are likely to occur on Venus.

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.



Notes

Notes

For more information on Amplify Science, visit **amplify.com/science/california**.

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