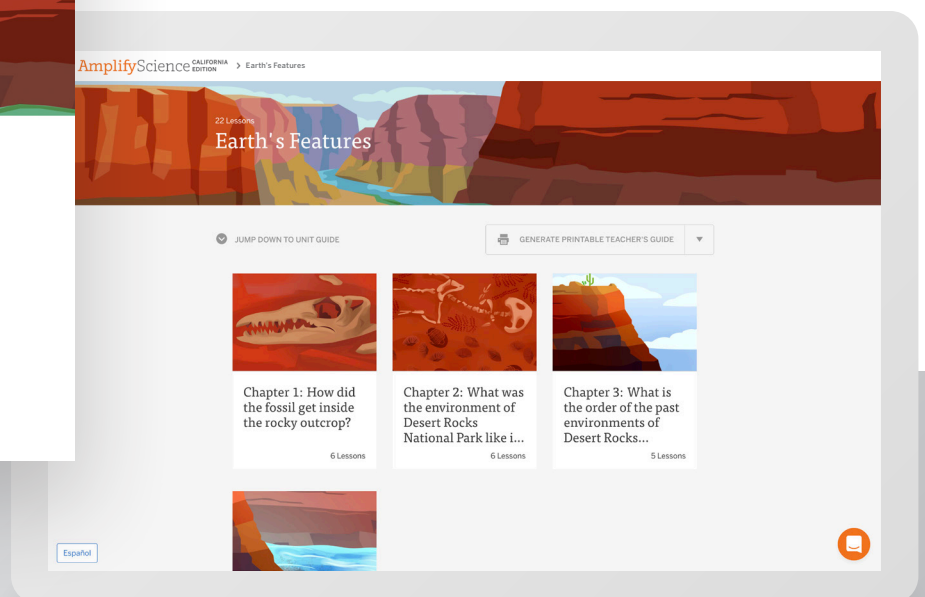
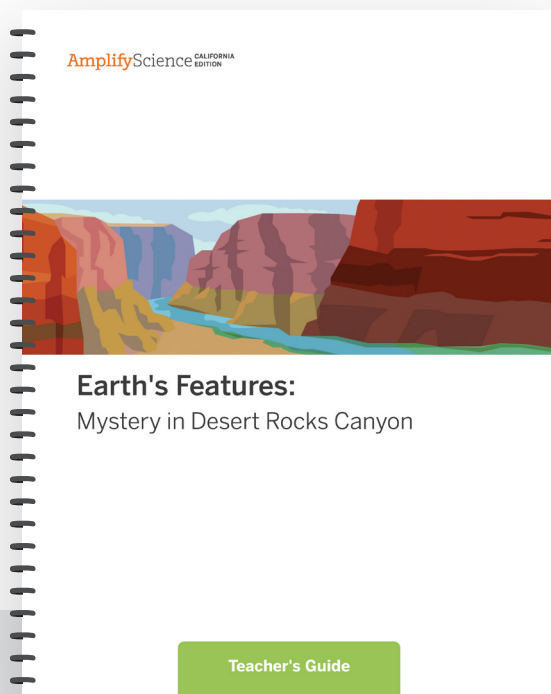


UNIT GUIDE

Earth's Features





Amplify.

