Core Knowledge® SCIENCE

Sun, Moon, and Stars

moon

Teacher Guide

sun

stars

changing position in the sky

Sun, Moon, and Stars

Teacher Guide

Core Knowledge®

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Sun, Moon, and Stars

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Teacher Guide

Core Knowledge Science™ 1

UNIT 1

Introduction

About this Unit

The Big Idea

This unit focuses on the patterns of the apparent movements of the sun, moon, and stars from Earth.

Students have substantial prior knowledge of the sun, moon, and stars from their observations and children's literature. In this unit, students will methodically investigate the science of the patterns of the apparent movement of the space objects they can see from Earth. Over the course of the unit, students will record observations of sunrise and sunset and the visible shape of the moon over periods of time. By recording observations of the sunrise and sunset throughout the school year, students will learn that the periods of daylight grow longer and shorter during summer and winter. By collecting data of the shape of the moon over two months, students will recognize the patterns of the phases of the moon. By studying star configurations, students will begin to realize that stars are fixed and it is Earth that is moving.

A key concept underlying all three studies is to build understanding of the predictable patterns of the apparent movements of the sun, moon, and stars. These patterns can be studied and predicted to tell where the objects will be in the sky at any given time.

In this unit, the guiding phenomenon is to use science to unlock the mystery of why the objects in the sky—the sun, moon, and stars—seem to move and change position over time. The unit builds on student understandings about sunlight from Kindergarten, such as K-ESS2-1: *Use and share observations of local weather conditions to describe patterns over time*. Lesson 1 also builds toward the Grade 1 target of 1-ESS1-2: *Make observations at different times of the year to relate the amount of daylight to the time of year.*

Students explore concepts that include the following:

- The sun appears to move across the sky in a predictable pattern throughout the day.
- Sunrise and sunset times throughout the year are related to periods of daytime and nighttime.
- The sun rises and sets in a predictable pattern.
- The amount of daylight changes during different seasons.
- Sunrise and sunset times can be predicted for future dates.
- The moon is an object in the sky.
- The moon appears to move across the sky in a predictable pattern.

- The appearance of the moon changes as it moves through different phases.
- The appearance of the moon in the future can be predicted.
- Stars and constellations are objects in the night sky.
- The Big Dipper appears to move in the sky.
- The location of the Big Dipper in the night sky can be predicted.

Scientists, including astronomers, climatologists, and meteorologists, observe, analyze, and study patterns of the apparent movement of celestial objects to describe patterns in the natural world in order to answer scientific questions. This series of lessons incorporates learning goals that support scientific principles and practices, such as analyzing and interpreting data, recognizing cause and effect, and planning and carrying out investigations.

Note to Teachers and Curriculum Planners

This unit introduces Grade 1 students to the patterns of the apparent movement of the sun, moon, and stars, which will be explored in greater depth in later grades. Students will investigate the sun, Earth, moon, and stars as celestial objects as they study Earth's place in the universe and weather patterns in Grades 2, 3, 4, and 5. Students will learn about how the times of the sunrise and sunset are related to the length of daytime and nighttime, understand the patterns of moon phases, and recognize the patterns of the apparent movement of stars in the night sky. The following are preliminary considerations for planning and instruction relative to this unit:

- **The study of the sun involves a months-long collection of sunrise and sunset data facilitated with family assistance to develop understanding of the patterns of daytime and nighttime.**
- **The study of moon phases involves a two-month-long collection of data facilitated with family assistance.**

Special Pacing Plan

Unit 1 *Sun, Moon, and Stars* includes two long-term investigations. To accommodate these, we suggest that you teach this unit in "blocks" throughout your school year, some spaced weeks or months apart.

The first long-term investigation involves observing the sunrise and sunset times throughout the year (September through May). The second long-term investigation involves observing the moon phases for a period of two consecutive months. Students will be required to present their findings or observations once a week as the investigations progress.

There are two types of teaching days.

- On **instructional** days, you should conduct full lesson segments from this unit.
- On **reporting** days, you take only a few minutes to record students' observational data, which will be collected over time to analyze later for patterns.

During extended reporting periods, you will likely also turn your attention to teaching other science units.

This calendar models how you might plan instructional days and reporting days for the long-term investigations.

Sample School Year

September

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

October

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

November

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

January

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

February

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

March

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

April

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Key

Instruction days Reporting days

Note to Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, students benefit not just from reading about concepts and ideas, but from hands-on experiences. Following the release of the Next Generation Science Standards (NGSS), the Core Knowledge Foundation used this opportunity to update and enhance the science portion of the *Core Knowledge Sequence*.

While there have been some shifts in the grade levels at which certain topics are recommended, the fundamental principles of pedagogy inherent to the Core Knowledge approach, such as the importance of building a sequential, coherent, and cumulative knowledge base, have been retained.

