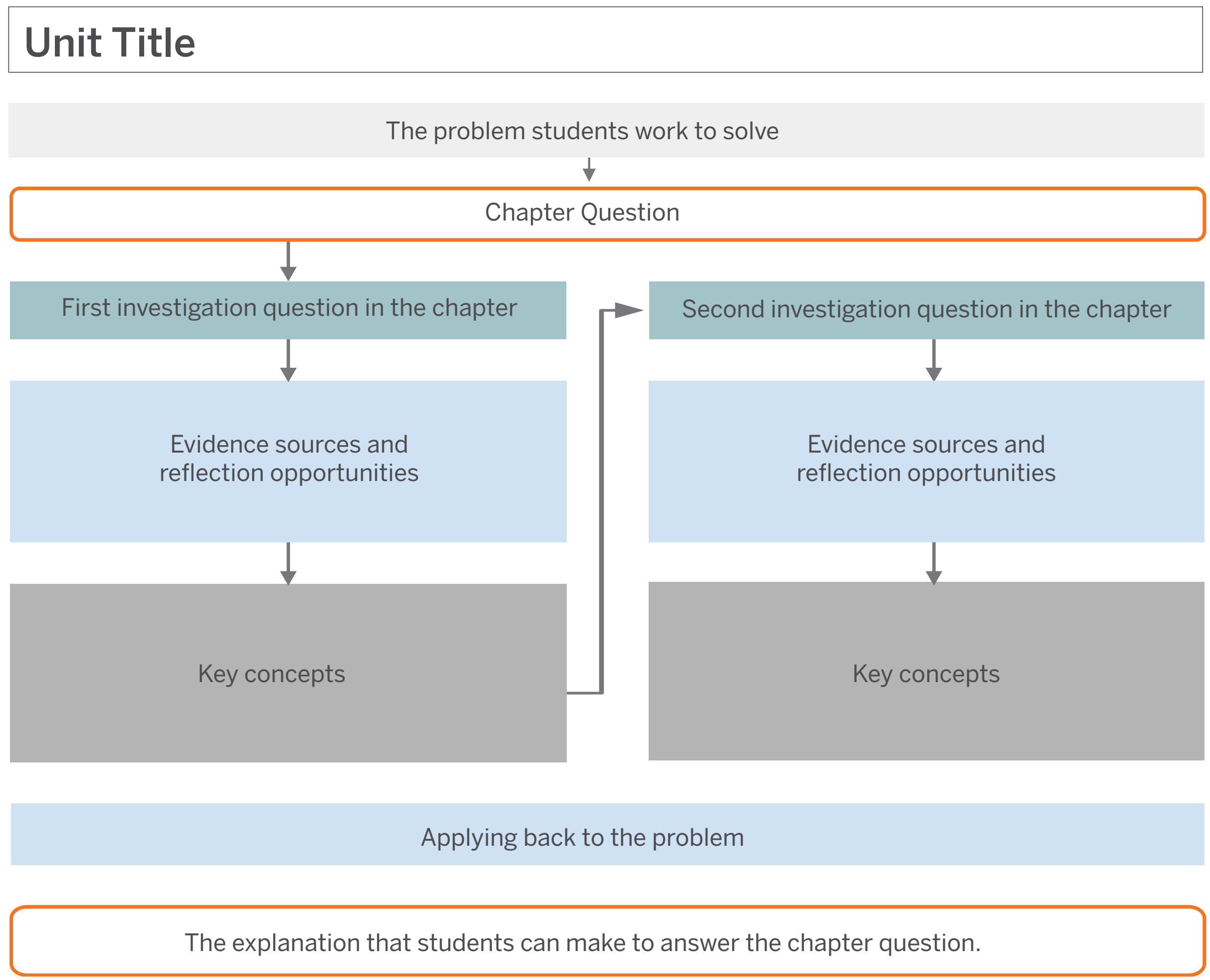
Plate Motion Coherence Flowchart

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, 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 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.

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, Investigation Questions focus students on a manageable piece of content that will help them figure out the Chapter Question. Each question 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 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.

AmplifyScience

Plate Motion: The Mystery of the *Mesosaurus* Fossils

Problem Students Work to Solve

Why are fossils of *Mesosaurus* separated by thousands of kilometers of ocean when the species once lived all together?

Chapter 1 Question

What is the land like where *Mesosaurus* fossils are found?

Investigation Question

What is the land like underneath Earth's surface? (1.2, 1.3, 1.4)

Evidence Sources and Reflection Opportunities

- Examine cross sections of Earth's surface (1.2)
- Watch *Revealing Earth's Outer Layer* video *(1.3)*
- Explore Earth's outer layer in the Sim (1.3)
- Analyze maps showing plate boundaries and earthquakes (1.3)
- Observe earthquakes in the Sim (1.4)

Key Concepts

- Earth's outer layer is made of hard, solid rock. (1.2)
- Earth's outer layer is divided into sections called plates. (1.3)
- Geologists look for patterns in landforms and in geologic events in order to better understand Earth. (1.3)
- The plates of Earth's outer layer move. (1.4)

Application of Key Concepts to Problem

- Model a plate boundary to show what the land is like where *Mesosaurus* fossils are found using the paper Modeling Tool(1.4)
- Discuss competing claims about the *Mesosaurus* fossils (1.4)
- Write an explanation to answer the Chapter 1 Question (1.4)

Explanation That Students Can Make to Answer the Chapter 1 Question

Earth's outer layer is made of hard, solid rock, and divided into sections called plates. The plates of Earth's outer layer move. The *Mesosaurus* fossils are found in hard, solid rock on two different plates of Earth's surface: the South American and African Plates. Maybe these two plates used to be together and moved apart somehow.