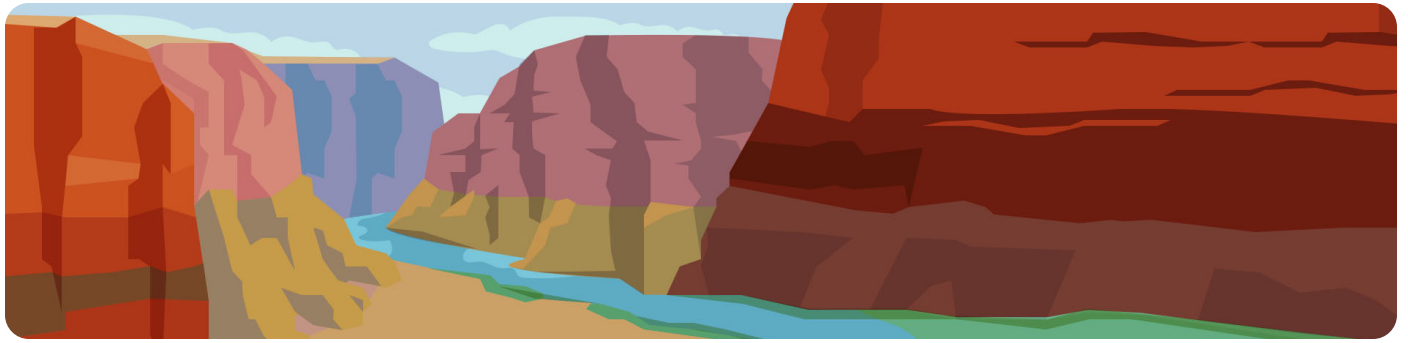


THE LAWRENCE
HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

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Table of contents

Welcome to Earth's Features	4
Chapter 1: The storyline begins	6
Chapter 2: The storyline builds	8
Chapter 3: The storyline goes deeper	10
Chapter 4: Application to a new context	12
All students. All standards.	14
3-D Statements	16



Welcome to Earth's Features

Most curricula that address the topic of rock formation focus on identifying and naming geographical features of Earth's surface, but don't delve any deeper. As a result, few students understand that these seemingly unchanging features have not always existed exactly as they are now. Amplify Science California prompts students to think about how these features formed incrementally as sediment deposited, compacted, and cemented into rock over millions of years. Armed with this understanding, students begin to conceptualize the small changes occurring in an environment that lead to dramatic changes to its landscape over time.

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 help the director of the fictional Desert Rocks National Park explain how and when a particular fossil formed and how it came to be in its current location. Working together, students learn how to tell the environmental history of a place by observing the rock layers present. By the end of the unit, students use the concept of rock and fossil formation to explain why two different canyons in the fictional Desert Rocks National Park have different amounts of exposed rock.

Unit Type: Argumentation

Student Role: Geologists

Phenomenon: A mysterious fossil is discovered in a canyon within the fictional Desert Rocks National Park.

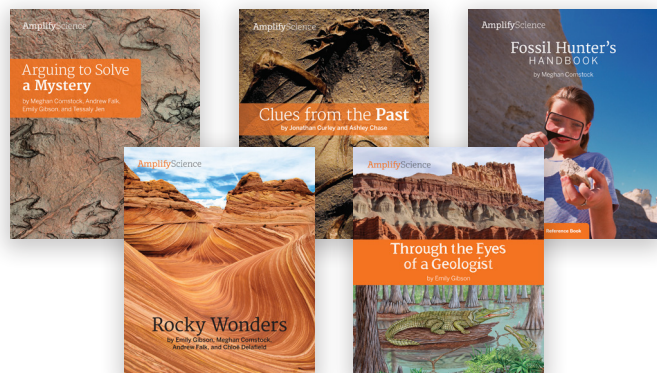
Core Concepts: Understanding of the connection between sediment deposition, rock formation, and the environment

Target Performance Expectations:

- 4-ESS1-1: Landscape Changes
- 4-ESS2-1: Evidence of Weathering or Erosion
- 4-ESS2-2: Patterns of Earth's Features
- 4-ESS3-1: Energy and Fuels
- 4-ESS3-2: Reduce Impacts of Earth Processes

