LESSON

02 Sky Patterns Over Time

Activity Guide, pages 264–265

Students can engage in the Can You Explain It? content by observing the photograph or by exploring the corresponding video online.

ONLINE Ed View a video related to sunsets.

ANCHORING PHENOMENON

From one day to the next, the time the sun sets at a location changes.

PHENOMENON EXPLAINED

Sunsets at the same location on consecutive days may look exactly the same, but because of Earth's motion in space the sunsets' times are different.

Lesson Objective

Students can explore patterns observed over different time scales and caused by Earth's motion and its interactions with the sun and moon. They collect and analyze data to detect patterns, including the path of the sun across the day sky, the movements of constellations in the night sky, and hours of sunlight.

Support Discovery

The following prompts can be used to guide student-led discovery.

I notice . . .

After observing the photograph or watching the video, students should record what they noticed about the sunset. If students struggle to record observations, ask them to focus on changes in the amount and color of light in the sky as the sun's position changes in the video, or ask them to focus on how the sky in the photograph looks different than the daytime sky.

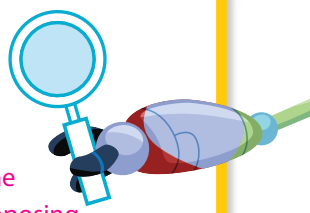
Sample answer: I notice that the sky is multiple colors. I notice that the landscape is darker than it would be during the day.

I wonder . . .

After observing the photograph or watching the video, students should record what they want to find out more about regarding the time the sun appears to set. If students struggle to record what they want to know more about, ask them to work with a partner to brainstorm as many questions as they can.

Sample answer: I wonder if the sun sets at the same time every day. I wonder what determines when the sun sets. The sun looks like it disappears because Earth is round and spinning.

Can You Explain It?



In the Can You Explain It?, students make an initial claim that explains the **Anchoring Phenomenon.**

Sample answer: Students may draw a model of a sunset with Earth and the sun, or they may write a sentence proposing a cause for the variation in the time of sunset.

In the lesson, students gather evidence about the motion of Earth in space. This will enable them to give a more complete explanation of the **Anchoring Phenomenon** at the end of the lesson.

Alternative Phenomenon

If students are unfamiliar with observing the position or timing of the setting sun, discuss other observations they might have made of the sun, such as how high it gets in the sky in summer versus winter or how the path it takes across the sky varies with the seasons.

SOCIAL EMOTIONAL LEARNING

Guide students to reflect on their goals from previous lessons and on any feedback they received from their teachers or peers. Then, have each student set a personal goal for this lesson and make a plan for how to achieve the goal. Throughout the lesson, take daily breaks for students to track their progress in meeting their goals. As students move from lesson to lesson, they can continue to work towards their initial goals or set new ones. If students struggle setting goals for this lesson, share with them some of the following ideas: connecting Earth's motion in space to observable patterns in the sky, interpreting data, identifying patterns in natural phenomena, or participating more during activity/group work.

LESSON 02

FUNomenal READER

Searching for Sunrise

HMH

WHEN TO USE

SCIENCE 30 min

- Anchoring Phenomenon / Alternative Phenomenon
- Options for ELA Instruction
- Build on Prior Knowledge
- Preview the Phenomenon
- Read to Learn
- Support Sense Making
- Science Stretch
- Check for Comprehension

Option 1 Use before students begin the lesson in the Activity Guide to provide an engaging model to introduce the lesson's phenomenon.

Option 2 Use after students have completed the Activity Guide to reinforce students' understanding of the lesson phenomenon by exploring a related phenomenon.

