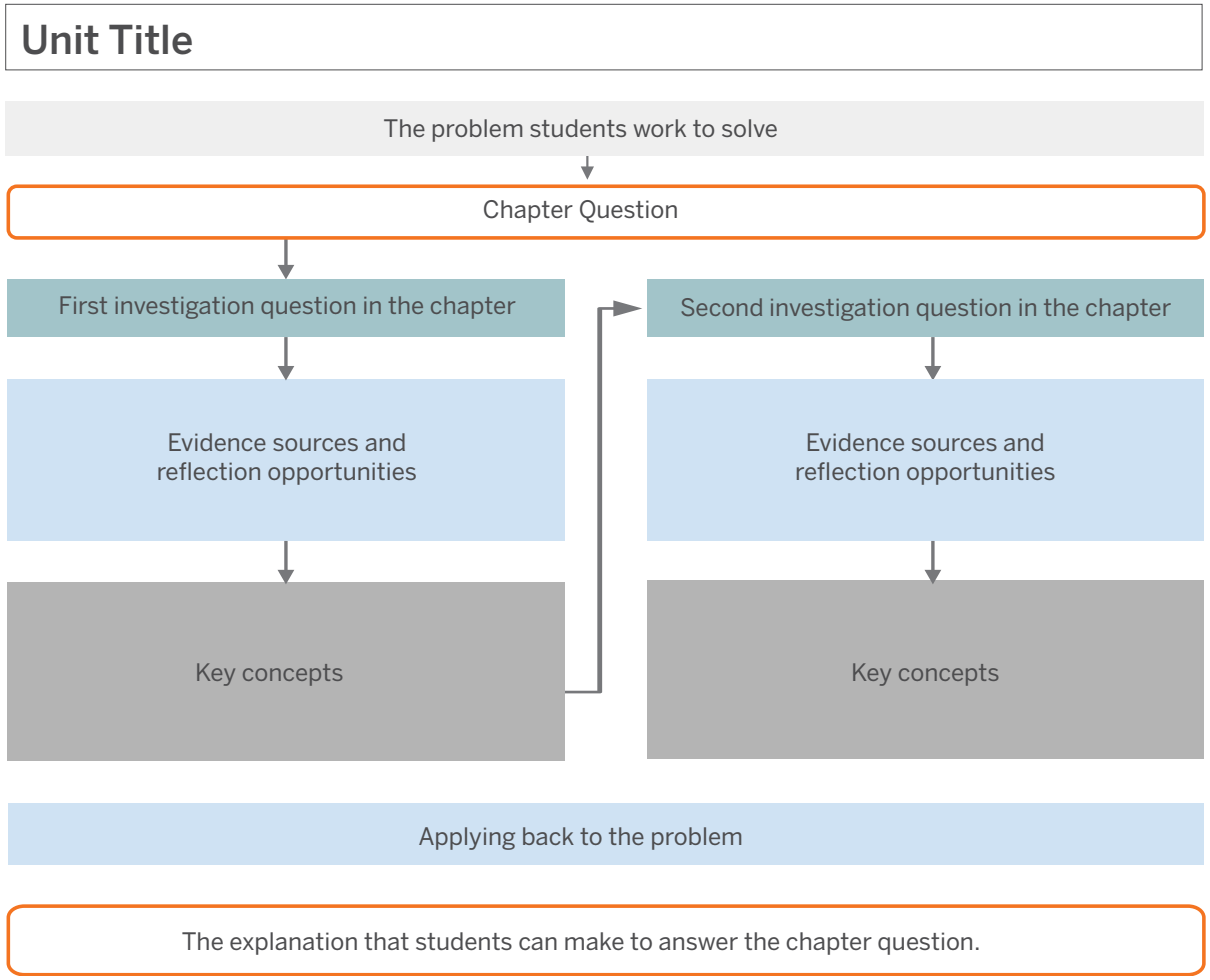
Weather Patterns Coherence Flowchart

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.

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Weather Patterns: Severe Storms in Galetown

The problem students work to solve

What caused Galetown to have more severe rainstorms?

Chapter 1 Question

What causes the rainfall in Galetown?

Investigation Questions

What makes rain happen? (1.2, 1.3)

What causes an air parcel to cool? (1.4, 1.5, 1.6)

Evidence sources and reflection opportunities

- Use the Sim to investigate how liquid water becomes water vapor (1.2)
- Use the Sim to observe what happens when water vapor cools. (1.3)
- Use plastic bags to create models of air parcels to observe the process of condensation. (1.3)

- Read "What Are Clouds?" (1.4)
- Revisit "What Are Clouds?" (1.5)
- Use the Sim to investigate the connections between energy transfer and the size of a rainstorm. (1.5)

Key concepts

- When liquid water becomes warmer it can evaporate and become water vapor in the air. All air contains water. (1.3)
- When water vapor in an air parcel cools, it can condense into liquid water which can form a cloud and fall as rain. (1.3)

- Energy transfers from warm air to cold air until their temperatures become equal. (1.5)
- The more an air parcel loses energy and cools, the more rainfall can happen. (1.5)

Application of key concepts to problem

- Use unit vocabulary to explain what causes the rainfall in Galetown. (1.6)
- Use the paper Modeling Tool to show how the amount of surface water caused different amounts of rain in Galetown (1.6)

Explanation that students can make to answer the Chapter 1 Question

When liquid water from the lake becomes warmer, it can evaporate and become water vapor in the air. All air contains water. When water vapor in an air parcel cools, it can condense into liquid water which can form a cloud and fall as rain. Energy transfers from warm air to cold air until the temperatures become equal. The more an air parcel loses energy and cools, the more rainfall can happen.