Online Resources

To learn more about the changes and to access resources for this unit, please use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit embodies Core Knowledge's vision of best practices in science instruction and knowledge-based schooling, such as the following:

- building students' knowledge of core ideas in life, physical, and Earth sciences, as well as engineering design
- developing scientific practices that give students firsthand experience in scientific inquiry, engineering, and technology
- connecting scientific learning to concepts across various disciplines, such as mathematics and literacy

What are the relevant NGSS Performance Expectations for this unit?*

This unit, *Sun, Moon, and Stars*, has been informed by the following Grade 1 Performance Expectations for the NGSS topic *Earth's Place in the Universe*.

1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

Online Resources

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

*NEXT GENERATION SCIENCE STANDARDS (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and their endorsement is not implied.

Sources:

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

National Research Council. 2012. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K–12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Building Science Knowledge

What Students Should Already Know

The concept of progressions, articulated in the National Research Council's *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, is very much aligned to the Core Knowledge principle of building new knowledge on prior knowledge. According to the NRC, students build "progressively more sophisticated explanations of natural phenomena" over the course of many years of schooling. "Because learning progressions extend over multiple years, they can prompt educators to consider how topics are presented at each grade level so that they build on prior understanding and can support increasingly sophisticated learning." In schools following NGSS recommendations, teachers can build on the "prior understandings" captured in the following summaries of NGSS Disciplinary Core Ideas:

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

ETS1.C: Optimizing the Design Solution

- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

What Students Need to Learn

For this unit, the Core Knowledge Science Sequence specifies the following content and skills. Specific learning objectives are provided in each lesson segment throughout the unit. NGSS References, including Performance Expectations, Disciplinary Core Ideas, and Crosscutting Concepts, are included at the start of each lesson segment as appropriate.

Lesson 1. The Sun and Its Predictable Patterns — SEGMENTS 1–4

- Describe how the sun appears to move across the sky.
- Identify patterns in where the sun is located in the sky throughout the day.
- Make predictions about daytime and nighttime.

Lesson 2. Annual Patterns of Sunrise and Sunset — SEGMENTS 1–5

- Identify sunrise and sunset times throughout the year.
- Identify patterns in when the sun rises and sets.
- Describe how the amount of daylight changes in different seasons.
- Make predictions about sunrise and sunset times for future dates.

Lesson 3. The Moon and Its Predictable Patterns — SEGMENTS 1–6

- Identify the moon as an object in the sky.
- Identify patterns in when the moon appears to move across the sky.
- Describe the different phases of the moon.
- Make predictions about what the moon will look like in the sky in the future.

Lesson 4. Stars and Their Predictable Patterns — SEGMENTS 1–4

- Identify the stars and constellations as objects in the sky that are seen at night.
- Describe how the Big Dipper appears to move in the sky.
- Predict where the Big Dipper will be viewed in the sky in the future.

What Teachers Need to Know

Supportive information on the content standards and the science they address is provided throughout the lessons at points of relevance:

Know the Standards: These sections, found later in this Teacher Guide, explain what to teach and why, with reference to NGSS and Core Knowledge expectations, as well as connections to relevant math and reading language arts standards.

Know the Science: These sections provide supporting, adult-level, background information or explanations related to specific science concepts, examples, or Disciplinary Core Ideas.

Using the Student Book

Student Book

The *Sun, Moon, and Stars* Student Book includes six chapters, intended to be read aloud by the teacher as the students look at images on each page.

As you will note when you examine the Student Book, minimal text is included on each page. Instead, colorful photos and engaging illustrations dominate the Student Book pages. The design of the Student Book in this way is intentional because students in Kindergarten through Grade 2 are just learning to read. At these grade levels, students are learning how to decode written words, so the complexity and amount of text that these young students can actually read is quite limited.

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

The intent of the Grades K–2 CKSci lessons is to build students' understanding and knowledge of science concepts, as well as of associated practices and skills. It is for this very reason that in Grades K–2 CKSci, the core content of each lesson is reinforced to students using a teacher Read Aloud, accompanied by example images and diagrams. Cognitive science research has clearly documented the fact that students' listening comprehension far surpasses their reading comprehension well into the late elementary and early middle school grades. Said another way, students are able to understand and grasp far more complex ideas and text that they hear read aloud than they would ever be able to read or comprehend when they read to themselves. Read Aloud support includes scaffolded questions to cultivate comprehension, noted as **LITERAL**, **INFERENTIAL**, or **EVALUATIVE**. For a more thorough discussion of listening and reading comprehension and the underlying cognitive science research, teachers may want to refer to Appendix A of the Common Core State Standards for English Language Arts, noting in particular the Speaking and Listening section of the appendix.

Use this link to download the CKSci Online Resources for this unit, where the specific link to this appendix can be found:

www.coreknowledge.org/cksci-online-resources

Using the Teacher Guide

Pacing

To meet NGSS Performance Expectations we encourage teachers to complete all Grade 1 CKSci units during the school year. To be sure all NGSS standards and dimensions are addressed, each Core Lesson segment should be completed. Each lesson segment requires thirty to forty-five minutes of instruction time. The time it takes to complete a full lesson depends on class size and individual circumstances.

