

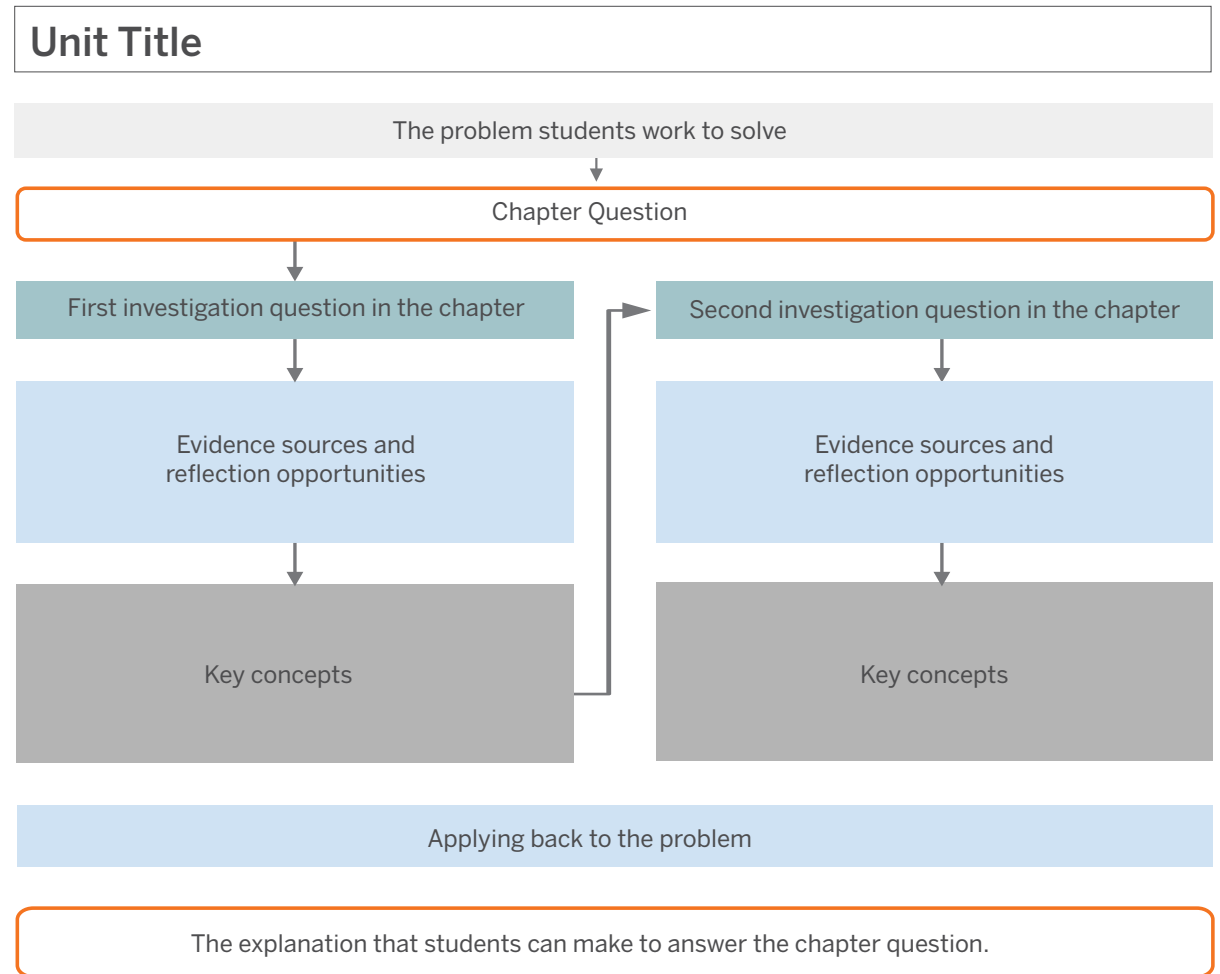
Matter and Energy in Ecosystems Coherence Flowchart

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.

Matter and Energy in Ecosystems: Biodome Collapse

The problem students work to solve

Chapter 1 Question

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

Why did the biodome ecosystem collapse?

Why didn't the plants and animals in the biodome have enough energy storage molecules?

Where do the energy storage molecules in an ecosystem come from? (1.2, 1.3, 1.4)

- Use the Sim to get evidence to answer the investigation question (1.2)
- Read "Sunlight and Life" (1.3)
- Revisit "Sunlight and Life" (1.4)
- Observe photosynthesis in the Sim (1.4)
- Use the Modeling Tool to show where the energy storage molecules in an ecosystem come from (1.5)

- Carbon is part of carbon dioxide, which is abiotic matter. Carbon is also part of energy storage molecules, which are biotic matter. (1.4)
- During the process of photosynthesis, producers make energy storage molecules, using carbon from carbon dioxide and energy from sunlight. This moves carbon from abiotic to biotic matter. (1.4)

- Examine graphs of sunlight, carbon dioxide, and water in the biodome to evaluate claims about why the plants and animals in the biodome didn't have enough energy storage molecules (1.6)
- Use the Reasoning Tool to connect the evidence about the biodome to a claim (1.6)

Producers make all of the energy storage molecules for an ecosystem through the process of photosynthesis, using carbon dioxide from abiotic matter. The organisms in the biodome did not have enough energy storage molecules because there was not enough carbon in abiotic matter.

