

# Earth's Features Coherence Flowchart

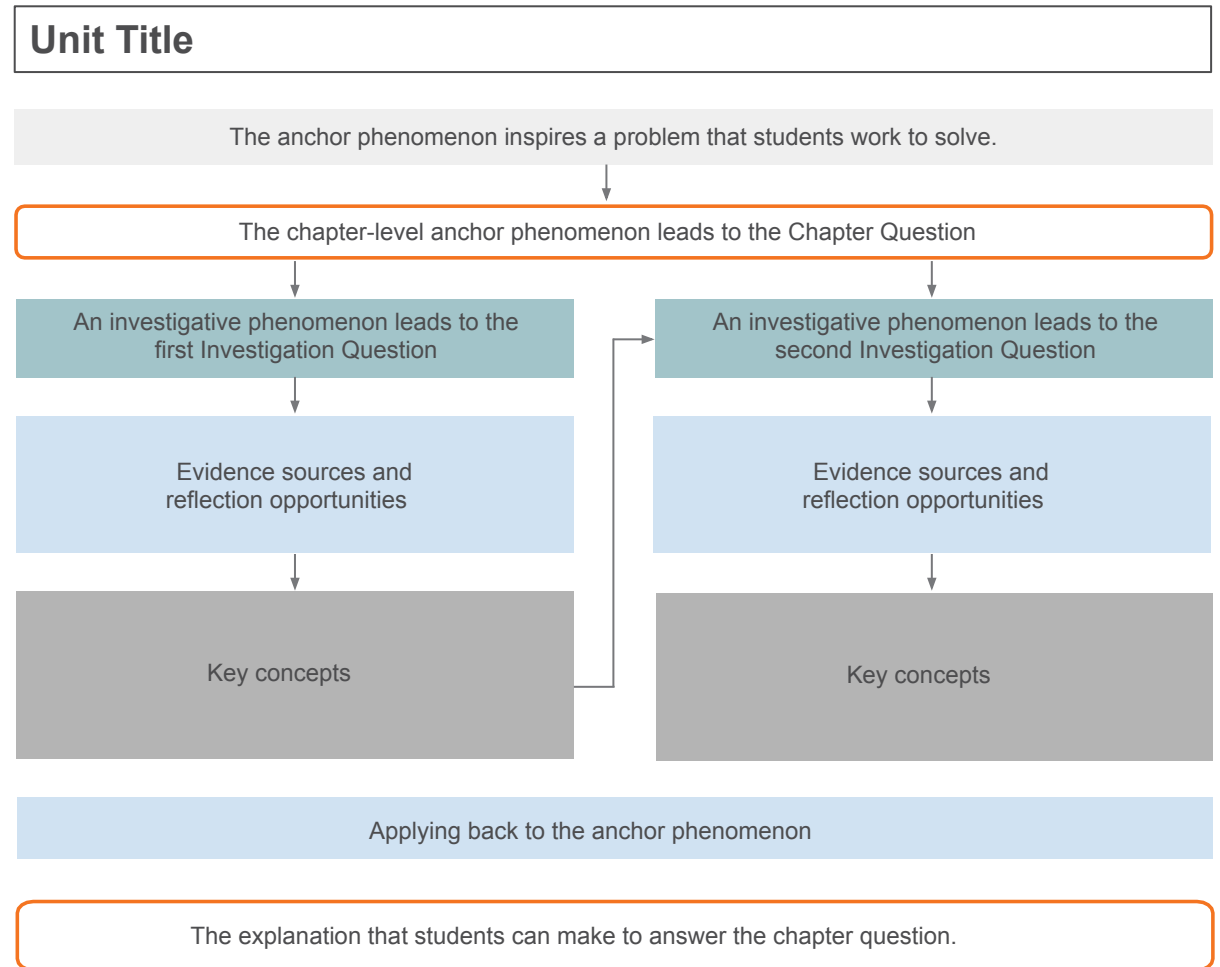
## The storyline of the unit

In each Amplify Science unit, students figure out a phenomenon by asking questions, gathering evidence, and coming up with an explanation of how the phenomenon works. The Coherence Flowchart visually represents the storyline of the unit, showing the coherent flow of questions based on phenomena, evidence, and ideas that support students as they build complex explanations of the unit's anchor phenomenon. The Coherence Flowchart on the following pages (one chapter per page) can be used to see the connections between the phenomena and questions that drive students' experiences, the evidence they gather, the ideas they figure out, and the new questions that those ideas generate. The diagram to the right explains the structure of a chapter in the Coherence Flowchart.

In some units a design problem drives the investigations of the unit or of specific lessons. In these cases the design problem will be noted in place of the phenomenon.

Note: The Coherence Flowchart is a tool for teachers and is not meant to be distributed to students.