ELA 20 min

- Options for ELA Instruction
- Build on Prior Knowledge
- Read to Learn

Option 3 To use during designated ELA Reading time for independent reading, whole-class instruction, or small-group instruction, look for this icon: ELA

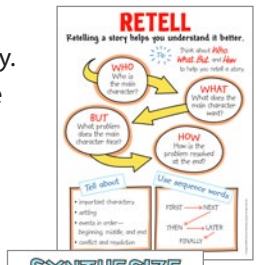
Plan

ANCHORING PHENOMENON / ALTERNATIVE PHENOMENON

The anchoring phenomenon in the Activity Guide is *From one day to the next, the time the sun sets at a location changes.* The main example is a photo of the sun appearing to set over mountains. The FUNomenal Reader presents a similar phenomenon *(From one day to the next, the time the sun rises at a location changes),* and the example is a girl who wonders why the sun appears in a different place in the sky each day at 7 a.m. Both present the same science concepts and cover the same standards but with different phenomena. Guide students to draw connections between the two situations and to understand the underlying principle: daily patterns in the sky are caused by interactions and relative positions of bodies in the solar system.

Options for ELA Instruction ELA

Choose one of the following anchor chart options and project it or print copies. Then display and introduce the chart before reading the text.



Retell Use the *Retell Anchor Chart* to help gauge students' understanding of the concepts in the story. Pair students and have them take turns retelling the story, focusing on the problem the main character addresses (why it gets light later each morning) and the resolution of that problem (learning about the effects on Earth of bodies in the solar system).

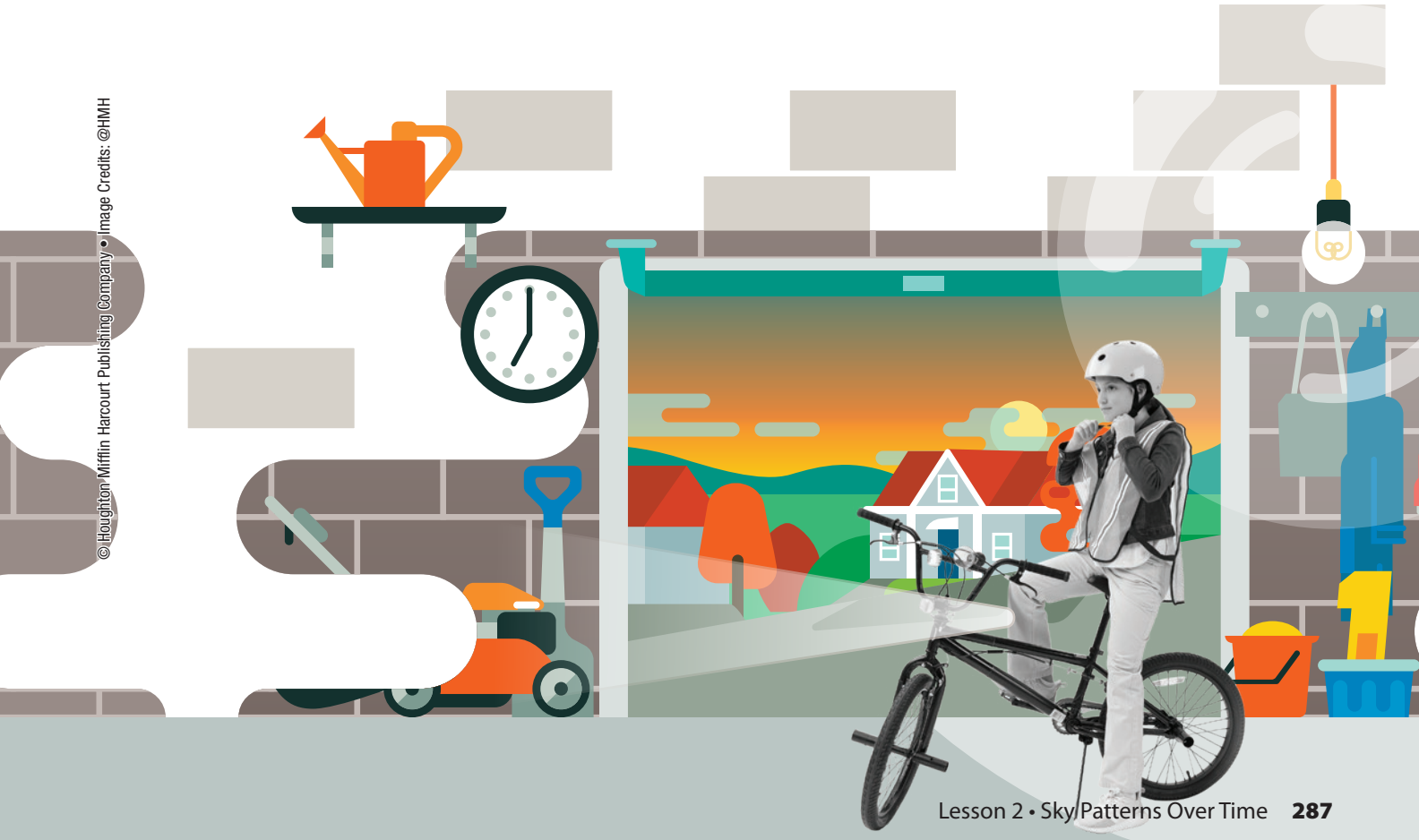
Synthesize Have students take what they already know about patterns in the sky and add it to what they learn in the story. After reading, they can synthesize their new understanding by applying it to their own daily schedule and future plans. They can use the *Synthesize Anchor Chart* as a guide.