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

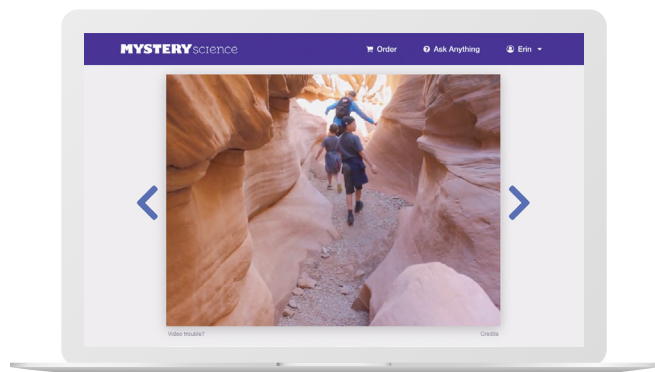
Student Books



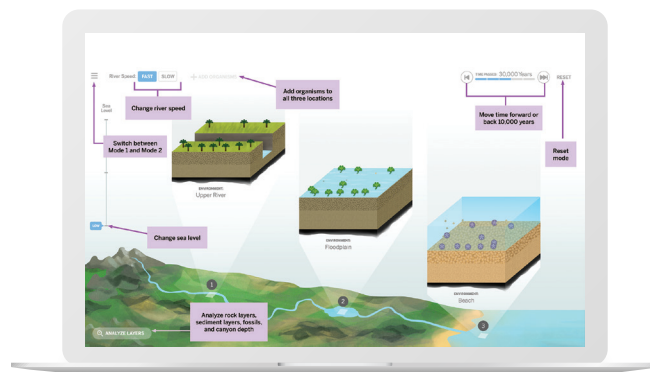
Hands-On Kit



Videos



Simulations



About technology in this unit:

Amplify Science California gives you the flexibility to use technology in the way that meets your needs best. In 3–5, teachers have the option of using:

- **Student digital licenses** that allow for online completion of work, teacher feedback and grading, and digital class management.
- **Traditional consumable resources** that allow for a more familiar paper and pencil experience.

Whether students use the student digital experience or print workbooks, there are some technology-based activities all students will experience from time to time.

In grade 4, technology-based activities include **Practice Tools** and **digital Simulations**. In this particular unit, 10 of the 22 lessons incorporate the use of devices with 13% of the unit's activities involving the use of a digital tool.

When the use of a digital tool is called for in a lesson, teachers have several implementation options:

- **If limited student devices are available**, students can do activities in pairs or small groups.
- **If no student devices are available**, teachers can project the digital tool to the class and create a whole class experience.

Chapter 1:

The storyline begins

What students investigate:

How did the fossil get inside the rocky outcrop?

What they figure out:

A fossil is the preserved remains of an organism that lived a long time ago. Fossils begin to form when the organism dies, and sediments sink through the water to completely cover its body. More and more sediment continues to build up over the body, compacting the sediment that was already there. That sediment cements and becomes rock. This process gradually makes a thicker and thicker rock layer. Parts of the organism are preserved in this rock layer.

How they figure it out:

- Gathering evidence from fossils and rocks
- Investigating how fossils form and the process of sedimentary rock formation as they read the student book *Clues from the Past*
- Investigating how fossils and rocks form in the Sim
- Creating a model of the process of sedimentary rock formation
- Constructing an argument about what Desert Rocks National Park was like in the past

KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT
DISCUSSION



TEACHER







TEACHER-LED
DISCUSSION



WRITING

DAY 1 | LESSON 1.1





Pre-Unit Assessment

-  Mystery in Desert Rocks Canyon (15 min)
-  Writing Initial Explanations (20 min)
-  Rocks and Fossils Anticipatory Chart (10 min)
-  Exploring the Earth's Features Simulation (15 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2





Clues from the Past

-  Introducing Observations and Inferences (10 min)
-  Preparing to Read *Clues from the Past* (10 min)
-  Partner Reading (25 min)
-  Sorting Observations and Inferences (15 min)

On-the-Fly Assessment

DAY 3 | LESSON 1.3





Fossil Formation

-  Observing Fossils (10 min)
-  Investigating Fossils in the Simulation (20 min)
-  Discussing Fossils (20 min)
-  Reflecting on How Fossils Form (10 min)

On-the-Fly Assessment

DAY 4 | LESSON 1.4





Sedimentary Rock Formation

-  Investigating Maps (10 min)
-  Observing Rocks (15 min)
-  Rock Formation in the Simulation (20 min)
-  Reflecting on How Rocks Form (15 min)

On-the-Fly Assessment




DAY 5 | LESSON 1.5

Modeling Sedimentary Rock Formation

-  Reading About Rock Formation (15 min)
-  Sedimentary Rock Formation Model (25 min)
-  Analyzing the Model (10 min)
-  Revisiting the Rocks and Fossils Chart (10 min)

DAY 6 | LESSON 1.6

Writing a Scientific Argument

-  Modeling Fossil and Sedimentary Rock Formation (25 min)
-  Evidence Circles (20 min)
-  Shared Writing of a Scientific Argument (25 min)

Critical Juncture Assessment
Self-Assessment

Chapter 2:

The storyline builds

What students investigate:

What was the environment of Desert Rocks National Park like in the past?