Within the Teacher Guide, each Core Lesson is composed of multiple numbered segments, generally four to six. Each segment concludes with a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this unit Introduction, you will find a blank Pacing Guide on pages 16–17, which you may use to plan how you might pace the lessons. We strongly recommend that you preview the unit in full before beginning and create your pacing guide before teaching the first lesson segment. As a general rule, we recommend that you spend a minimum of twenty-nine days and a maximum of thirty-seven days teaching the *Sun, Moon, and Stars* unit so that you have time to teach the other units in the Grade 1 CKSci series.

The Core Lessons

- Lesson time: Most Core Lesson segments constitute one classroom session of thirty to forty-five minutes. However, some segments cover two or three days of instruction, and some single-day activities and performance tasks will require setting aside a longer block of time.
- Lesson order: The lesson segments are coherently sequenced to build from one to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

Unit Opener: Introduction to the Unit Phenomenon and Problem	**Unit Opener:** Sun, Moon, and Stars	**Big Question:** How do the sun, the moon, and stars appear to change position in the sky?
Lesson 1: The Sun and Its Predictable Patterns (1-ESS1-1)	**1.1** What Are Daytime and Nighttime?	**Lesson 1 Guiding Question:** When and where can you see the sun in the sky? **1.1** What are daytime and nighttime?
	1.2 Sunrise, Sunset (three class sessions)	**1.2** When does the sun rise and set?
	1.3 The Sun Changes Positions	**1.3** How does the position of the sun in the sky appear to change?
	1.4 **Lesson 1 Roundup:** The Sun in the Sky	**1.4** When and where can you see the sun in the sky?
Lesson 2: Annual Patterns of Sunrise and Sunset (1-ESS1-2)	**2.1** What Are Sunrise and Sunset?	**Lesson 2 Guiding Question:** How does the amount of daylight change during the year? **2.1** What are sunrise and sunset?
	2.2 What Time Does the Sun Rise and Set?	**2.2** What time does the sun rise and set throughout the year?
	2.3 How Can We Present Our Sunrise and Sunset Data? (two class sessions)	**2.3** How can you tell how long daylight is in a day?
	2.4 What Sunrise and Sunset Patterns Do We See?	**2.4** How does the amount of daylight change in a pattern?
	2.5 **Lesson 2 Roundup:** Daylight Changes Through the Year	**2.5** How does the amount of daylight change during the year?

Lesson 3: The Moon and Its Predictable Patterns (1-ESS1-1)	**3.1** What Is the Moon?	**Lesson 3 Guiding Question:** How does the moon's appearance in the sky change? **3.1** When can you see the moon in the sky?
	3.2 The Moon on the Move (three class sessions)	**3.2** When and where does the moon rise and set?
	3.3 What Is the Motion of the Moon?	**3.3** How does the position of the moon in the sky change?
	3.4 What Are the Moon's Phases?	**3.4** What does the moon look like at different times in a month?
	3.5 Why the Moon's Appearance Changes	**3.5** How does the moon's appearance vary?
	3.6 **Lesson 3 Roundup:** Patterns of the Moon	**3.6** How does the moon's appearance in the sky change?
Lesson 4: Stars and Their Predictable Patterns (1-ESS1-1)	**4.1** What Are Stars?	**Lesson 4 Guiding Question:** How do stars seem to move in the night sky? **4.1** How can you identify stars in the sky?
	4.2 The Stars in the Sky	**4.2** Where does the same star appear in the sky at different times during the night?
	4.3 How Do the Stars Move?	**4.3** How do stars seem to move in the night sky?
	4.4 **Lesson 4 Roundup:** Patterns of the Stars	**4.4** How do stars seem to move in the night sky?
Unit Capstone	**Unit Capstone:** Sun, Moon, and Stars (two class sessions)	**Big Question:** How do the sun, the moon, and stars appear to change position in the sky?
Unit Supplement	Science in Action (two class sessions)	Who are some people who work in this type of science, and what do they do?

Activity Pages

Black-line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 187–210. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced. The Activity Pages can be organized into a learning portfolio for each student to demonstrate their progress relative to NGSS expectations and as student work products.

Activity Pages

AP UO.1
AP 1.1.1
AP 1.2.1
AP 1.3.1
AP 1.4.1
AP 2.1.1
AP 2.1.2
AP 2.4.1
AP 2.5.1
AP 3.2.1
AP 3.3.1
AP 3.4.1
AP 3.4.2
AP 3.5.1
AP 3.6.1
AP 4.1.1
AP 4.2.1
AP 4.2.2
AP 4.4.1

Make sufficient copies for your students in advance of each lesson segment.