Research In the story, Rylie does online research to learn more about sunrise times throughout the year. Have students refer to the *Research Anchor Chart* as a reminder of good sources to use when doing their own research.

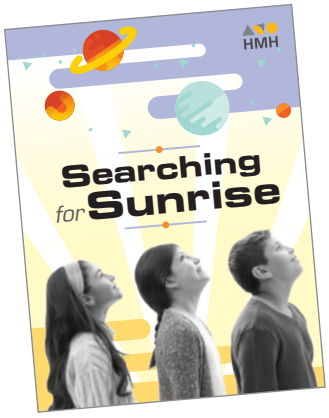
Preview

Build on Prior Knowledge Have students discuss the kinds of patterns they see in relation to day and night. For example, they know that the sun "comes up" every morning and "goes back down" at night. They know that on most nights the moon can be seen, although it may appear to vary in size and shape.

Preview the Phenomenon Ask students to study the photos and illustrations on page 2–3 of the story, which show a girl getting ready to ride her bike to school at 7 a.m. The two scenes are alike except for the clothes she is wearing, the color of the sky behind her, the sun's position, and that her bike light is on. Encourage students to record the first questions that come into their minds about why the scenes might be slightly different. Point out that their questions might change as they read through the selection. Have them keep their questions nearby and periodically check to see if any can be answered.



Searching for Sunrise (continued)



Discover

Read to Learn ELA

The **Read to Learn** suggestions inside the book's front cover encourage students to interact with the book multiple times for different purposes.

Preview Students look for unfamiliar words and share them with a partner. New terms may include *axis, revolve,* and *hemisphere.* Have students look up words they aren't sure about and notice how they are used in the context of the story.

Skim Students skim the photos and illustrations. Have them turn to a partner and share their predictions of what the story will be about.

Read As students read the story, ask them to look for connections to one of the following anchor chart skills. **Retell, Synthesize, Research**

Support Sense Making

Choose one or more of the following:

