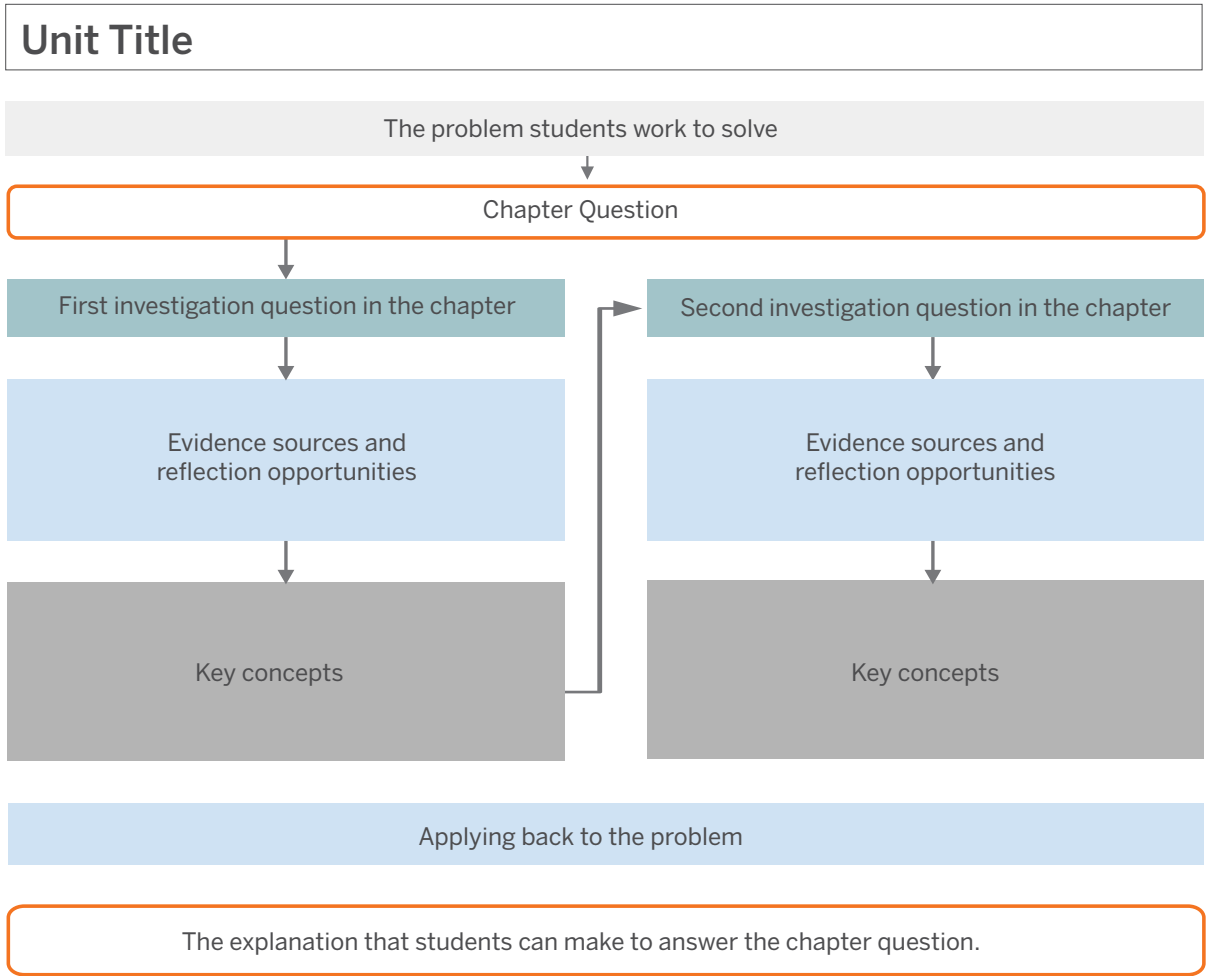
Light Waves Coherence Flowchart

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

Light Waves: Skin Cancer in Australia

Problem students work to solve

Why is there a higher rate of skin cancer in Australia than in other parts of the world?

Chapter 1 Question

How does light from the sun cause skin cancer?

Investigation Question

Why can light cause materials to change? (1.3-1.4)

Evidence sources and reflection opportunities

- Conduct a hands-on activity to observe evidence of energy from light (1.2)
- Use the Sim to identify a material that is changed by light from the sun and one that is not (1.3)

Key concepts

- The movement of energy can be tracked by observing the changes the energy causes to matter. (1.2)
- Light carries energy that causes materials to change. (1.2)
- When light hits a material, the material can absorb energy from the light. (1.3)
- When a material absorbs energy from light, the energy causes the material to change. (1.3)

Application of key concepts to problem

- Use the Sim to test effects of light from the sun on genetic material (1.3)
- Model how light can cause skin cancer with the paper Modeling Tool (1.4)
- Evaluate a claim explaining Australia's high skin cancer rate (1.4)

Explanation that students can make to answer the Chapter 1 Question

Light causes skin cancer because the energy from light can damage materials in cells. When light hits a material, the material can absorb energy from the light. When a material absorbs energy from light, the energy causes the material to change. Sunlight is causing the changes to cells that lead to skin cancer.

