Ecosystem Restoration Coherence Flowchart

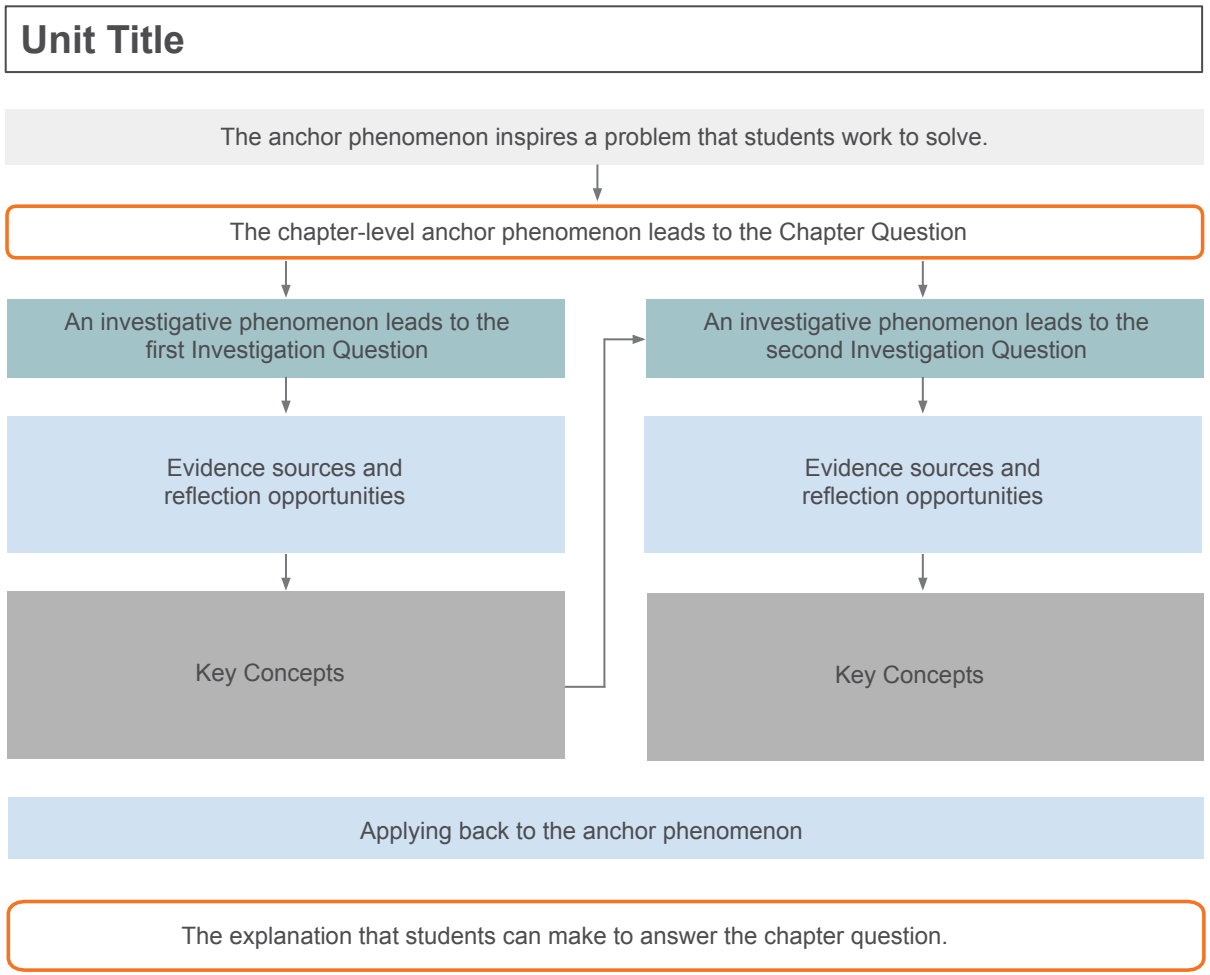
The storyline of the unit

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

Ecosystem Restoration: Matter and Energy in a Rain Forest

Unit Anchor Phenomenon
Problem students work to solve

The jaguars and sloths in the reforested part of the Costa Rican rain forest ecosystem are underweight and few in number.
Why aren't the jaguars and sloths in a reforested part of the Costa Rican rain forest ecosystem growing and thriving?