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Weather Patterns: Severe Storms in Galetown

The problem students work to solve

What caused Galetown to have more severe rainstorms?

Chapter 2 Question

Why is the amount of rain in Galetown different from storm to storm?

Investigation Question

What determines how much an air parcel will cool? (2.1, 2.2, 2.3, 2.4)

Evidence sources and reflection opportunities

- Use the Sim to observe how the initial temperature of an air parcel affects its final height (2.1)
- Observe an air parcel model (dry cleaner bag) rise when the temperature of the air parcel is higher than the temperature of the surrounding air (2.1)
- Read "Disaster in California!" (2.2)
- Revisit "Disaster in California!" (2.3)
- Use the Sim to investigate how the temperature of air can affect the amount of rain (2.3)

Key concepts

- The troposphere is warmest at the surface and coldest at its highest point. (2.1)
- If an air parcel is warmer than the surrounding air it will rise. (2.1)
- As an air parcel rises, energy transfers from the warm air parcel to the cold surrounding air until their temperatures become equal. (2.3)
- When an air parcel starts with a higher temperature, it will rise higher and lose more energy, causing more rainfall. (2.3)
- Systems go through periods of stability and periods of change. (2.4)

Application of key concepts to the problem

- Use unit vocabulary to explain what caused Galetown to have more severe rainstorms. (2.4)
- Use the paper Modeling Tool to show how warmer temperatures caused different amounts of rain for different storms in Galetown (2.4)

Explanation that students can make to answer the Chapter 2 Question

Warmer weather caused Galetown to have more severe rainstorms. When the temperature of an air parcel starts out higher, it will have to rise higher in the troposphere before the temperature of the air parcel and the surrounding air are equal. When the temperatures become equal the air parcel will stop rising. The higher the air parcel rises in the troposphere, the more energy the air parcel will lose and the more condensation can happen. This leads to more severe rainfall.

Weather Patterns: Severe Storms in Galetown

The problem students work to solve

What caused Galetown to have more severe rainstorms?

Chapter 3 Question

Why did the most recent storm in Galetown have the greatest amount of rain?

Investigation Question

How can wind affect the cooling of an air parcel? (3.1, 3.2)

Evidence sources and reflection opportunities

- Use syringes to feel air pressure and observe that air moves from high to low pressure (3.1)
- Watch a video modeling the effect of wind on air parcels (3.1)
- Use the Sim to investigate wind and how wind can affect an air parcel and the amount of rain it can produce (3.1)

Key concepts

- Air moving from areas of high pressure to areas of low pressure is wind. (3.1)
- Air parcels can be pushed up into the troposphere by wind (moving air). (3.1)

Application of key concepts to the problem

- Use the paper Modeling Tool to show how wind caused different amounts of rain in Galetown (3.3)
- Discuss the effect of surface water, temperature, and wind on storms in Galetown (3.3)

Explanation that students can make to answer the Chapter 3 Question

The lake, warmer weather, and stronger winds all caused the most recent storm to have the greatest amount of rain. The addition of the lake caused there to be more water available to evaporate into water vapor in the air parcel. The more water vapor in the air parcel, the more condensation can occur, and therefore, more rain. Warmer temperatures would cause the air parcel to rise higher in the troposphere. The air parcel then loses more energy, causing more rainfall. Wind pushes air parcels even higher in the troposphere, where it is colder. The air parcels will then lose more energy and more rain can happen.

Weather Patterns: Severe Storms in Galetown

Problem students work to solve and the Chapter 4 Question

How was the Carson Wilderness Education Center damaged?

Application of key concepts to new problem

- Evaluate the quality of evidence (4.1)
- Analyze and sort evidence based on claims (4.2)
- Participate in the Science Seminar (4.3)
- Write an argument to support a claim (4.3)

Explanation that students can make to answer the Chapter 4 Question

One possible explanation students can make:

The Carson Wilderness Education Center was damaged by one very severe storm. The conditions from May 16–20 could have caused a big storm that would have damaged the center. During May 16–20 there was a medium amount of water vapor in the air and the temperature was hot, 33°C. Because the air parcel was hot, it would have risen high through the troposphere, where it is colder. As it rose it would have lost energy to the surrounding air until it reached the same temperature as the cold air around it. When the water vapor lost energy, it would have condensed and fallen down as rain. Even though we don't know if there was wind to push the air parcel even higher, its very high starting temperature would mean that it would already rise high in the troposphere and would lose a lot of energy. So this one storm could have caused the damage to the center.