Light and Sound Coherence Flowchart

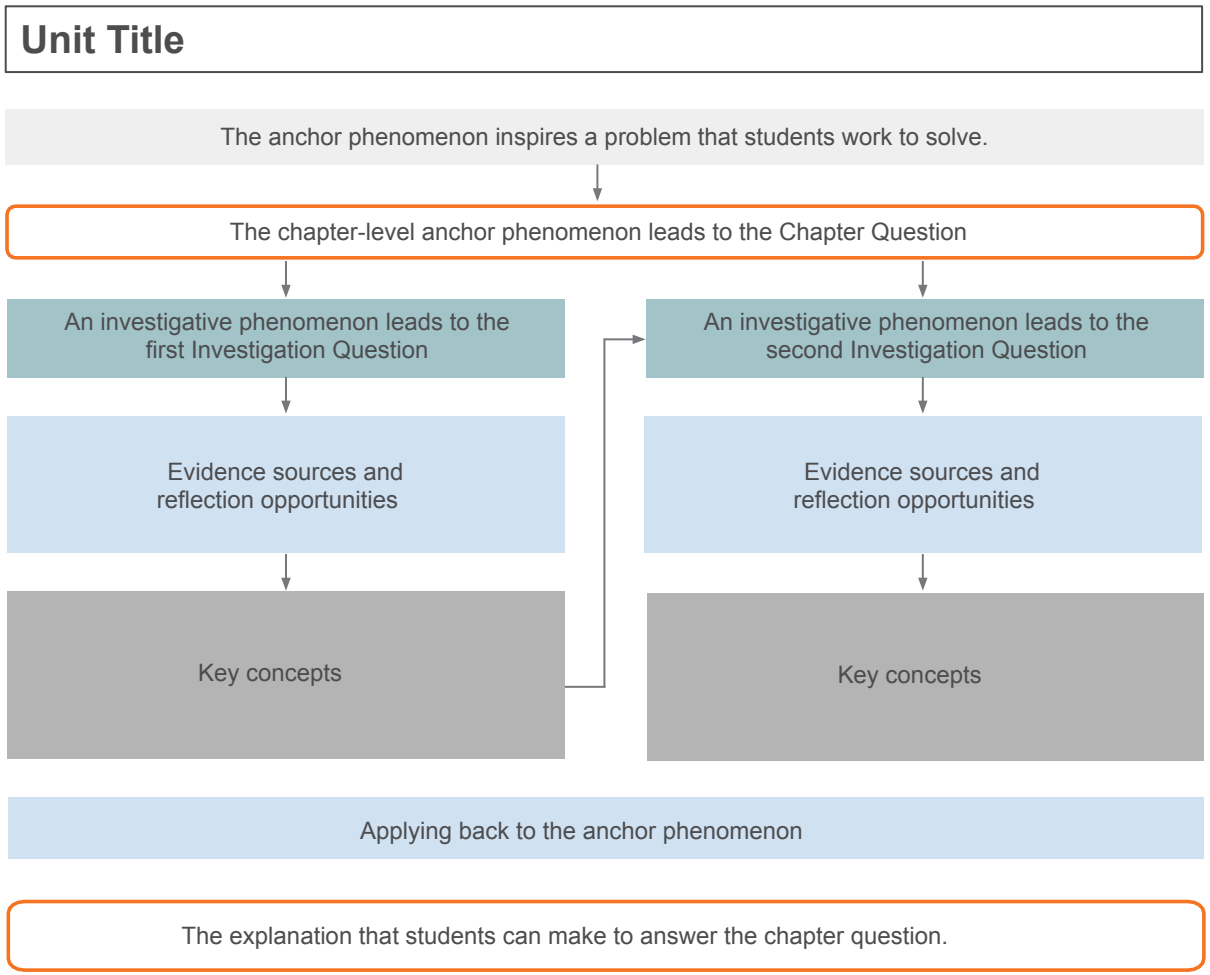
The storyline of the unit

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

Light and Sound: Puppet-Theater Engineers

Unit Design Problem

Problem students work to solve

We want to make light and dark scenery for a puppet theater.
How can we use light to design shadow scenery for a puppet theater?