- Be sure students can identify the phenomenon presented on the opening pages of the reader: Rylie wonders why the sun's position changes over several weeks when she leaves home for school at 7 a.m. The story follows her efforts to understand how Earth's rotation, revolution around the sun, and tilt cause the time of sunrise to change.
- In the story, Rylie keeps track of sunrise and sunset times in a chart. Have students work in small groups to discuss the benefits of using charts and graphs to analyze data. Elicit that this is one way scientists organize information to help themselves and others understand concepts.
- Discuss the steps Rylie takes to answer her question about why the sun rises later and later each day. Write the steps on the board as students call them out. The list should include that Rylie first asks questions. Then she does research on the computer to find answers. She adds the data she finds to a chart and makes observations of the daytime and nighttime sky. At the science center, she watches a planetarium show, looks at models, and uses an interactive program.
- Challenge students to chart their own observations of sunrise or sunset times over several weeks and share their findings with the class. Discuss the role the sun plays in sustaining life on Earth. Help students understand that Earth's rotation and revolution around the sun affects the number of hours of daylight each day, which, in turn, has an impact on temperature, climate, and food chains.

Extend

Science Stretch

The **Science Stretch** suggestions inside the book's back cover help students think about what they read. Students can complete one or more as time allows.

Have students research how moons move around a planet such as Saturn. Provide books and links to approved websites for students to use as they do their research.

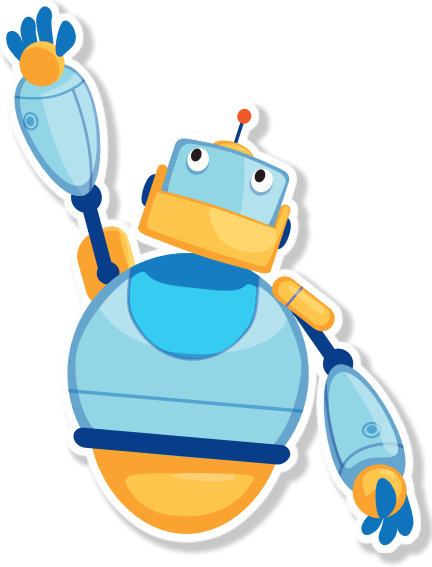
Students may discover how Earth's tilt affects climate. Students can work in pairs or small groups to make a model for demonstrating their findings.

Make a claim about the position of a constellation in the evening. Collect data to support your claim. Refer students to the online *Science and Engineering Handbook* for more information on using claims, evidence, and reasoning.

SOCIAL EMOTIONAL LEARNING

Make a plan to find out more about a topic that interests you. As needed, guide students in setting short-term goals on how they will go about finding answers to their questions.

Check for Comprehension Have students write three things they found out in this story, two things they found particularly interesting, and one question they still have about sunrise, sunset, and the seasons.



EXPLORATION 2 HANDS-ON ACTIVITY

The Night Moves

Activity Guide, pages 270–271

TIME ESTIMATE

40 min

POSSIBLE MATERIALS

- ☐ butcher paper
- ☐ string
- ☐ star maps for each season, labeled with the season

PREPARATION

Make a large sun out of butcher paper by cutting a circle. Ideally this should be very large, about 6 feet in diameter. Hang the model sun in the center of the room. Tell students it is the sun and they must look in the opposite direction from the sun throughout the activity. Make large copies of star maps of constellations for each season—one for each station students will stop at as they revolve around the sun. See page 282 for examples of seasonal constellations. Hang or tape the star maps on each wall of the room; label the maps with the appropriate season. Have students begin with summer.

INVESTIGATIVE PHENOMENON

Earth's revolution around the sun can explain patterns in the sky.

Phenomenon Explained Students explore the **investigative phenomenon** by using a model to gather evidence and explain how Earth's motion around the sun causes the apparent position of stars in the sky to change over the course of a year.

Form a Question After reading about constellations and observing the photograph, students should form a question about how Earth's motion relates to which constellations are visible. If students struggle to form a question, have them brainstorm ideas with a partner. **Sample answer:** What causes different constellations to be visible at different times?

Everyday Phenomenon **Objects blocking our view affect what we can see.**

Students should understand that we cannot see through objects such as desks or books. Ask students to identify objects in the classroom that block their view of another object in the classroom. As students work through this modeling activity, encourage them to think about which objects in space affect the view of the constellations from Earth.