Unit Opener—Day or Night? (AP UO.1)

Lesson 1—The Sun (AP 1.1.1)

Lesson 1—Where Is the Sun? (AP 1.2.1)

Lesson 1—Day and Night Activities (AP 1.3.1)

Lesson 1—What Is the Pattern? (AP 1.4.1)

Lesson 2—Sunrise, Sunset Sheet (AP 2.1.1)

Lesson 2—Take-Home Letter (AP 2.1.2)

Lesson 2—What Did We Learn? (AP 2.4.1)

Lesson 2—Draw the Future (AP 2.5.1)

Lesson 3—Moon on the Move (AP 3.2.1)

Lesson 3—Moon Models (AP 3.3.1)

Lesson 3—Moon Phase Sheet (AP 3.4.1)

Lesson 3—Take-Home Letter (AP 3.4.2)

Lesson 3—Moon Comic (AP 3.5.1)

Lesson 3—What Will the Moon Look Like? (AP 3.6.1)

Lesson 4—Connect the Dots (AP 4.1.1)

Lesson 4—The Big Dipper (AP 4.2.1)

Lesson 4—Big Dipper Investigation (AP 4.2.2)

Lesson 4—What Will the Sky Look Like? (AP 4.4.1)

Online Resources for Science

Online Resources

For each CKSci unit, the Teacher Guide includes references to online resources (including external websites and downloadable documents) to enhance classroom instruction. Look for the icon on the left.

Use this link to download the CKSci Online Resources for this unit:

www.coreknowledge.org/cksci-online-resources

The Online Resources Guide also links to lists of additional recommended children's books that support the content of this unit.

Teaching Strategies

Start with the familiar.	Lead with an experience. Begin each lesson with a demonstration, activity, or question about a phenomenon to engage students and focus their attention on the topic. Start with the familiar. Every science topic introduced to students relates in some way to their known world and everyday experiences. The purpose of every lesson is to build a bridge between what is familiar to students and broader knowledge about the way the world works.
Ask driving questions.	The unit is governed by a Big Question, related to the unifying phenomenon. Each multipart lesson is built around a lesson Guiding Question. And then at the beginning of each Teacher Guide lesson segment, you will find a driving question and Core Lesson segment devoted to encouraging students to think about this question as they are introduced to new science content. Use this opportunity to engage students in conversation, to think about how their own real-world experiences relate to the topic, or to participate in a demonstration that relates to the driving question.
Encourage scientific thinking.	Approach the lessons with students not as learning about science, but as learning about the world with a scientific mind. Science learning models science practice. Throughout the lessons, encourage students to ask questions about what they observe, do, and read. Record relevant questions in a prominent place in the classroom. Guide students back to these questions as opportunities to answer them emerge from readings, demonstrations, and activities.
Use continuous Core Vocabulary instruction.	During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Through scaffolded questioning, encourage students to come up with definitions in their own words and to use the words in their own sentences. Core Vocabulary words for each lesson, as well as Language of Instruction, other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary and Language of Instruction definitions in the Glossary on pages 211–212.
Emphasize observation and experience.	Lessons employ various ways for students to learn, including watching, listening, reading, doing, discussing, and writing. To meet the NGSS Performance Expectations, which are multidimensional standards, students must not only gain factual knowledge associated with Disciplinary Core Ideas, but also use the content knowledge they acquire.
Use science practices.	Give students opportunities to discover new content knowledge through investigation and to use their new knowledge both in problem-solving exercises and as evidence to support reasoning. Students learn what science and engineering practices are by engaging in those same practices as they learn.

Make frequent connections.	Use a combination of demonstrations and reading materials, rich with examples, to help students recognize how the science concepts they are learning apply in their everyday lives. Prompt students to relate lesson content to their own experiences, to relate the new and unfamiliar to the familiar, and to connect ideas and examples across disciplines. Refer to the Crosscutting Concepts cited in the lessons, often included in the NGSS References listed at the start of each lesson.
Monitor student progress.	Use verbal questioning, student work, and the Check for Understanding assessments at the end of each lesson to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.

Instructional Design

The unit is composed with several integrated features that support three-dimensional learning for all students and development for teachers. Within each lesson, notations appear in the column to the left to indicate certain features in the instructional support.

Differentiation	Adjustments to instruction appear in the text, indicated by **SUPPORT**, **EXTEND**, and **CHALLENGE** notations. **SUPPORT**—Reading, writing, listening, and/or speaking alternatives appear for students who are English language learners, have special needs, or read below the grade level. Extra support is suggested for students who struggle to meet targeted expectations. **EXTEND**—Extensions are suggested for students with high interest or who have already met the performance expectations. **CHALLENGE**—Additional, relevant, and interesting exercises are suggested for students to explore that exercise math, reading, or science skill/comprehension that pushes beyond the grade level.
Teacher Development	Information in the instructional text, Know the Science boxes, and Know the Standards boxes is provided to support ongoing teacher development with regard to both content and the teaching process.
Monitor Progress	Opportunities for formative assessment appear throughout the instructional support. These instances are most consistently noted in a Check for Understanding that concludes each lesson segment.
Math Connection	Connections to math standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.
Language Arts Connection	Connections to reading and language arts standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.