Chapter-level Anchor Phenomenon
Chapter 1 Question

The jaguars and sloths in the project area have lower average weights.
Why aren't the jaguars and sloths growing and thriving?

Investigative Phenomena
Investigation Questions

Some animals grow less than others.
How do animals grow? (1.3-1.6)

Animals eat food.
Where do food molecules in an ecosystem come from? (1.6-1.8)

Evidence sources and reflection opportunities

- Set up terrariums (1.2)
- Observe illustrations of ecosystems (1.2)

- Observe digital Scale Tool (1.3)
- Read first half of *Matter Makes It All Up* (1.3)
- Observe *Otter* video to gather evidence about how animals grow (1.4)
- Write arguments about how animals grow (1.4)
- Model how animals grow (1.4)
- Investigate how animals use food molecules in the Sim (1.5)
- Synthesize information from Sim and text (1.5)
- Use digital Food Matter Model to how how animals use food molecules (1.5)
- Discuss and make a scientific argument as a class about how animals grow (1.6)
- Use the Ecosystem Modeling Tool to model the flow of matter in an ecosystem (1.6)

- Read second half of *Matter Makes It All Up* (1.6)
- Use the Food Web Model to visualize and investigate food webs (1.7)

Key concepts

- Everything is made of matter. Matter is made of molecules. (1.3)
- Animals grow by changing food molecules into body molecules that can build their bodies. (1.5)
- Animals use some food molecules to release energy for movement and growth. (1.5)

- Food molecules in an ecosystem can always be traced back to plants. (1.7)

Application of key concepts to the problem

- Explain how animals in the project area grow and thrive (1.6)
- Engage in Evidence Circles to discuss the Chapter 1 Question (1.8)
- Write scientific arguments to answer the Chapter 1 Question (1.8)
- Create Rain Forest Restoration Plan 1 (1.8)

Explanation that students can make to answer the Chapter 1 Question

Jaguars eat the body matter of sloths as food so they can grow. They change the food molecules from the sloth into molecules that build their body matter or release energy for movement and growth. The sloths eat the body matter of cecropia trees as food so they can grow. They change the food molecules from the cecropia trees into molecules that build their body matter or release energy for movement and growth. Because there weren't enough cecropia trees in the failing rain forest ecosystem, the sloths and jaguars did not have enough food.

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Unit Anchor Phenomenon

Problem students work to solve

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Chapter-level Anchor Phenomenon

Chapter 2 Question

There are fewer, smaller cecropia trees in the project area.
Why aren't the cecropia trees growing and thriving?

Investigative Phenomena

Investigation Questions

Plants grow but do not eat.
Where do food molecules for plants come from? (2.1-2.3)

Organisms in an ecosystem move and grow.
Where does energy in an ecosystem come from? (2.4-2.5)

Scientists offer data and ideas to support their claims.
How do scientists convince others that their claims are correct? (2.4-2.5)

Evidence sources and reflection opportunities

- Analyze data from the project area (2.1)
- Observe plants in terrariums (2.1)
- Use the Sim to explore how plants get food molecules (2.1)
- Observe a balloon to investigate what is made of matter (2.1)
- Read *Energy Makes It All Go* (2.2)
- Synthesize information from text and Sim (2.2)
- Engage in the Leaves and Roots game (2.3)
- Use the Ecosystem Modeling Tool to show where plants get their food (2.3)
- Explain where cecropia trees in the project area get food (2.3)