What they figure out:

The environment was a floodplain when the lower rock layer formed and a deep ocean when the upper rock layer formed. The lower layer is made of siltstone and contains a *Lepidodendron* fossil. This is evidence that the environment was a floodplain because siltstone can form in floodplains and *Lepidodendron* lived in watery areas with a lot of plants. The upper layer is made of mudstone, and a *Mosasaurus* fossil was found in this rock layer. This is evidence that it was a deep ocean because mudstone can form in a deep ocean and a *Mosasaurus* was a large animal that swam in deep water.

How they figure it out:

- Exploring how geologists make inferences about the past based on rocks and fossils as they read the student book *Through the Eyes of a Geologist*
- Using physical and digital models to investigate how fossils and rock can be used to make inferences about past environments
- Gathering and analyzing data from observations and diagrams of an area, and as they read the student book *Fossil Hunter's Handbook*
- Engaging in arguments about what the area was like in the past

KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT
DISCUSSION



TEACHER







TEACHER-LED
DISCUSSION



WRITING

DAY 7 | LESSON 2.1




Through the Eyes of a Geologist

-  Returning to Desert Rocks National Park (5 min)
-  Partner Reading (25 min)
-  Discussing Past Environments (15 min)
-  *Fossil Hunter's Handbook* (15 min)

On-the-Fly Assessment

DAY 8 | LESSON 2.2




Exploring Rock Formation and Environment

-  Sedimentary Rock Observations (20 min)
-  Gathering Information About Sedimentary Rock (15 min)
-  Investigating Rocks and Environments (25 min)

On-the-Fly Assessment

DAY 9 | LESSON 2.3





Rock-Forming Environments

-  Environments in *Fossil Hunter's Handbook* (20 min)
-  Sedimentary Rock Formation Model (25 min)
-  Writing About Rock-Forming Environments (15 min)

On-the-Fly Assessment

DAY 10 | LESSON 2.4




Layers in a Rocky Outcrop

-  Data from the Rocky Outcrop (5 min)
-  Forming Rock Layers in the Simulation (20 min)
-  Gathering Information About the Rocky Outcrop (20 min)
-  Stability and Change in Rock Layers (15 min)

On-the-Fly Assessment




DAY 11 | LESSON 2.5

Making Inferences About Fossils

-  *Fossil Hunter's Handbook* (20 min)
-  Shared Writing of a Scientific Argument (25 min)
-  Reflecting on the Rocky Outcrop (15 min)

DAY 12 | LESSON 2.6

Writing an Argument About Past Environments

-  Making Inferences About the Upper Layer (10 min)
-  Evidence Circles (20 min)
-  Writing an Argument (30 min)

Critical Juncture Assessment
Self-Assessment

Chapter 3:

The storyline goes deeper

What students investigate:

What is the order of the past environments of Desert Rocks National Park?

What they figure out:

Lower rock layers form first, and new rock layers form on top of them, so lower rock layers are older than the layers above them. Since the siltstone layer is below the mudstone layer, which is below the shale layer, this means that the siltstone layer formed first, then the mudstone layer, and then the shale layer. Therefore, the environment was a floodplain first, then a deep ocean, and then a shallow ocean.

How they figure it out:

- Using physical and digital models as well as analogies to discover that the lowest rock layers formed first
- Obtaining information from texts and a digital model about which types of rock tend to form in particular environments
- Exploring the fascinating mystery of why the dinosaurs went extinct, and how scientists use argumentation to further our understanding of what might have happened as they read the student book *Arguing to Solve a Mystery*
- Making evidence-based arguments about the order of past environments in Desert Rocks Canyon

KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT
DISCUSSION



TEACHER







TEACHER-LED
DISCUSSION



WRITING

DAY 13 | LESSON 3.1





Rock Layers

-  Returning to the Rocky Outcrop (15 min)
-  The Paper Pile Model (25 min)
-  Investigating the Order of Rock Layers (10 min)
-  Reflecting on Order of Rock Layers (10 min)