What factors affect how many energy storage molecules producers are able to make? (1.5, 1.6)

- Use the Sim to find ways to decrease energy storage molecules in an ecosystem's living things (1.5)

- If one part of a system changes, this affects the rest of the system. (1.5)
- When there is more carbon (in the form of carbon dioxide) in abiotic matter, more carbon is available to producers for making energy storage molecules. (1.6)
- When there is less carbon (in the form of carbon dioxide) in abiotic matter, less carbon is available to producers for making energy storage molecules. (1.6)
- When there is more sunlight, producers can make more energy storage molecules from the carbon in carbon dioxide. (1.6)
- When there is less sunlight, producers cannot make as many energy storage molecules from the carbon in carbon dioxide. (1.6)

The problem students work to solve

Chapter 2 Question

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

Matter and Energy in Ecosystems: Biodome Collapse

Why did the biodome ecosystem collapse?

What caused carbon dioxide to decrease in the air (abiotic matter) of the biodome?

Where does the carbon dioxide in abiotic matter come from? (2.1)

- Sort different parts of an ecosystem according to initial ideas about whether they give off carbon dioxide or not (2.1)
- Observe video of an experiment to get evidence about whether producers and consumers give off carbon dioxide (2.1)
- Read and discuss *A Feast for Decomposers* (2.1)

Students figure out:

- Producers, consumers, and decomposers give off carbon dioxide to abiotic matter. (not key concepts)

How do organisms give off carbon dioxide? (2.2, 2.3)

- Compare cellular respiration in the Sim to a diagram depicting this process (2.2)
- Use the Modeling Tool to show how organisms give off carbon dioxide (2.2)

- As organisms release energy during cellular respiration, carbon dioxide is produced from the carbon in energy storage molecules. This process moves carbon from biotic to abiotic matter. (2.3)

- Use the Sim to test the claim that a decrease in decomposers led to a decrease in carbon dioxide in the air of the biodome (2.3)
- Use unit vocabulary to explain why the amount of carbon dioxide in the biodome decreased (2.3)

As organisms release energy during cellular respiration, carbon dioxide is produced from the carbon in energy storage molecules. This process moves carbon from biotic to abiotic matter. Carbon dioxide in the biodome decreased because decomposers decreased which means there was a decrease in cellular respiration overall.

Matter and Energy in Ecosystems: Biodome Collapse

The problem students work to solve

Chapter 3 Question

Investigation Question

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 3 Question

Why did the biodome ecosystem collapse?

What happened to the carbon that used to be in the air (abiotic matter) of the biodome?

If the amount of carbon changed in one part of a closed ecosystem, what happened to the carbon in the rest of the ecosystem? (3.1, 3.2)

- Read “Carbon in the Global Ecosystem” (3.1)
- Revisit “Carbon in the Global Ecosystem” (3.2)
- Model how carbon moves through an ecosystem by playing the Carbon Game (3.2)
- Use the Sim to get evidence about where the carbon that used to be in the abiotic matter of the biodome went. (3.3)

- Since carbon cannot be produced or used up, the total amount of carbon in a closed ecosystem does not change. (3.3)
- If the amount of carbon increased in abiotic matter, then it also decreased in biotic matter. If the amount of carbon decreased in abiotic matter, then it also increased in biotic matter. (3.3)

- Review the Biodome Files to get evidence to support a claim about what caused the decomposer population to decrease (3.3)
- Use the Sorting Tool to show the series of causes and effects that happened in the biodome ecosystem (3.4)
- Model how carbon moves through the different parts of the biodome ecosystem using the Modeling Tool (3.4)

Since carbon cannot be produced or used up, the total amount of carbon in a closed ecosystem does not change. The decrease in carbon in the abiotic matter and in living things in the biodome means there was an increase somewhere in the system—in this case in un-decomposed dead matter.

Matter and Energy in Ecosystems: Biodome Collapse

Problem students work to solve and the Chapter 4 Question

Application of key concepts to new problem

Explanation that students can make to answer the Chapter 4 Question

Why does deforestation lead to increased carbon dioxide in the air?

- Analyze and sort evidence based on claims (4.1)
- Participate in the Science Seminar (4.2)
- Use the Reasoning Tool to connect the evidence to the claims (4.3)
- Write an argument to support a claim (4.3)

One possible explanation students can make:

Deforestation leads to increased carbon dioxide because there is less photosynthesis. Less photosynthesis could cause carbon dioxide to increase because producers take in carbon dioxide from the air during photosynthesis to make energy storage molecules. The evidence that supports my claim is that after the forest was cut down, there were fewer trees and more grass plants in the ecosystem. This is important because trees and grass plants are two types of producers and producers are the only organisms that do photosynthesis. One tree produces a lot more energy storage molecules than one grass plant. If one tree produces a lot more energy storage molecules than one grass plant, then one tree must be doing more photosynthesis and taking in more carbon dioxide. Since the population of trees decreases a lot after deforestation and trees take in more carbon dioxide than grass plants, then there must be less carbon dioxide taken in by plants through photosynthesis, and more carbon dioxide stays in the air.