Chapter-level Anchor Phenomenon
Chapter 1 Question

Puppet show scenes have brighter and darker areas.
How do we make brighter or darker areas?

Investigative Phenomena
Investigation Questions

Some places are dark. Some places are bright. *What makes something look bright or dark? (1.2)*	Some surfaces are bright. Some surfaces are dark. *Where does the light come from that makes surfaces look bright or dark? (1.3-1.4)*	Some surfaces are bright. Some surfaces are dark. *What makes a surface look bright or dark? (1.5) (Revised from 1.2)*

Evidence sources and reflection opportunities

• Browse *Engineering with Light and Sound* reference book (1.1)
• Explore how to make the classroom completely dark (1.2)
• Observe a video of a very dark cave (1.2)
• Read *Can You See in the Dark?* (1.2)
	• Search for light sources around the school in a Light Source Hunt (1.3)
	  ○ Write about light sources (1.4)
	  ○ Revisit Can You See in the Dark? (1.4)
	• Practice using cause and effect to explain everyday scenarios (1.4)
	• Use Explanation Language Frame to explain bright areas in Can You See in the Dark? (1.4)
		• Investigate how to make surfaces look bright (1.5)
		• Diagram light making a surface bright (1.5)

Key concepts

• Light makes things look bright. (1.2) • You need some light to see. (1.2)	• All light comes from a source. (1.4)	• When light from a source gets to a surface, the surface looks bright. (1.5)

Application of key concepts to problem

- Use Explanation Language Frame to explain bright and dark areas (1.5)
- Shared Writing to explain the Chapter 1 Question (1.5)

Explanation that students can make to answer the Chapter 1 Question

Without light, we cannot see. Light comes from a source and travels to a surface. Light from the source must be getting to the surface in order to make some parts of the surface look bright. If there is no light source, a surface looks dark.

Light and Sound: Puppet-Theater Engineers

Unit Design Problem

Problem students work to solve

We want to make light and dark scenery for a puppet theater.
How can we use light to design shadow scenery for a puppet theater?

Chapter-level Anchor Phenomenon
Chapter 2 Question

Puppet show scenes have brighter and darker areas.
How do we make a dark area in a bright puppet show scene?

Investigative Phenomenon
Investigation Question

Some areas of a surface can be dark even when there is a light source.
How do we stop light from getting to one part of a surface? (2.1-2.3)

Evidence sources and reflection opportunities

- Explore how to make shadows of different shapes and sizes around the classroom (2.1)
- Use Explanation Language Frame to explain how shadows were formed (2.1)
- Draw and write engineer's notes about making shadows (2.1)
- Read What Made This Shadow? (2.2)
- Engage in kinesthetic Blocking Model to show how shadows are made by blocking light (2.2)
- Sort shadow cards (light source, blocking object, shadow) (2.2)
- Draw and write to explain how shadows formed in What Made This Shadow? (2.2)
- Investigate how different materials block light using Investigation Kits (2.3)

Key concepts

- When light is blocked by an object, the surface behind the object looks dark, and we call this a shadow. (2.2)
- When light is blocked by a material, the surface behind the material looks dark, and we call this a shadow. (2.3) (Revised from 2.2)

Application of key concepts to problem

- Design, test, and evaluate a cutout to form a dark area in the puppet scene (2.4)
- Diagram how the designed cutout blocks light in the puppet scene (2.5)
- Use Explanation Language Frame and Writing Planner to explain the Chapter 2 Question (2.5)

Explanation that students can make to answer the Chapter 2 Question

A dark area is the result of putting an object between a light source and a surface. When an object blocks a light source, the surface behind the object looks darker. This dark area is called a shadow.