- In the Sim, investigate where plants get their energy and where energy in an ecosystem comes from (2.4)
- Discuss claims about where energy in an ecosystem comes from (2.4)
- Create models of energy in an ecosystem (2.5)
- Read *Restoration Case Studies* (2.5)

- Read *Why Do Scientists Argue?*(2.6)

Key concepts

- Plants use water molecules, carbon dioxide molecules from the air, and energy from the sun to make food. (2.3)
- Animals and plants grow by changing food molecules into body
- molecules that can build their bodies. (2.3)

- Animals and plants use some food molecules to release energy for movement and growth. (2.4)
- Energy in an ecosystem can always be traced back to the sun (2.5)

- Scientists convince others that their claims are correct by using data and ideas as evidence. (2.6)

Application of key concepts to the problem

- Engage in Evidence Circles to discuss the Chapter 2 Question (2.7)
- Write scientific arguments to answer the Chapter 2 Question (2.7)
- Create Rain Forest Restoration Plan 2 (2.7)

Explanation that students can make to answer the Chapter 2 Question

Cecropia trees in the rain forest ecosystem make their own food. Like all plants, they use energy from the sun to turn carbon dioxide and water into food molecules. They change these food molecules into molecules that build their bodies or release energy. The cecropia trees must not be getting the sunlight, water molecules, or air molecules that they need to grow and thrive.

Ecosystem Restoration: Matter and Energy in a Rain Forest

Unit Anchor Phenomenon

Problem students work to solve

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Why aren't the jaguars and sloths in a reforested part of the Costa Rican rain forest ecosystem growing and thriving?

Chapter-level Anchor Phenomenon

Chapter 3 Question

The cecropia trees aren't growing in the soil of the project area, which has no organisms and is sandy with large chunks.
Why aren't the cecropia trees growing and thriving in the soil?

Investigative Phenomena

Investigation Questions

Soil is different in different places.
Why is the matter that makes up soil different in different places? (3.1-3.3)

Plants grow more in soil that has a lot of decomposers.
How do nutrients in the soil help plants grow? (3.4-3.5)

Evidence sources and reflection opportunities

- Analyze data from the project area (3.1)
- Analyze soil samples (3.1)
- Observe soil in terrariums (3.1)
- Read *Walk in the Woods* (3.2)
- Use the Sim to investigate the role of decomposers (3.3)
- Synthesize firsthand and secondhand information (3.3)
- Write arguments about why soil in the project area is different from soil in the healthy rain forest ecosystem (3.3)

- Analyze data from the project area (3.4)
- Use the Sim to investigate plant growth (3.4)
- Discuss the role of nutrients in an ecosystem (3.4)
- Use the digital Environments Model to to show
- what plants need to grow and thrive (3.5)
- Read *Restoration Case Studies* (3.5)
- Critique a scientific argument about soil (3.5)
- Use the Ecosystem Modeling Tool to show the impact of removing decomposers from an ecosystem (3.7)

Key concepts

- Decomposers release nutrients from dead plants and animals into the soil. (3.3)
- Animals, plants, and decomposers grow by changing food molecules into
- body molecules that can build their bodies. (3.3)
- Animals, plants, and decomposers use some food molecules to release energy for movement and growth. (3.3)

- Plants need nutrients to help make food for energy and body matter. (3.5)

Application of key concepts to the problem

- Engage in Evidence Circles to discuss the Chapter 3 Question (3.6)
- Write scientific arguments to answer the Chapter 3 Question (3.6)
- Create Rainforest Restoration Plan 3 (3.6)

Explanation that students can make to answer the Chapter 3 Question

Decomposers live in the soil in the rain forest ecosystem and use matter from dead organisms as food. Decomposers change the food molecules into molecules that build their own body matter or release energy for movement and growth, and decomposers also release nutrients into the soil. Nutrients in the soil are important for cecropia trees because they help the plants make food and body matter. Because there are not enough decomposers in the soil, there are not enough nutrients. This is the reason the cecropia trees are not