Building Progressions

Prior expected student learning and how the prior learning will be built upon are explained throughout the instructional support and in Know the Standards boxes.

DCI
SEP
CCC
PE

Opportunities for students to develop and use specific elements of NGSS Disciplinary Core Ideas (DCI), Science and Engineering Practices (SEP), and Crosscutting Concepts (CCC) are highlighted throughout the instructional support text.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit. Use the following link to download any of the CKSci Online Resources Guides:

www.coreknowledge.org/cksci-online-resources

Icon Key:

DCI ESS1.A The Universe and its stars

DCI ESS1.B Earth and the solar system

SEP 1 Asking questions (for science) and defining problems (for engineering)

SEP 2 Developing and using models

SEP 3 Planning and carrying out investigations

SEP 4 Analyzing and interpreting data

SEP 5 Using mathematics and computational thinking

SEP 6 Constructing explanations (for science) and designing solutions (for engineering)

SEP 7 Engaging in argument from evidence

SEP 8 Obtaining, evaluating, and communicating information

CCC 1 Patterns

CCC 2 Cause and effect

CCC 3 Scale, proportion, and quantity

CCC 4 Systems and system models

CCC 5 Energy and matter: flows, cycles, and conservation

CCC 6 Structure and function

CCC 7 Stability and change

3D Learning

Student performance in a given task related to making sense of a phenomenon or designing a solution requires integrated elements of the SEPs, CCCs, and DCIs. At certain points of instruction, the Teacher Guide identifies when all three dimensions are integrated for student learning and as support for the teacher.

Effective and Safe Classroom Activities

Online Resources

Conducting safe classroom demonstrations and activities is essential to successful elementary science education. The following resources provide Core Knowledge's recommendations for developing effective science classroom activities.

These resources, included at the back of the Teacher Guide on pages 213–217, consist of the following:

- Classroom Safety for Activities and Demonstrations
- Strategies for Acquiring Materials
- Advance Preparation for Activities and Demonstrations
- What to Do When Activities Don't Give Expected Results

These resources may also be accessed within the CKSci Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Materials and Equipment

The unit, like all hands-on science, requires a large variety of materials to support various ways of learning (including doing, discussing, listening, watching, reading, and writing). Prepare in advance by collecting the materials and equipment needed for all the demonstrations and hands-on investigations.

- Roll paper, poster board, or a bulletin board should be dedicated at the beginning of the unit to serve as a question board to cumulatively document and return to student questions. The question board is referred to in the materials for lesson segments in which it is used but is not repeated in the materials listed here.
- Internet access and the means to project images/videos for whole-class viewing is also required in many lesson segments but is not repeated below.
- Additional materials may be required for suggested but optional support, challenge, and extension activities.

Lesson 1 The Sun and Its Predictable Patterns

Lesson 1.1

- globe (or ball)
- flashlight

Lesson 1.2

- compass

Lesson 1.3

- scissors (1 per student)

Lesson 1.4

- large sheet of butcher paper or poster paper (or a large area of space on the board)
- marker

Lesson 2 Annual Patterns of Sunrise and Sunset

Lesson 2.1

- assortment of sunrise pictures
- assortment of sunset pictures

Lesson 2.2

- large sheet of paper
- markers (in 4 assorted colors)

Lesson 2.3

- roll of butcher paper (white or a light color)
- markers (in assorted colors, 2 of each color)

Lesson 2.5

- coloring utensils (crayons, colored pencils, markers)

Lesson 3 The Moon and Its Predictable Patterns

Lesson 3.1

- poster paper
- marker

Lesson 3.2

- compass

Lesson 3.3

- clay (4 small balls per student, plus extra)
- paper plates (1 per student)
- plastic dull or play dough knife (1 per student)

Lesson 3.4

- large sheet of paper
- markers
- ruler
- variety of pictures of the moon in the new moon, full moon, quarter moon, and crescent moon phases

Lesson 3.5

- coloring utensils

Lesson 4 Stars and Their Predictable Patterns

Lesson 4.1

- flashlight

Lesson 4.2

- 2 pictures of a starry sky

Lesson 4.3

- beach ball
- red construction paper (several sheets)
- yellow construction paper (several sheets)
- green construction paper (several sheets)
- scissors
- tape

Unit Capstone

- flip chart poster paper
- markers

Unit Supplement

- glow-in-the-dark markers or fabric paint (2 per group)
- black construction paper (1 sheet per group)
- tape

Sun, Moon, and Stars Pacing

_____'s Class

Note to Teacher: *Sun, Moon, and Stars* is intended to be taught as the first unit of Grade 1 CKSci. To remain faithful to the spirit of the NGSS Performance Expectations, students must be able to observe changing times of sunrise and sunset throughout the school year, as well as discern patterns associated with the moon that require observations made over a period of a month or more. As such, the twenty-nine days of instruction required for this unit are not recommended to be conducted consecutively. Please see pages 2 and 3 of this Introduction for recommendations about special pacing for the unit.

