Changing Landforms Coherence Flowchart

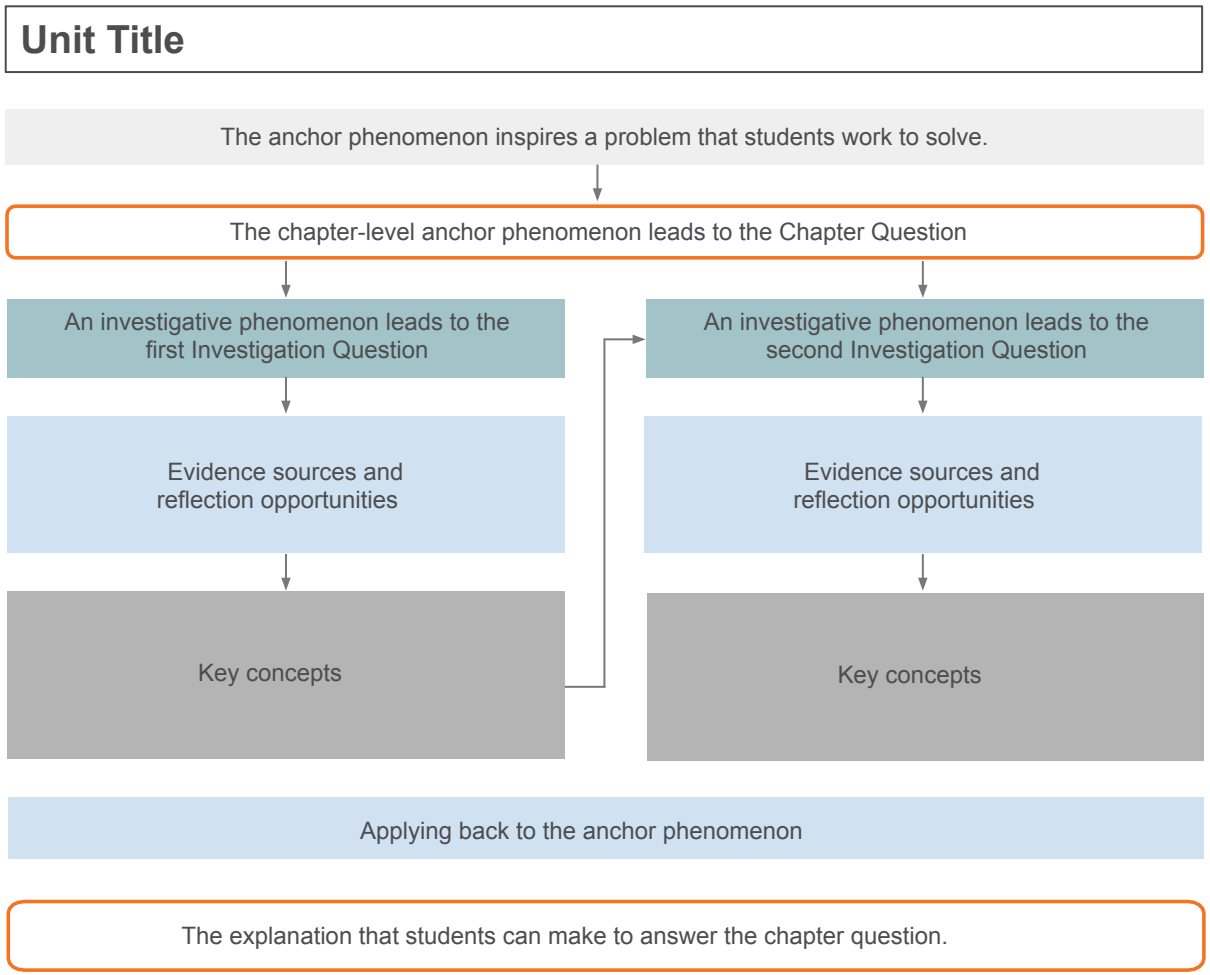
The storyline of the unit

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.

AmplifyScience

Changing Landforms: The Disappearing Cliff

Unit Anchor Phenomenon

Problem students work to solve

The cliff where Oceanside Recreation Center is situated appears to be receding.
Why is the edge of the ocean cliff closer to the flagpole than it used to be?

Chapter-level Anchor Phenomenon
Chapter 1 Question

The flagpole is closer to the edge of the ocean cliff than it used to be.
How did the edge of the cliff get to be so close to the flagpole?

Investigative Phenomena
Investigation Questions

Landforms can change.
What are landforms made of? (1.2)

Landforms can look different now than they did in the past.
How do geologists figure out how something changed when they can't observe it changing? (1.3-1.6)

Evidence sources and reflection opportunities

- Read *Landform Postcards* (1.1)
- Discuss and record ideas about landforms on Anticipatory Chart (1.2)
- Observe landforms in *Handbook of Land and Water* (1.2)
- Return to Anticipatory Chart and revise ideas (1.2)

- Observe sand samples and generate questions about sand (1.3)
- Compare sand samples (1.3)
- Read *Gary's Sand Journal* (1.4)
- Observe a mystery sand (1.4)
- Use evidence from observations of sand samples as evidence for how the sand got to be the way it is (1.5)
- Write and share explanations about sand samples (1.5)
- Use Hard Candy Model to gather evidence that sand and rock can change shape (1.6)

Key concepts

- Landforms are made of rock. (1.2)

- Even if geologists can't see a change happening, they can use models to visualize how it may have happened. (1.6)
- Even though rock is hard, it can change shape. (1.6)

Application of key concepts to problem

- Write an explanation as a class to answer the Chapter 1 Question (1.6)

Explanation that students can make to answer the Chapter 1 Question

The shape of the cliff changed when the rock it is made of changed.