Typical structure of one chapter in a Coherence Flowchart



Instruction is framed by questions about the unit's anchor phenomenon and the related problem students are solving. Chapter Questions then guide students in figuring out the phenomenon, piece by piece. Within each chapter, investigative phenomena lead to Investigation Questions that focus students on a manageable piece of content that will help them figure out the Chapter Question. Each phenomenon leads to a question which motivates activities, and each activity provides specific evidence related to the Investigation Question. Students synthesize the understanding constructed over multiple activities, and this understanding is formalized through key concepts. Often a key concept leads students to an additional investigative phenomenon and Investigation Question students need to pursue to answer the Chapter Question. At the end of the chapter, students' new understanding is applied back to the unit's anchor phenomenon and leads students to a new Chapter Question or a final explanation.

**Unit Anchor Phenomenon**

*Problem students work to solve*

**Chapter-level Anchor Phenomenon**  
**Chapter 1 Question**

**Investigative Phenomena**  
*Investigation Questions*

**Evidence sources and reflection opportunities**

**Key concepts**

**Application of key concepts to problem**

**Explanation that students can make to answer the Chapter 1 Question**

# Earth's Features: Mystery in Desert Rocks Canyon

A rocky outcrop in Desert Rocks National Park has rock layers and a fossil in it.  
*What was the environment of Desert Rocks National Park like in the past?*

A rocky outcrop in Desert Rocks National Park has a fossil in it.  
*How did the fossil get inside the rocky outcrop?*

There are fossils in the world.  
*How do fossils form? (1.2-1.3)*

- Discuss initial ideas about rocks and fossils, add them to the Rocks and Fossils Anticipatory Chart (1.1)
- Read *Clues from the Past* (1.2)
- Observe fossils (1.3)
- Use the Sim to investigate how fossils form (1.3)

• A fossil forms when an organism dies and is covered with sediment that turns into rock. (1.3)

- Use the Evidence Circles routine to prepare to write an argument about the Chapter 1 Question (1.6)
- Shared write an argument about the Chapter 1 Question (1.6)

The fossil is the preserved remains of an organism that lived a long time ago. The fossil formed when the organism died and sediments sank through the water and completely covered its body. More and more sediment continued to build up over the body. As more sediment landed on top, it compacted the sediment that was already there. That sediment cemented and became rock. This process gradually made a thicker and thicker rock layer. Parts of the organism became preserved in this rock layer.

There is sedimentary rock in the world.  
*How does sedimentary rock form? (1.4-1.5)*

- Observe conglomerate rock samples (1.4)
- Use the Sim to investigate how sedimentary rock forms (1.4)
- Revisit *Clues from the Past* to obtain information about how sedimentary rock forms (1.5)
- Develop student sedimentary rock formation models (1.5)
- Discuss and evaluate the class sedimentary rock formation model (1.5)
- Revisit the Rocks and Fossils Anticipatory Chart to reflect on new ideas (1.5)

• A sedimentary rock layer forms when sediment sinks and builds up in water, compacts under more sediment, and cements over time. (1.5)

• Over time, a rock layer becomes thicker as sediment continues to build up. (1.5)

## Unit Anchor Phenomenon

Problem students work to solve

## Chapter-level Anchor Phenomenon Chapter 2 Question

## Investigative Phenomena Investigation Questions

## Evidence sources and reflection opportunities

## Key concepts

## Application of key concepts to problem

## Explanation that students can make to answer the Chapter 2 Question

# Earth's Features: Mystery in Desert Rocks Canyon

A rocky outcrop in Desert Rocks National Park has rock layers and a fossil in it.  
What was the environment of Desert Rocks National Park like in the past?

The rock of the rocky outcrop in Desert Rocks National Park formed in water.  
What was the environment of Desert Rocks National Park like in the past?

Different places have different rock.  
How do geologists learn what a place was like in the past? (2.1)

- Read *Through the Eyes of a Geologist* (2.1)
- Use *Fossil Hunter's Handbook* to identify the fossil found in Desert Rocks National Park (2.1)

Geologists use observations of and ideas about rocks and fossils to make inferences about past environments. (2.1)

Different rocks have different characteristics.  
How do rocks provide information about what an environment was like in the past? (2.2-2.3)

- Observe and compare two types of sedimentary rock (2.2)
- Use the Sim to investigate rocks forming in different environments (2.2)
- Read *Fossil Hunter's Handbook* to obtain information about types of sediment in different environments (2.3)
- Add to student rock formation models with a different type of sediment (2.3)
- Revisit the Rocks and Fossils anticipatory chart to reflect on new ideas (2.3)

Different sediments build up in different environments. Therefore, different kinds of sedimentary rock form in different environments. (2.3)

Some outcrops have layers of different sedimentary rock.  
How can there be different sedimentary rock layers in the same place? (2.4)

- Use the Sim to investigate forming different rock layers (2.4)

Different sedimentary rock layers in a place mean that the environment in that place has changed. (2.4)

- Research rock layers from Desert Rocks National Park in *Fossil Hunter's Handbook* (2.5)
- Use the Evidence Circles routine to prepare to write an argument about the Chapter 2 Question (2.6)
- Write an argument about the Chapter 1 Question (2.6)

The environment at Desert Rocks National Park was a floodplain when the lower rock layer was formed and a deep ocean when the upper rock layer was formed. The lower layer is made of siltstone and contains a *Lepidodendron* fossil. Siltstone can form in floodplains. *Lepidodendron* lived in watery areas with a lot of plants. Floodplains have water and a lot of plants so the environment must have been a floodplain when the lower layer was formed. The upper layer of the rocky outcrop is made of mudstone. A *Mosasaurus* fossil, and a *Mortoniceras* fossil were found in this rock layer. Mudstone can form in a deep ocean. *Mosasaurus* was a large animal that swam in water. *Mortoniceras* used to eat plankton, which live in deep water. The environment must have been a deep ocean when the upper rock layer was formed.

