This is the fourth bundle of the Fifth Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 4 Question: This bundle is assembled to address the question "How far away are the stars?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of the Earth's position in the solar system and universe. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that the sun is a star that appears larger and brighter than other stars because it is closer (ESS1.A as in 5-ESS1-1) connects to the idea that there are observable patterns – such as different positions of the sun at different times of the day, month, and year – caused by the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis (ESS1.B as in 5-ESS1-2), as both address the appearance of objects in the sky based on our position relative to other objects in the solar system and universe.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of analyzing and interpreting data (5-ESS1-2) and engaging in argument from evidence (5-ESS1-1). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (5-ESS1-2) and Scale, Proportion, and Quantity (5-ESS1-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	5-ESS1-1. **Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*] 5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]
Example Phenomena	The constellation Orion appears to move across the sky throughout the night. People can tell the time from a sundial.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Identify scientific (testable) and non-scientific (non-testable) questions. Students *could identify testable and non-testable questions* [about] **the orbits of Earth around the sun and of the moon around Earth**. 5-ESS1-2

Additional Practices Building to the PEs (Continued)	**Developing and Using Models** ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. Students could *develop a model using an analogy to describe* [that] ***the sun is a star that appears larger and brighter than other stars because it is closer***. 5-ESS1-1 **Planning and Carrying Out Investigations** ● Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods and tools for collecting data* [on the relative] ***distance of stars from Earth***. 5-ESS1-1 **Analyzing and Interpreting Data** ● Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. Students could *represent data in various graphical displays to reveal patterns that indicate* [that] ***the sun appears larger and brighter than other stars because it is closer***. 5-ESS1-1 **Mathematical and Computational Thinking** ● Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets to reveal patterns* [such as] ***daily changes in the length and direction of shadows*** *that suggest relationships* [such as between the shadows and] ***the rotation of Earth about an axis***. 5-ESS1-2 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Students could construct an explanation of observed relationships [between] ***different positions of the sun, moon, and stars*** [at] ***different times of the day, month, and year***. 5-ESS1-2 **Engaging in Argument from Evidence** ● Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. Students could *distinguish among facts, reasoned judgment, and speculation in an explanation* [that] ***the rotation of Earth about an axis causes the different positions of the sun*** [in the sky] ***at different times of the day***. 5-ESS1-2 **Obtaining, Evaluating, and Communicating Information** ● Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Students could *communicate scientific information* [about] ***the orbits of Earth around the sun and of the moon around Earth*** *using written formats*. 5-ESS1-2

Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [between] **the brightness and distance of stars**. 5-ESS1-1 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe **the Earth, the sun, and the orbit of the Earth around the sun** [as] *a system* [that] *can be described in terms of its components and their interactions*. 5-ESS1-2 **Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students could describe that *change is measured in terms of differences over time,* [using examples of the] **observable patterns** [caused by] **the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis**. 5-ESS1-2
Additional Connections to Nature of Science	**Science is a Way of Knowing** ● Science is a way of knowing that is used by many people. Students could describe that *science is a way of knowing that is used by many people,* [using as examples ways that people build an understanding of] **patterns** [caused by] **the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis**. 5-ESS1-2 **Science is a Human Endeavor** ● Science affects everyday life. Students could describe how our knowledge of **the rotation of Earth about an axis between its North and South poles** *affects everyday life*. 5-ESS1-2

5-ESS1-1   Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. **Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model.	**ESS1.A: The Universe and its Stars** • The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

	Observable features of the student performance by the end of the grade:	
1	Supported claims	
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.
2	Identifying scientific evidence	
	a	Students describe* the evidence, data, and/or models that support the claim, including:
	i.	The sun and other stars are natural bodies in the sky that give off their own light.
	ii.	The apparent brightness of a variety of stars, including the sun.
	iii.	A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
	iv.	The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.
	b	Students determine whether additional evidence is needed to support the claim.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe* a chain of reasoning that includes:
	i.	Because stars are defined as natural bodies that give off their own light, the sun is a star.
	ii.	The sun is many times larger than Earth but appears small because it is very far away.
	iii.	Even though the sun is very far from Earth, it is much closer than other stars.
	iv.	Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
	v.	Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
	vi.	Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
	vii.	Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

5-ESS1-2 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	**ESS1.B: Earth and the Solar System** • The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	**Patterns** • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

		Observable features of the student performance by the end of the grade:
1		Organizing data
	a	Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:
	i.	The length and direction of shadows observed several times during one day.
	ii.	The duration of daylight throughout the year, as determined by sunrise and sunset times.
	iii.	Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
2		Identifying relationships
	a	Students use the organized data to find and describe* relationships within the datasets, including:
	i.	The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
	ii.	The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter.
	iii.	Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
	b	Students use the organized data to find and describe* relationships among the datasets, including:
	i.	Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).