The chart below is provided to help you plan the dates on which you will conduct the unit's instructional lesson segments. If you cannot intersperse the instruction for this unit throughout your school year to allow students to make real observations themselves, and you must teach the unit in a block of twenty-nine consecutive days, sun and moon data are provided from which students can be guided to discern patterns.

Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Unit Opener	L1.1 *What Are Daytime and Nighttime?*	L1.2 *Sunrise, Sunset* (day 1)	L1.2 *Sunrise, Sunset* (day 2)	L1.2 *Sunrise, Sunset* (day 3)
Planned _____	_____	_____	_____	_____
Dates:				

Day 6	**Day 7**	**Day 8**	**Day 9**	**Day 10**
L1.3 *The Sun Changes Positions*	L1.4 *Lesson 1 Roundup: The Sun in the Sky*	L2.1 *What are Sunrise and Sunset?*	L2.2 *What Time Does the Sun Rise and Set?* (Lesson 2 will resume after several months of observation and data collection.)	L3.1 *What is the Moon?*
Planned _____	_____	_____	_____	_____
Dates:				

Day 11	**Day 12**	**Day 13**	**Day 14**	**Day 15**
L3.2 *The Moon on the Move* (day 1)	L3.2 *The Moon on the Move* (day 2)	L3.2 *The Moon on the Move* (day 3)	L3.3 *What Is the Motion of the Moon?*	L3.4 *What Are the Moon's Phases?* (Lesson 3 will resume after two months of observation and data collection.)
Planned _____	_____	_____	_____	_____
Dates:				

Day 16	Day 17	Day 18	Day 19	Day 20
L4.1 *What Are Stars?*	L4.2 *The Stars in the Sky*	L4.3 *How Do the Stars Move?*	L4.4 *Lesson 4 Roundup: Patterns of the Stars*	(Resume Lesson 3 after two months of data collection.) L3.5 *Why the Moon's Appearance Changes*

Planned _____ _____ _____ _____ _____

Dates:

Day 21	Day 22	Day 23	Day 24	Day 25
L3.6 *Lesson 3 Roundup: Patterns of the Moon*	(Resume Lesson 2 after eight months of data collection.) L2.3 *How Can We Present Our Sunrise and Sunset Data? (day 1)*	L2.3 *How Can We Present Our Sunrise and Sunset Data? (day 2)*	L2.4 *What Sunrise and Sunset Patterns Do We See?*	L2.5 *Lesson 2 Roundup: Daylight Changes Through the Year*

Planned _____ _____ _____ _____ _____

Dates:

Day 26	Day 27	Day 28	Day 29	Day 30
Unit Capstone (day 1)	Unit Capstone (day 2)	Unit Supplement (day 1)	Unit Supplement (day 2)	

Planned _____ _____ _____ _____ _____

Dates:

UNIT 1

Sun, Moon, and Stars

Overview

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Anchoring Phenomenon: Objects in the sky seem to move slowly as we seem to be standing still. The driving question we explore in this unit is "How do the sun, the moon, and stars appear to change position in the sky?" To answer this question over the course of the unit, students will observe positions of the sun, the moon, and stars. By recording observations within a given day, daily for a month, and weekly for several months, students will be able to detect and describe patterns of the apparent movement of these celestial objects. The observation reporting routine is brief but spans several months of the school year to allow students to collect their own real data.

Student Book storyline: Lin has a hard time waking up for school when it is still dark outside in the morning. He notices the moon in the sky out the window as he eats breakfast. But wait, doesn't the moon come out at night? He takes the dog for a walk after school right before dinner, and it is getting dark then, too. He notices the moon in the sky when he is walking the dog, but at dinnertime, he can't see the moon out the window where he saw it at breakfast. Lin remembers that when school started at the beginning of first grade, it was bright and sunny when he woke up to get ready in the morning. He also recalls walking the dog shortly before bedtime on those school nights, and it was still daylight. What's going on?

Long-term project: Students watch the sky to make observations and record data. These data reveal the path of the sun across the sky within a day, the shape of the moon and its position across the sky within a month, the pattern of sunrise and sunset times across several months, and the position of a few select stars across several months.

At a Glance

Introductory Class Session
What's in the Sky?

Students share their prior personal experiences and understandings of daytime and nighttime to discuss how the sun, the moon, and stars change position in the sky and how they can predict what those positions will be by studying patterns over a long period of time.

Unit Opener Objective

✓ Describe the position of the sun, the moon, and stars in the sky.