# Earth's Features: Mystery in Desert Rocks Canyon

## Unit Anchor Phenomenon

Problem students work to solve

## Chapter-level Anchor Phenomenon Chapter 3 Question

## Investigative Phenomena Investigation Questions

## Evidence sources and reflection opportunities

## Key concepts

## Application of key concepts to problem

## Explanation that students can make to answer the Chapter 3 Question

A rocky outcrop in Desert Rocks National Park has rock layers and a fossil in it.  
*What was the environment of Desert Rocks National Park like in the past?*

There are different sedimentary rock layers in Desert Rocks National Park.  
*What is the order of the past environments in Desert Rock National Park?*

Rock layers are often arranged vertically.  
*How can geologists tell what order rock layers formed in? (3.1- 3.3)*

- Develop a paper pile model of sedimentary rock layers using colored paper (3.1)
- Reflect on the order of layers in the paper pile model (3.1)
- Search for evidence about the order of rock layers in *Fossil Hunter's Handbook* (3.2)
- Gather evidence about the order of rock layers by observing the completed class sedimentary rock formation model(3.2)
- Develop digital models of rock layers forming in different orders (3.2)
- Read *Arguing to Solve a Mystery* (3.3)

New rock layers form on top of existing rock layers. Therefore, lower rock layers are older than the layers above them. (3.2)

- Use the Evidence Circles routine to prepare to write an argument how Desert Rocks National Park has changed over time (3.5)
- Write an argument about how Desert Rocks National Park has changed over time (3.5)

The siltstone layer is below the mudstone layer which is below the shale layer. 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. This means that the siltstone layer formed first and then the mudstone layer and then the shale layer. This also means that the environment was a floodplain first, then was a deep ocean, and then a shallow ocean.

Rock layers are made of rock with different characteristics.  
*How can geologists figure out the order of past environments? (3.4)*

- Use the Sim to investigate how to determine the order of past environments (3.4)
- Use a diagram and information sheet to make inferences about how an environment changed over time (3.4)
- Revisit the Rocks and Fossils anticipatory chart to reflect on new ideas (3.4)

- Geologists observe the order of rock layers to infer the order of past environments. (3.4)
- New rock layers form on top of existing rock layers. Therefore, the environments that lower rock layers formed in came earlier. (3.4) (Revised from 3.2)

# Earth's Features: Mystery in Desert Rocks Canyon

## Unit Anchor Phenomenon

Another problem students work to solve

## Chapter-level Anchor Phenomenon Chapter 4 Question

## Investigative Phenomena Investigation Questions

## Evidence sources and reflection opportunities

## Key concepts

## Application of key concepts to problem

## Explanation that students can make to answer the Chapter 4 Question

The rock layers in Desert Rocks Canyon are exposed.  
*How did the rock layers in Desert Rocks Canyon get exposed?*

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

In some places rock below the surface is exposed.  
*How does rock get exposed? (4.1)*

- Read *Rocky Wonders* to figure out how rock layers become exposed (4.1)
- Discuss natural hazards and how they relate to erosion (4.1)

Rock can be broken down and eroded by things in the environment, such as wind, water, plants, and ice. (4.2)

Some canyons are deeper than others.  
*What affects the amount of rock that water can erode? (4.2-4.5)*

- Revisit the Rocks and Fossils anticipatory chart to reflect on new ideas about erosion (4.2)
- Revisit *Rocky Wonders* to obtain information about how rivers can erode different amounts of rock (4.2)
- Use the Sim to investigate how water from a river forms canyons of different depths (4.2)
- Use the stream table Erosion Model to plan and carry out an investigation about how the amount of time a river has flowed affects erosion (4.3)
- Use the stream table Erosion Model to plan and carry out an investigation about how the a river's speed affects erosion (4.3)
- Develop a digital model showing how the speed of a river, and the time it has been flowing, affects erosion (4.4)

The speed of water and amount of time it flows affect how much rock it erodes. (4.4)

- Use the Evidence Circles routine to prepare to write an argument about the Chapter 4 Question (4.5)
- Write an argument about the Chapter 4 Question (4.5)

More rock layers got exposed in Desert Rocks Canyon because the river that flows in Desert Rocks Canyon is faster and has been there longer than the river in Keller's Canyon. Rock can be broken down by water and the longer a river flows the more rock it can erode. Also, a faster river can erode more rock. This means that the river in Desert Rocks Canyon eroded more rock and exposed more rock layers because it has been flowing over the rock longer and because the river is faster.