STEP 1 Students position themselves with their backs to the sun and record the constellations they observe in front of them.

STEP 2 Students model one-quarter revolution of Earth and record their observations, then repeat the same step twice.

STEP 3 Students model one rotation of Earth and record their observations. **Sample answer:** It was daytime when I faced the sun.

- **Make a Claim** Claims should indicate that the constellations appear to move as Earth revolves around the sun.
- **Evidence** Students should cite as evidence the data from the activity that they observed different constellations with each partial revolution.
- **Reasoning** Students should explain their reasoning that relates Earth revolving around the sun as the cause of the changes in which constellations are observable from Earth.

FORMATIVE ASSESSMENT

MAKING SENSE OF PHENOMENA

Students gain understanding that Earth's revolution around the sun can explain patterns in the sky as they explore the **investigative phenomenon.** They should connect this to the **anchoring phenomenon** that Earth has regular patterns of motion which can explain how and when objects become visible and appear to move in the sky. Students should understand that patterns in the constellations visible at different times of the year and in the time of sunset can be explained by Earth's revolution around the sun.

REMEDIATION If students struggle to connect the **investigative phenomenon** back to the **anchoring phenomenon,** have a class discussion of what students modeled in the activity and how they could make a model to investigate patterns in the time of sunset.

MAKING SENSE OF PHENOMENA IDEA ORGANIZER

After completing Exploration 2, students can fill in the **Idea Organizer** to summarize the connection between Earth's revolution around the sun explaining patterns in the sky and the anchoring phenomenon that Earth has regular patterns of motion, which can explain patterns in the sky, such as the time the sun appears to set.

Activity Outcome

Students should use a model to observe changes in the apparent position of the stars in the sky in order to make and support a claim connecting those changes to Earth's revolution around the sun.

Performance Indicators	
	use a model to observe changes in the apparent position of the stars in the sky
	make a claim that Earth's revolution around the sun causes different stars to be visible during different times of the year
	support the claim using observations as evidence

EXPLORATION 4

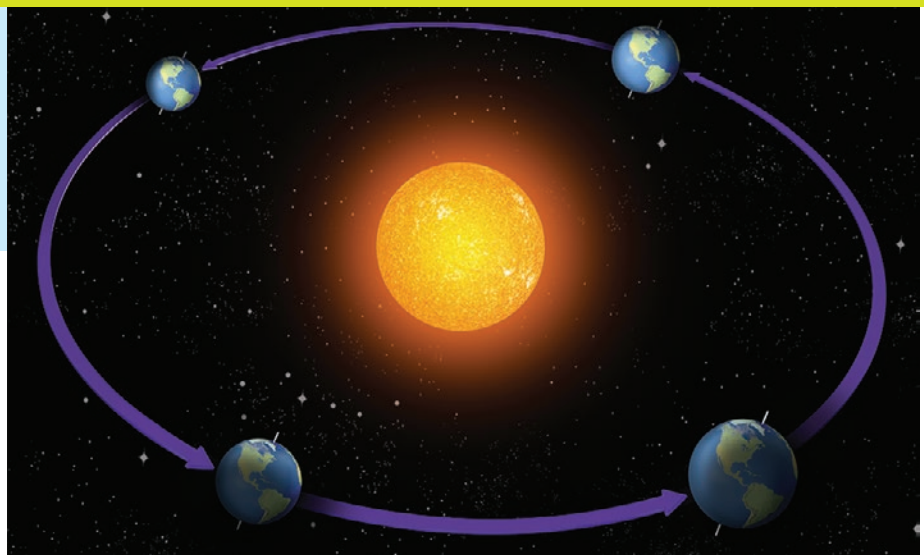
What Patterns Do the Sun and Moon Cause During the Year?

Activity Guide, pages 279–284

TIME ESTIMATE

40 min

Materials Alert You may wish to provide students with colored pencils and poster paper for drawing their models.



