

Patterns of Earth and Sky Coherence Flowchart

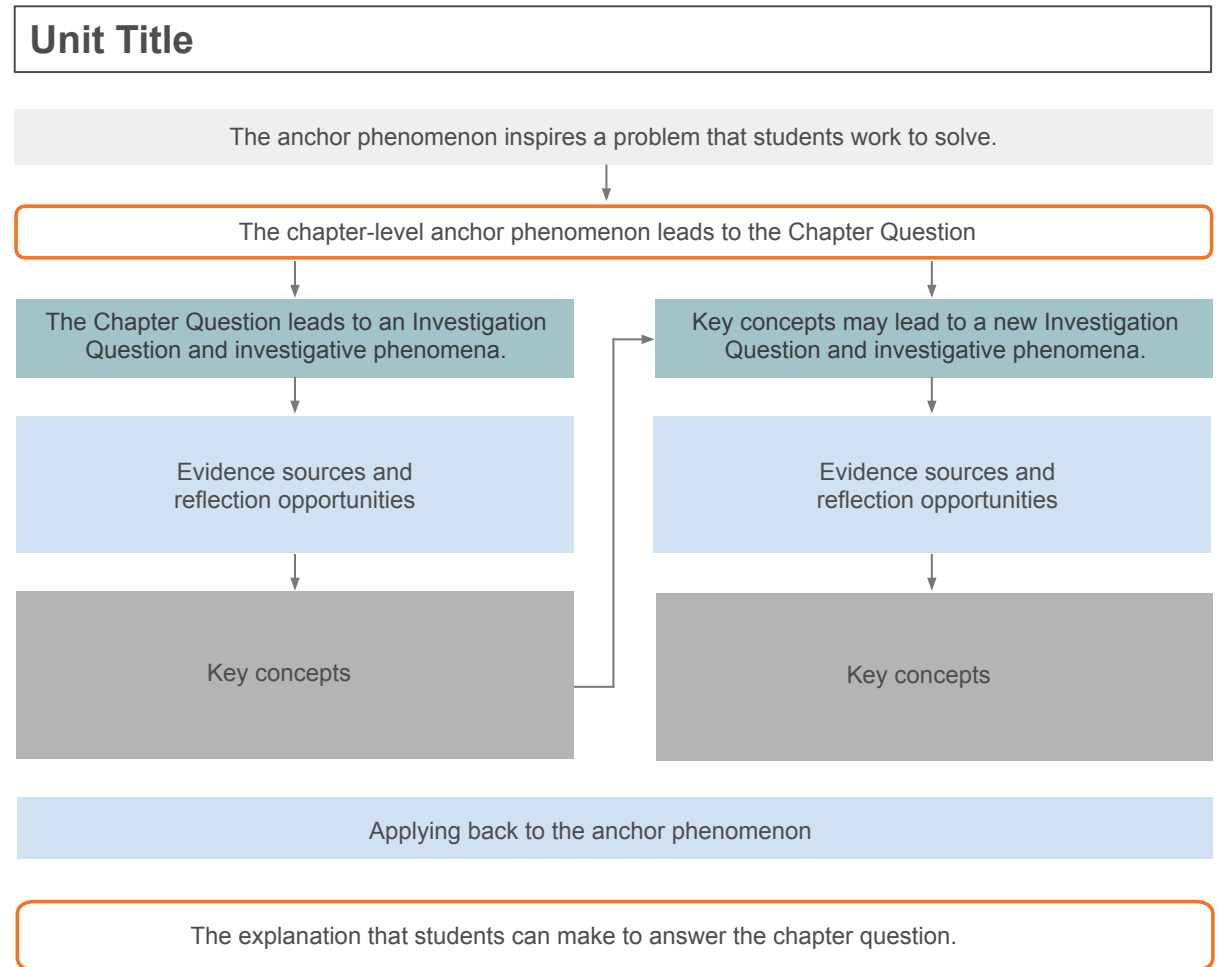
The storyline of the unit

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.

Patterns of Earth and Sky: Analyzing Stars on Ancient Artifacts

Unit Anchor Phenomenon

Problem students work to solve

Different stars are visible in the sky at different times

Archaeologists discovered part of an ancient artifact that depicts the sun and other stars. How can we figure out what would have appeared on the missing piece?

Chapter-level Anchor Phenomenon

Chapter 1 Question

In the daytime the sun is visible in the sky but other stars are not. Why don't we see a lot of stars in the daytime?

Investigation Questions

Where are the stars in space? (1.2–1.4)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

If the stars are all around us, why can't we always see them? (1.5–1.6)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

Evidence sources and reflection opportunities

- Compare models of Earth (1.2)
- Read *How Big Is Big? How Far Is Far?* (1.3)
- Investigate distances to stars in the Sim (1.4)
- Create a physical model of Great Square of Pegasus (1.4)
- Compare representations of stars (1.4)

- Observe stars in the Sim (1.5)
- Investigate size and distance of stars with a physical model (1.5)
- Read about star visibility in *Handbook of Stars and Constellations* (1.6)
- Watch *Lost in Light* video (1.6)
- Discuss why we can't always see stars using unit vocabulary (1.6)

Key concepts

- Stars are very far away from Earth in every direction. (1.4)
- The sun is the only star in our solar system. Other stars are far outside our solar system. (1.4)

- The sun looks bigger and brighter because it is much closer to Earth than other stars. (1.6)
- The sun is the only star we can see in the daytime because the sun looks so bright. (1.6)

Application of key concepts to the problem

- Discuss the Chapter 1 Question in pairs (1.7)
- Write a scientific explanation to answer the Chapter 1 Question (1.7)
- Discuss ideas about the artifact (1.7)

Explanation that students can make to answer the Chapter 1 Question

The stars are all around Earth in every direction. Because the sun is much closer to Earth than all other stars it appears bigger and brighter. The sun's brightness overwhelms the brightness of all other stars during the daytime, and that is why we can see only the sun during the daytime. This is why the artifact doesn't show the sun and the other stars being visible at the same time.