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 1 Patterns

Students ask questions and look for patterns among the sun, moon, and stars in the sky.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Language of Instruction

The Language of Instruction consists of terms not considered a part of Core Vocabulary that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

universe

Instructional Activities

- class discussion
- teacher Read Aloud
- question generation

Instructional Resources

Student Book

Ch. 1

Activity Page

AP UO.1

Student Book, Chapter 1
"The Mysterious Movement of the Moon"

Activity Page
Day or Night? (UO.1)

Materials and Equipment

- question board

The Unit Opener

1. Introduce the Anchoring Phenomenon.

- Introduce the unit by writing the Big Question—**How do the sun, the moon, and stars appear to change position in the sky?**—on the question board.
- **Ask,** What do you see when you look up at the sky?
  - » the sun, the moon, birds, planes, clouds, stars, planets, rainbows, the color blue
- **Ask,** Are the sun and the moon always in the same spot? How do you know?
  - » no, because sometimes the sun is over there and later it is over here
- **Ask,** Have you ever seen the moon in the morning?
  - » Yes or no are both acceptable.
- Tell students that in this unit they will explore how the sun, moon, and stars change position in the sky during the day and night.

2. Read together: "The Mysterious Movement of the Moon."

Student Book

Ch. 1

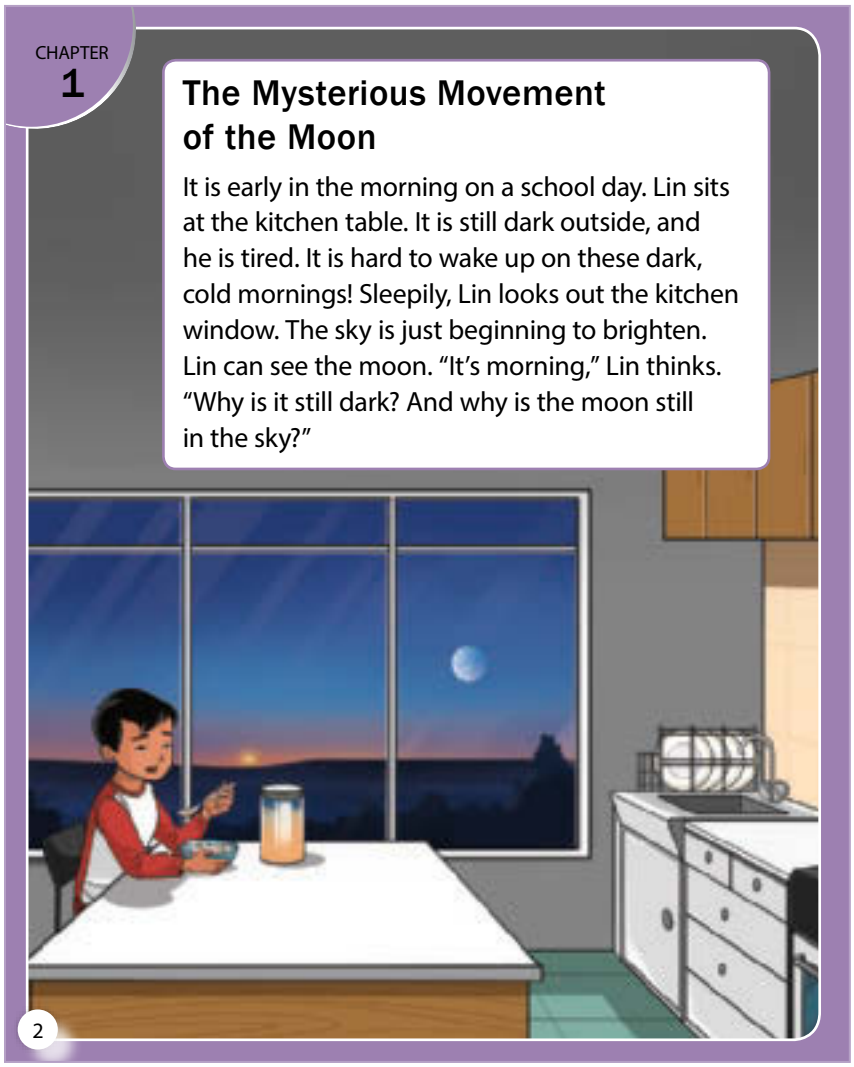
While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Page 2

Student Book

Ch. 1

Ask students to turn to page 2 of the Student Book. Remind them that the title of this chapter is "The Mysterious Movement of the Moon," and tell them to pay special attention to the light outside Lin's windows as you read.



CHAPTER 1

The Mysterious Movement of the Moon

It is early in the morning on a school day. Lin sits at the kitchen table. It is still dark outside, and he is tired. It is hard to wake up on these dark, cold mornings! Sleepily, Lin looks out the kitchen window. The sky is just beginning to brighten. Lin can see the moon. "It's morning," Lin thinks. "Why is it still dark? And why is the moon still in the sky?"

2

Ask students to look at the picture on page 2. Explain that the picture shows the early morning. Tell students that sometimes it is still dark outside when we wake up and get ready for school.

LITERAL—What do you notice about the sky in the picture?

» It is mostly dark blue; it has some orange color at the bottom.

LITERAL—What is the sun doing in the picture?

» It is rising/coming up.

LITERAL—What else do you see in the sky in the picture?

» the moon

INFERENTIAL—What do you think is going to happen to the sun? What will happen to the sky?