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Problem Students Work to Solve

Why are fossils of *Mesosaurus* separated by thousands of kilometers of ocean when the species once lived all together?

Chapter 2 Question

How did the South American Plate and African Plate move?

Investigation Questions

How do Earth's plates move? (2.1)

What happens to the plates and the mantle at plate boundaries? (2.2, 2.3, 2.4, 2.5)

Evidence Sources and Reflection Opportunities

- Investigate the mantle using the Sim (2.1)
- Explore the properties of the mantle with a Silly Putty® model (2.1)
- Discuss the mantle and plate motion using unit vocabulary (2.1)

- Read "Listening to Earth" (2.2)
- Revisit "Listening to Earth" (2.3)
- Create a physical model of plate boundaries (2.3)
- Explore plate boundaries in the Sim (2.4)
- Model what happens at plate boundaries using the paper Modeling Tool (2.4)

Key Concepts

- Earth's plates move on top of a soft, solid layer of rock called the mantle. (2.1)

- At divergent plate boundaries, rock rises from the mantle and hardens, adding new solid rock to the edges of both plates. (2.4)
- At convergent plate boundaries, one plate moves underneath the other plate and sinks into the mantle. (2.4)

Application of Key Concepts to Problem

- Examine evidence about the South American and African Plates to identify the type of plate boundary (2.5)
- Model the plate boundary between the South American and African Plates (2.5)

Explanation That Students Can Make to Answer the Chapter 2 Question

Earth's plates move on top of a soft, solid layer of rock called the mantle. At divergent plate boundaries, rock rises from the mantle and hardens, adding new solid rock to the edges of both plates. At convergent plate boundaries, one plate moves underneath the other plate and sinks into the mantle. The South American and African Plates moved apart as a divergent boundary formed between them and an ocean basin formed and spread.

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Problem Students Work to Solve

Why are fossils of *Mesosaurus* separated by thousands of kilometers of ocean when the species once lived all together?

Chapter 3 Question

How did the *Mesosaurus* fossils on the South American Plate and African Plate get so far apart?

Investigation Questions

What do we know about plate motion that is currently taking place? (3.1)

What evidence do we have of past plate motion? (3.2, 3.3, 3.4)

Evidence Sources and Reflection Opportunities

- Watch *Plate Motion and GPS* video (3.1)
- Calculate rates of plate movement based on evidence from the Sim (3.1)
- Discuss the slow movement of plate boundaries using unit vocabulary (3.1)

- Read "A Continental Puzzle" (3.2)
- Revisit "A Continental Puzzle" (3.3)
- Reconstruct a map of Gondwanaland (3.3)

Key Concepts

- Earth's plates travel at a rate too slow to be experienced by humans. (3.1)

- It takes a long time for Earth's plates to travel great distances. (3.3)

Application of Key Concepts to Problem

- Examine and reason about evidence and claims related to plate motion (3.4)
- Write an argument for the claim that best answers the Chapter 3 Question (3.4)

Explanation That Students Can Make to Answer the Chapter 3 Question

Earth's plates travel at a rate too slow to be experienced by humans. It takes a long time for Earth's plates to travel great distances. The *Mesosaurus* fossils moved apart gradually over tens of millions of years.

Plate Motion: The Mystery of the *Mesosaurus* Fossils

Problem Students Work to Solve and the Chapter 4 Question

What best explains the pattern of volcanic activity and earthquakes on the Jalisco Block?

Application of key concepts to new problem

- Analyze and sort evidence based on claims (4.1)
- Participate in the Science Seminar (4.2)
- Reason about evidence and claims (4.3)
- Write an argument to support one claim (4.3)

Explanation That Students Can Make to Answer the Chapter 4 Question

One possible explanation students can make:
Convergent movement between the Jalisco Block and the Rivera Plate best explains the pattern of volcanic activity and earthquakes on the Jalisco Block. There is volcanic activity in the area, and volcanic activity can indicate the presence of a convergent plate boundary. Also, the pattern of earthquakes there is consistent with a convergent plate boundary, as these earthquakes occur near or at the plate boundary. There is a trench at the plate boundary, which indicates convergent movement because trenches form when one plate goes under another plate into the soft mantle below. Plates move toward each other at convergent plate boundaries, and we know the Rivera Plate is moving toward the Jalisco Block at a rate of 3 cm per year. Even though this seems very slow, plates move very slowly over time, so this is still evidence of convergent movement.