On-the-Fly Assessment

DAY 14 | LESSON 3.2




Ordering Rock Layers

-  Reflecting on the Order of Rock Layers (15 min)
-  Reading About Rock Layer Formation (20 min)
-  Evidence from the Class Sedimentary Rock Model (10 min)
-  Modeling Rock Layers (15 min)

On-the-Fly Assessment

DAY 15 | LESSON 3.3




Arguing to Solve a Mystery

-  Introducing *Arguing to Solve a Mystery* (10 min)
-  Partner Reading (40 min)
-  Reflecting on the Practice of Argumentation (10 min)

On-the-Fly Assessment

DAY 16 | LESSON 3.4



Environmental Change

-  Ordering Rock Layers in the Simulation (25 min)
-  Writing Descriptions About Environments (25 min)
-  Returning to the Rocks and Fossils Chart (10 min)

Critical Juncture Assessment
Optional Flexextension: *Rock Layer Mysteries*

DAY 17 | LESSON 3.5

Students' Arguments

-  Evidence Circles (30 min)
-  Writing an Argument (30 min)

End-of-Unit Assessment Part 1
Self-Assessment

Chapter 4:

Application to a new context

What students investigate:

Why did more rock layers get exposed in Desert Rocks Canyon than in Keller's Canyon?

What they figure out:

More rock layers got exposed in Desert Rocks Canyon because its river is faster and has been there longer than the river in Keller's Canyon. Water can erode rock. The longer the time period that a river flows, the more the rock will erode, and a faster river can erode more rock than a river that flows slowly. Based on evidence about the speed and age of the river in Desert Rocks Canyon, this river eroded more rock because it has been flowing over the rock for a longer time and at a faster speed.

How they figure it out:

- Planning and carrying out investigations of the effects of water eroding rock using a model of a river as well as the Sim
- Observing how both the speed of the water and the flow of water over time affects how a rock formation can look
- Applying ideas about erosion to understanding how many different rock formations came to be as they read the student book *Rocky Wonders*
- Analyzing evidence from models, maps, diagrams, and text to construct an argument that explains the factors that can cause more erosion in a canyon

KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT DISCUSSION



TEACHER







TEACHER-LED DISCUSSION



WRITING

DAY 18 | LESSON 4.1




Rocky Wonders

-  Comparing Canyons (10 min)
-  Introducing *Rocky Wonders* (10 min)
-  Partner Reading (30 min)
-  Discussing Erosion and Natural Hazards (10 min)

On-the-Fly Assessment





DAY 19 | LESSON 4.2

Exposing Rock

-  Revisiting the Rocks and Fossils Chart (10 min)
-  Rivers in Desert Rocks Canyon (20 min)
-  Investigating Erosion in the Simulation (30 min)

DAY 20 | LESSON 4.3




Modeling Erosion: Time

-  Introducing to the Erosion Model (5 min)
-  Planning the Erosion Model (10 min)
-  Conducting the Erosion Model (35 min)
-  Reflecting on the Erosion Model (10 min)

On-the-Fly Assessment






DAY 21 | LESSON 4.4

Modeling Erosion: Speed

-  Planning the Erosion Model (10 min)
-  Erosion Model, Part 2 (25 min)
-  Modeling Erosion (25 min)

DAY 22 | LESSON 4.5

Students' Arguments

-  Stability and Change (10 min)
-  Evidence Circles (20 min)
-  Writing an Argument: Erosion in Two Canyons (20 min)
-  Finding Patterns on Maps (20 min)
-  Concluding the Unit (10 min)

On-the-Fly Assessment
End-of-Unit Assessment Part 2
Self-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.

Earth's Features 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 and fossils can be used to infer the environmental history of the area.

Progress Build Level 1:

Sedimentary rock forms when sediment piles up and hardens over time. Fossils can form in the rock if organisms are buried in the sediment.

Progress Build Level 2:

Different sedimentary rock forms in different environments.

Progress Build Level 3:

The lowest layer of sedimentary rock formed first, and younger layers formed on top.