Light and Sound: Puppet-Theater Engineers

Unit Design Problem

Problem students work to solve

We want to make light and dark scenery for a puppet theater.
How can we use light to design shadow scenery for a puppet theater?

Chapter-level Anchor Phenomenon
Chapter 3 Question

Puppet show scenes have bright, medium bright, and dark areas.
How do we make bright, medium bright, and dark areas in a puppet show scene?

Investigative Phenomenon
Investigation Question

A surface can have a medium-bright area.
How do materials make areas on a surface that are not dark? (3.1)

Evidence sources and reflection opportunities

- Investigate and compare materials that do not block light using Investigation Kits (3.1)
- Read Let's Test! (3.2)
- Organize and analyze results of the investigation in Let's Test! (3.2)
- Engage in kinesthetic Passing Through Model to show how bright and medium bright areas are made (3.2)
- Use Explanation Language Frame to explain bright, medium bright, and dark areas (3.2)
- Diagram light passing through materials to create bright and medium bright areas on a surface (3.3)
- Revisit Engineering with Light and Sound to find examples of solutions engineers created that require completely blocking or partially blocking light (3.3)

Key concepts

- When all light passes through a material, the surface behind the material looks bright. (3.3)
- When some light passes through a material, the surface behind the material looks medium bright. (3.3)

Application of key concepts to problem

- Plan, make, and test puppet scene stencils to create areas of varying brightness (3.4)
- Revisit Let's Test to figure out how engineers iterate on designed solutions (3.5)
- Test and revise puppet scene stencils to meet design goals, then diagram solutions (3.5)
- Use Explanation Language Frame to compose oral and written explanations for the Chapter 3 Question (3.6)

Explanation that students can make to answer the Chapter 3 Question

Different materials let different amounts of light pass through. Bright areas are the result of all or almost all the light passing through an object and reaching a surface. This happens if there is no object or if the object is transparent. Medium bright areas result when only some of the light passes through and reaches the surface. Dark areas happen because no light passes through an object. Light is blocked, so the surface looks dark.

Light and Sound: Puppet-Theater Engineers

Unit Design Problem

Another problem students work to solve

We want to make sound effects for the puppet show.
How can we use sound to make sound effects for a puppet show scene?

Chapter-level Design Problem
Chapter 4 Question

We want to use sound sources to design sound effects for the puppet show.
How do we design a sound source to go with a puppet show scene?

Investigative Phenomenon
Investigation Question

Sometimes something will start to make a sound.
What happens when something starts making a sound? (4.1-4.3)

Evidence sources and reflection opportunities

- Search for sound sources around the school in a Sound Source Hunt (4.1)
- Investigate how objects start to make sounds in Sound Source Stations (4.1)
- Search for sound source solutions in Engineering with Light and Sound (4.1)
- Observe a vibrating object making sound (4.2)
- Investigate vibration by revisiting Sound Source Stations (4.2)
- Read What Vibrates? (4.2)
- Revisit What Vibrates? to identify what parts of a sound-making object vibrate (4.3)
- Construct explanations of how objects in the Sound Source Stations made noise by writing I Hear a Sound. What Vibrates? mini-books (4.3)

Key concepts

- All sound comes from a source. (4.1)
- A source makes a sound because part of it is vibrating. (4.3)

Investigative Phenomenon
Investigation Question

There are different kinds of sounds.
*How do we make different vibrations to make different kinds of sounds for our puppet show scenes? (4.4)**

Application of key concepts to problem

- Plan and make sound sources to accompany puppet scenes (4.4)
- Test and revise sound sources based on design goals (4.4)
- Complete I Hear a Sound. What Vibrates? mini-books with an explanation of designed puppet scene sound source (4.5)

Explanation that students can make to answer the Chapter 4 Question

Sound has a source, just like light does. Sound is made when an object vibrates. The object that vibrates is the source of the sound. Like light, sound also travels. Sound travels from the source to our ears. You can start and stop sound by starting and stopping the vibration of an object.

*This Investigation Question guides application of key concepts to the problem.