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Unit Anchor Phenomenon

Problem students work to solve

The cliff where Oceanside Recreation Center is situated appears to be receding.
Why is the edge of the ocean cliff closer to the flagpole than it used to be?

Chapter-level Anchor Phenomenon
Chapter 2 Question

The rock of the cliff where Oceanside Recreation Center is situated receded.
How did the recreation center's cliff change?

Investigative Phenomena
Investigation Questions

Landforms made of rock can change.
What can make landforms change? (2.1- 2.2)

Water can change landforms made of rock.
How could water change a landform even though landforms are made of hard rock? (2.3-2.5)

Evidence sources and reflection opportunities

- Create diagrams of initial ideas about how landforms change (2.1)
- Observe and discuss images of landforms that have changed (2.1)
- Discuss and record ideas about water's role in landform change on Anticipatory Chart (2.2)
- Use Chalk Model to gather evidence about how water changes landforms (2.2)

- Read *What's Stronger?* (2.3)
- Discuss how water can change the shape of a landform (2.3)
- Create and share diagrams of landform change from *What's Stronger?* (2.4)
- Return to Anticipatory Chart and revise ideas (2.4)
- Use Chalk Model to gather evidence about the scale of erosion (2.5)
- Investigate the scale of erosion with pumice rocks (2.5)
- Use Building on Ideas routine to discuss how landforms change shape (2.6)

Key concepts

- The shape of a landform changes when water causes pieces of rock to break off. (2.4)
- Water hitting a landform causes tiny pieces of the landform to break off. (2.5)
- Scientists make diagrams to show their ideas about how the world works, based on evidence from investigations, models, and books. (2.6)

Application of key concepts to problem

- Create diagrams of the changing cliff at the recreation center (2.6)
- Write explanations to answer the Chapter 2 Question (2.6)

Explanation that students can make to answer the Chapter 2 Question

Water hit the cliff and caused tiny pieces of the cliff to break off and move away.

Changing Landforms: The Disappearing Cliff

Unit Anchor Phenomenon

Problem students work to solve

The cliff where Oceanside Recreation Center is situated appears to be receding.
Why is the edge of the ocean cliff closer to the flagpole than it used to be?

Chapter-level Anchor Phenomenon
Chapter 3 Question

The flagpole is closer to the edge of the ocean cliff than it used to be.
How did the recreation center's cliff erode without the director noticing?

Investigative Phenomena
Investigation Questions

Changes to landforms are big changes relative to the size of a rock eroded by water.
If erosion moves small pieces of rock, how can it cause a big change? (3.2-3.4)

Evidence sources and reflection opportunities

- Interpret maps in *Handbook of Land and Water* (3.1)
- Match side view photos of landforms to bird's-eye view maps of them (3.1)
- Create maps in digital Modeling Tool to represent landforms from above (3.1)

- Create maps of the Mountain Model (3.2)
- Erode the Mountain Model (3.2)
- Discuss scale in Mountain Model maps (3.2)
- Read about slow change over time in *Handbook of Land and Water* (3.3)
- Write about how small changes can accumulate to create a big change (3.3)
- Sort Erosion Cards according to how long erosion takes (3.3)
- Observe landform changes on maps (3.4)
- Model change over time using a digital Modeling Tool (3.4)
- Use Building on Ideas routine to reflect on scale of erosion (3.4)

Key concepts

- Maps show where water and land are and where different landforms are. (3.1)

- Many small changes that are hard to notice can add up to a bigger change that is easy to notice. (3.3)
- When many small changes happen over a long time, the whole landform changes. (3.4)

Application of key concepts to problem

- Write explanations to answer the Chapter 3 Question (3.5)
- Create diagrams of the cliff's erosion (3.5)

Explanation that students can make to answer the Chapter 3 Question

Because the pieces are so small, it took a really long time to observe a big change to the cliff.

Changing Landforms: The Disappearing Cliff

Unit Anchor Phenomenon

Another problem students work to solve

A nearby cliff eroded overnight..
How did a nearby cliff erode overnight?

Chapter-level Anchor Phenomenon
Chapter 4 Question

The ocean cliff by the flagpole eroded slowly but the nearby cliff eroded quickly.
Could the recreation center's cliff erode quickly?

Investigative Phenomena
Investigation Questions

Landforms can change quickly.
How can landforms erode quickly? (4.1-4.4)

Evidence sources and reflection opportunities

- Discuss and record ideas about what could cause a landform to erode quickly on Anticipatory Chart (4.1)
- Create diagrams to show initial ideas about how a cliff eroded quickly (4.1)
- Read about how landforms erode quickly in *Handbook of Land and Water* (4.1)
- Discuss the rate of erosion for landforms with cracks and landforms made of loose material (4.1)
- Model erosion of different materials with the Chalk and Sand Models (4.2)
- Observe a demonstration of how wind erodes landforms made of loose materials (4.2)
- Read *Making Models of Streams* (4.3)
- Reflect on similarities and differences between the real world and models used in the unit (4.3)
- Use a digital Modeling Tool to model the rate of erosion of different landforms (4.4)
- Use Building on Ideas routine to discuss rate of erosion of different landforms (4.4)

Key concepts

- Wind and water can erode a landform quickly if the landform is made of loose materials. (4.2)

Application of key concepts to problem

- Create diagrams to show new ideas about how the nearby cliff eroded (4.5)
- Write explanations to answer the Chapter 4 Question (4.5)
- Discuss solutions to slow or prevent erosion (4.5)

Explanation that students can make to answer the Chapter 4 Question

The nearby cliff eroded quickly because it is made of loose materials, such as clay and dirt, which are not as strong as rock. When wind or water hits the cliff, big pieces can break off. This causes the cliff to change more quickly than rock would.