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:

Students summarize (Example from Lesson 3.1)

Hearing summaries in students' own words can help all students, and especially English learners, better comprehend and engage in an activity. During Activity 2, the Paper Pile Model, you may want to invite one or two students to summarize what they've just done after the first few rock layers are laid down. Pausing briefly to summarize a few times during this activity can help students to comprehend what the model is showing and help them connect this to what they are doing as they lay the colored papers down. If many of your English learners speak the same primary language, you might invite students to summarize in their primary language.

For students needing more support:

Reading support (Example from Lesson 2.1)

If students need more support in reading *Through the Eyes of a Geologist*, you can describe and model how to use the visual representations in the book as tools to help students understand the text. In particular, this book contains photographs of a place in the present contrasted with illustrations showing what the place could have been like in the past. You might want to meet with a small group and read the book together while the rest of the class reads more independently. With this group, have students look carefully at the photographs of the rock formations and fossils in each place and describe their observations aloud. Then, read the text together and talk about how the observations students made of the photographs are similar to what geologists would observe. Next, read the description of what the place was like in the past, making sure that students understand that this is an artist's rendition of what the place could have been like. Have students describe what they see in the illustration, and talk about how geologists could infer that this is what the place was like. Explicitly showing students how to engage with the visual representations in the book and supporting them as they make sense of the images and text helps all students access the ideas.

For students ready for a challenge:

Apply ideas (Examples from Lesson 4.2)

Ask students who need more challenge to imagine a river flowing near the Desert Rocks Canyon where the canyon is even deeper than the one shown in Desert Rocks Canyon. Ask these students to describe (orally, in writing, and/or by drawing) what the river would be like, and what they would see along the canyon walls.

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.

Earth's Features 3-D Coverage

SEPs

Science and Engineering Practices

DCIs

Disciplinary Core Ideas

CCCs

Cross-Cutting Concepts

Unit Level

Students obtain information from text and use physical and digital models to construct understanding about how rock forms and erodes, how rock layers form, and how to use rock layers to infer the environmental changes that have happened in a place (stability and change). They apply their understanding to engage in oral and written argument about the geologic history of Desert Rocks National Park.

Chapter Level

Chapter 1: How did the fossil get inside the rocky outcrop?

Students use physical and digital models to investigate rock samples and the changes that occur over time to form fossils and sedimentary rock (stability and change). Students combine evidence from investigations with evidence obtained from text to engage in argument about what Desert Rocks National Park was like in the past.

Chapter 2: What was the environment of Desert Rocks National Park like in the past?

Students obtain and evaluate information from text, investigate samples of rock, and use a digital model of rock formation to construct understanding that different sediments build up in different environments, so a change in the environment (stability and change) can cause different rock types to form (cause and effect). At the end of the chapter, students analyze and interpret data from Desert Rocks National Park to infer and write scientific arguments about the park's past environments.

Chapter 3: What is the order of the past environments of Desert Rocks National Park?

Students develop and use models to figure out how the order of rock layers in a place can be used to infer the environmental changes that occurred there in the past (stability and change). Students then apply their understanding to write scientific arguments about the order of past environments at Desert Rocks National Park.

Chapter 4: Why did more rock layers get exposed in Desert Canyon than Keller's Canyon?

Students obtain information from text, investigate in a digital model, and use physical models to construct understanding about what factors might cause one canyon to erode more than another (cause and effect, stability and change). Students then apply what they've figured out to support claims in written arguments about why more rock layers got exposed in Desert Rocks Canyon than in Keller's Canyon.

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

The image displays several overlapping pages from a lesson plan. The top-most page is titled "Earth's Features Teacher References" and includes a "3-D Statements" icon. Below this, a "Key" section defines color-coding: Practices (orange), Disciplinary Core Ideas (green), and Crosscutting Concepts (blue). The page lists "3-D Statements" for Unit Level, Chapter Level, and Lesson Level. The Chapter Level section includes three chapters with their respective questions and student activities. The Lesson Level section includes Lesson 11: Pre-Unit Assessment: Students' Initial Explanation. Other pages in the collage show lesson-specific content, such as "Lesson 4.3: Modeling Erosion" and "Lesson 4.2: Exposing Rock".

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