INVESTIGATIVE PHENOMENON

Monthly and yearly patterns in the sky are caused by Earth's and the moon's motion in space.

Phenomenon Explained Students explore the **investigative phenomenon** by interpreting data and making a model to explore and explain how Earth's revolution around the sun and the moon's revolution around Earth cause observable monthly and yearly patterns in the sky.

Round and Round

Use the illustrations to contrast *orbit* and *revolution*. Explain that *orbit* can be a noun or a verb. For example, in "Earth *orbits* the sun," it's a verb. *Revolution,* on the other hand, is always a noun. Its verb form is *revolve*.

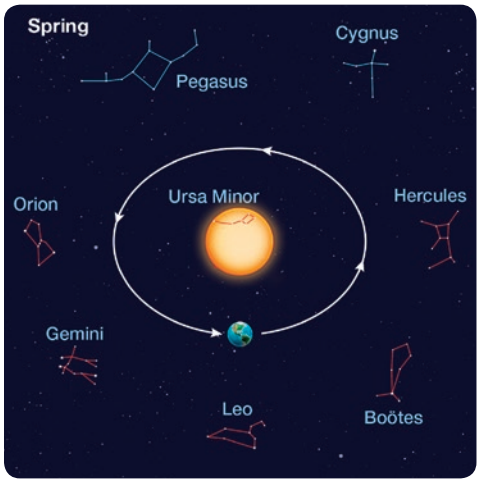
Students infer patterns caused by the revolutions of Earth and the moon. **Sample answer:** the apparent shape of the moon and the seasons; Accept all preliminary ideas based on what students have learned so far.

Moon Shapes

Students interpret a lunar calendar, determine the time from one full moon to the next, and describe patterns. **Sample answer:** In about a month's time, the moon changes from partial moons on the right side to full moon. Then, it goes from full to partial moons on the left side and ends as a dark moon. Finally, it repeats the pattern on the right side.

Revolution and Patterns

Students interpret data and graph seasonal patterns in the sun's position in the sky. Discuss how the illustrations and the graph suggest that seasonal changes repeat yearly due to Earth's motion in space.



Shifting Stars and Changing Constellations

Students analyze images and answer questions in order to explore a pattern in the positions of stars as Earth revolves around the sun.

Students explain why you can't see Pegasus in the spring.
Sample answer: Pegasus is located on the opposite side of the sun from where Earth is located during springtime.

Students record observations of constellations and complete a data chart. They use the data to identify constellations visible in winter.

Campus Constellations

Students choose a daily, monthly, or yearly pattern to model. They make a model showing how objects in space, including Earth and the sun, moon, and stars, interact to cause a pattern people observe from Earth's surface.

FORMATIVE ASSESSMENT

MAKING SENSE OF PHENOMENA

Students gain understanding that monthly and yearly patterns in the sky are caused by Earth's and the moon's motion in space as they explore the **investigative phenomenon.** They should connect this to the **anchoring phenomenon** that the apparent motion of the sun across the sky due to Earth's rotation and revolution causes patterns that can be observed, such as changes in the time the sun sets at a location. Students should understand that the observed yearly patterns in the position of the sun in the sky support an explanation of Earth's revolution around the sun, and that Earth's revolution around the sun causes Earth to be in a different position with respect to the sun each day at sunset, causing the time of sunset to change.

REMEDIATION If students struggle to connect the **investigative phenomenon** back to the **anchoring phenomenon,** have small groups of students explain in words or drawings how Earth's revolution around the sun causes the time of sunset to change.

MAKING SENSE OF PHENOMENA IDEA ORGANIZER

After completing Exploration 4, students can fill in the **Idea Organizer** to summarize the connection between Earth's and the moon's motion in space causing monthly and yearly patterns in the sky and the anchoring phenomenon that the apparent motion of the sun across the sky due to Earth's rotation and revolution causes patterns that can be observed, including changes in the time the sun sets at a location.