Light Waves: Skin Cancer in Australia

Problem students work to solve

Why is there a higher rate of skin cancer in Australia than in other parts of the world?

Chapter 2 Question

How can the same amount of sunlight cause different rates of skin cancer?

Investigation Questions

Is all light the same? (2.1-2.2)

What makes types of light different? (2.3-2.4)

Evidence sources and reflection opportunities

- Investigate different types of light with a hands-on activity (2.1)
- Watch a video showing the effects of light from different sources on sun paper (2.1)
- Read "Harvesting Sunlight" (2.2)

- Revisit "Harvesting Sunlight" (2.3)
- Investigate types of light in the Sim (2.3)
- Watch animations showing the shape of waves (2.3)
- Investigate the effect of different types of light on genetic material in the Sim (2.4)

Key concepts

- There are different types of light that can change a material in different ways. (2.2)

- A light source can emit more than one type of light. (2.3)
- Different types of light have different wavelengths. (2.3)
- A material absorbs energy from some types of light and not others. (2.4)

Application of key concepts to problem

- Model the effect of light on genetic material using the paper Modeling Tool (2.4)
- Use evidence to explain how melanin provides protection against skin cancer (2.5)
- Use new evidence about melanin to evaluate claims explaining Australia's high skin cancer rate.

Explanation that students can make to answer the Chapter 2 Question

Australia gets more ultraviolet light from sunlight than many other places do. Melanin in cells absorbs ultraviolet light and prevents it from being absorbed by other parts of the cell which can be damaged. Many people in Australia have low levels of melanin.

Light Waves: Skin Cancer in Australia

Problem students work to solve

Why is there a higher rate of skin cancer in Australia than in other parts of the world?

Chapter 3 Question

Why does Australia get more ultraviolet light than other parts of the world?

Investigation Questions

What can happen to light as it travels? (3.1-3.2)

What happens to energy when light is transmitted through or reflected off of a material? (3.3)

Evidence sources and reflection opportunities

- Investigate the path of light with a hands-on activity (3.1)
- Test how different types of light interact with materials in the Sim (3.1)
- Read "What Eyes Can See" (3.2)

- Observe reflection and transmission in the Sim (3.3)
- Revisit "What Eyes Can See" (3.3)

Key concepts

- Light travels in a straight line. (3.1)
- When a light wave hits a material, the light can be absorbed by the material, transmitted through the material, or reflected off the material. (3.1)
- A material transmits or reflects some types of light and not others. (3.2)

- When light is transmitted through or reflected off a material, the energy is not absorbed, so the material does not change. (3.3)

Application of key concepts to problem

- Model ultraviolet light in the atmosphere using the paper Modeling Tool (3.6)
- Use new evidence about substances in the atmosphere to evaluate claims (3.6)
- Write a final argument explaining Australia's high skin cancer rate (3.6)

Explanation that students can make to answer the Chapter 3 Question

Ozone in the atmosphere can absorb ultraviolet light, which stops the light from reaching Earth's surface, so people absorb less of it. Australia has less ozone than other places, like Brazil, and this is why Australia gets more ultraviolet light. The increased ultraviolet light in Australia helps explain why the skin cancer rate there is so high.

Light Waves: Skin Cancer in Australia

Problem students work to solve and the Chapter 4 Question

Can the crabs see the plankton they eat near the ocean floor?

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:
The crabs cannot see the plankton they eat near the ocean floor. For the crabs to see the plankton, some color of visible light would need to reach the plankton so that it can be reflected into the crabs' eyes. Any visible light that reaches the ocean floor can be seen by the crabs, but no visible light reaches the ocean floor. Red, blue, indigo, and violet light cannot transmit down that far because they are absorbed by the ocean water. Orange gets close, but it must not reach the plankton because a fish that looks orange at the surface cannot be seen where the crabs live. That means that orange light is not getting down to the plankton. Even though yellow light could reach down that far, the algae at the surface absorb yellow light, and there is a lot of algae in the ocean. When light is absorbed, the energy goes into the algae and the light stops, so the yellow light cannot reach the plankton. Green light can also transmit down to where the crabs and the plankton live, but the algae reflect green light. If the green light is reflected sideways or up, it cannot reach the plankton. Since the water and algae absorb or reflect all colors of visible light, there is no visible light that reaches the plankton or the crabs' eyes.