Patterns of Earth and Sky: Analyzing Stars on Ancient Artifacts

Unit Anchor Phenomenon

Problem students work to solve

Chapter-level Anchor Phenomenon

Chapter 2 Question

Investigation Questions

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 2 Question

Different stars are visible in the sky at different times
Archaeologists discovered part of an ancient artifact that depicts the sun and other stars. How can we figure out what would have appeared on the missing piece?

Sometimes the sun is visible in the sky, sometimes it is not.
Why is the sun up sometimes, but not other times?

What causes the daily pattern of when we see the sun and other stars? (2.1–2.3)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

- Use the Mount Nose Model to visualize the view from Earth. (2.1)
- Investigate patterns of when the sun and other “stars are visible” in the Sim (2.2)
- Watch the *One Year on Earth* video (2.3)
- Revisit the Mount Nose Model (2.3)
- Model the daily pattern of how stars look from different places on Earth using the digital modeling tool (2.3)

- Scientists plan investigations to answer their questions. They think about what they will observe and record, as well as what they will keep the same. (2.2)
- Earth spins once each day. We face the sun in daytime, and we face away from the sun at nighttime. (2.3)

- Use the Mount Nose Models and images of the Sun and Orion to discuss the Chapter 2 Question (2.3)
- Write a scientific explanation to answer the Chapter 2 Question (2.6)
- Revisit the artifact and identify one constellation (2.6)

The sun is only up sometimes and not at other times because Earth spins once per day. Since gravity pulls us down toward Earth, we are carried with Earth as it spins. What we see up above us changes as we spin. When the side of Earth we are on faces the sun, the sun is up in the sky. When Earth spins to face away from the sun, the sun is not up, and we can see other stars. This is why each artifact panel shows a repeating pattern: the sun is in the sky, then other stars are in the sky, and so on.

If Earth is spinning, which way is up? (2.4–2.5)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

- Watch a video to observe the way things fall (2.4)
- Read *Which Way is Up?* (2.4)
- Model which way is up using the digital modeling tool (2.5)
- Use the Spinning Globe Model to visualize what people see in the sky (2.5)
- Model how people on opposite sides of the Earth can see the same things in the sky at different times using the digital modeling tool (2.5)

- Earth pulls objects down toward the ground with the force of gravity, so up is away from the ground, anywhere on Earth. (2.5)

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Unit Anchor Phenomenon

Problem students work to solve

Chapter-level Anchor Phenomenon

Chapter 3 Question

Investigation Questions

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

Different stars are visible in the sky at different times
Archaeologists discovered part of an ancient artifact that depicts the sun and other stars. How can we figure out what would have appeared on the missing piece?

Different stars are visible in the nighttime sky at different times of year.
Why do we see different stars at different times of year?

Do we see different stars at different times of year? (3.1)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

- Investigate stars visibility throughout the year in the Sim (3.1)
- Share ideas about why we see different stars at different times of the year. (3.1)

- Throughout the year, we see different stars. But every year on the same date, we see the same stars. (3.1)

What causes the yearly pattern of stars that we see? (3.2–3.5)
(Note: See Lesson Overviews for lesson-level Investigative Phenomena)

- Construct a constellation poster (3.2)
- Make a classroom model of Earth, the Sun, and stars (3.2)
- Investigate star visibility for one year in the Sim (3.3)
- Read *The Dog Days of Summer* (3.4)
- Model how Earth's orbit affects visibility patterns of stars using the digital modeling tool (3.5)

- Earth orbits the sun at the same time as it spins. (3.3)
- Earth's position in its yearly orbit determines which stars we see in the night sky. (3.4)

- Identify more constellations on the artifact (3.5)
- Write a scientific explanation about why the sky looks different in different sections of the artifact (3.6)

As Earth spins, it also orbits around the sun once a year. This means that Earth is in different places around the sun at different times of the year. Different stars can be seen up in the sky when the side of Earth we are on faces away from the sun at these different points around the sun. This is why the artifact shows different constellations in the different nighttime panels.

Patterns of Earth and Sky: Analyzing Stars on Ancient Artifacts

Unit Anchor Phenomenon

Problem students work to solve

Chapter-level Anchor Phenomenon

Chapter 4 Question

Opportunities to engage in practices and apply key concepts

Practice that students can do in response to the Chapter 4 Question

Different stars are visible in the sky at different times
Archaeologists discovered part of an ancient artifact that depicts the sun and other stars. How can we figure out what would have appeared on the missing piece?

Different stars are visible on different nights.
How can we investigate why we see different stars on different nights?

- Read *Star Scientist* (4.1)
- Choose a question to investigate. (4.1)
- Practice giving feedback on an investigation plan (4.2)
- Plan an investigation and revise based on feedback (4.2)
- Conduct and revise the investigation in the Sim (4.3)

Students can more independently plan and carry out investigations that use systematic observations to figure out why we see different stars on different nights.