» It is going to come all the way up. The sky will get lighter.

Page 3 **Ask students to look at the picture on page 3 as you read aloud.**

LITERAL—What do you see in the sky?

» the moon

LITERAL—What does the sky look like now?

» It is a little dark. There is no sun.

SUPPORT—Explain that this is what the sky looks like when the sun is setting for the day. Give students a chance to reference this time of day by calling on personal experience.

Ask, What do you usually do around this time of the day or evening?

» have dinner, go inside

Page 4 **Ask students to look at the picture on page 4 as you read aloud.** (See **Know the Standards 1**.)

When he sits down to dinner, Lin looks for the moon through the kitchen window. But the moon is not there! Lin saw the moon when he walked Luna just a few minutes ago. He knows it is in the sky. So why can't he see it through the window like he could at breakfast this morning? He knows he saw the moon this morning when he was sitting in this same spot. He was looking through this same window.

4

LITERAL—What do you see in the sky?

» Nothing! It is dark.

INFERENTIAL—Why do you think you cannot see the moon now?

» Maybe it moved.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students observe the picture of the sky at different times of the day and notice the position and presence of the moon.

Page 5

Ask students to look closely at the picture on page 5 as you read aloud. Explain that this is the same kitchen scene they saw on page 2.

Lin thinks back to the beginning of first grade. The mornings were bright and sunny, not dark. He walked the dog before bedtime instead of before dinner because it was still light outside later in the day.

"But where was the moon?" Lin thinks to himself. "Why can I only see the moon sometimes? And why does it seem to move from place to place?"

5

LITERAL—What is different about the sky outside between this picture and the picture on page 2? (Give students a chance to look back at the picture on page 2 again.)

» In this picture, the sky is bright and sunny. In this picture, we do not see the moon.

3. Generate questions.

NGSS Elements

SEP 1

DCI ESS1.A

Activity Page

AP UO.1

Differentiation

- Show students the question board. Ask students what they wonder about the moon after reading the chapter about Lin. Record their questions on the question board. (See **Know the Standards 2**.)
- Distribute Day or Night? (AP UO.1). Place students in pairs, and tell them to work together on identifying whether the picture shows daytime or nighttime. Show students where they should write the words *Day* and *Night* on the page.
- Circulate around the room as students work on Activity Page UO.1, and listen for understanding of how students tell whether something is daytime or nighttime. If necessary, **ask,** What do you notice in the sky?

  SUPPORT—Replace Activity Page UO.1 with an activity in which you show students more pictures of daytime and nighttime scenes to establish a pattern in what they see. Ask students to tell what they notice about the series of pictures.

  CHALLENGE—Challenge students to draw their own pictures of daytime and nighttime, including the objects they see in the sky during each time of the day.

  EXTEND—Have students draw pictures of what they notice in the sky in the morning before school and in the evening before they go to bed. Have students keep a picture log for one week and share what they notice with the class.

4. Check for understanding.

Monitor Progress

- Review student responses on Day or Night? (AP UO.1) to determine students' understanding of the following concepts:
  - The sun can be seen during the daytime.
  - The sun cannot be seen during the nighttime.
  - The moon can be seen during the nighttime and sometimes during the daytime.
- Revisit the question board, adding student questions and generating answers with students throughout the unit. Tell students that all questions on the question board will be addressed.

Tie to the Anchoring Phenomenon

Students get an introduction to the concepts of day and night and the objects that are visible in the sky as Lin discovers these phenomena in the Student Book. They will use this information and build upon it throughout the unit to figure out patterns of how objects move across the sky.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 1 Asking Questions: Questions are important tools that drive scientific discoveries. Guide students to get in the habit of asking questions, which is a skill that will be reinforced throughout this unit.

LESSON 1

The Sun and Its Predictable Patterns

Overview

Guiding Question: When and where can you see the sun in the sky?

Lesson 1 Segments	Segment Questions	Advance Preparation
1.1 What Are Daytime and Nighttime? Students observe the sky and do a demonstration to see why the sky is light during the day and dark at night.	What are daytime and nighttime?	Gather materials for the demonstration. See Materials and Equipment.
1.2 Sunrise, Sunset (3 days) Students participate in a three-day investigation where they observe the apparent movement of the sun in the sky in the morning and afternoon.	When does the sun rise and set?	Gather materials for student investigation. See Materials and Equipment.
1.3 The Sun Changes Positions Students read about how the sun changes positions in the sky over a twenty-four-hour period.	How does the position of the sun in the sky appear to change?	Read Chapter 2 in the Student Book.
1.4 Lesson 1 Roundup: The Sun in the Sky Students use their observations from their investigation to draw a class diagram, make conclusions about how the sun appears to move across the sky, identify patterns, and make predictions about where the sun will be located at different points throughout the day.	When and where can you see the sun in the sky?	Gather materials for class diagram. See Materials and Equipment.

What's the Story?

Summary: In Lesson 1 (Segments 1–4), students explore how the sun appears to move across the sky. They participate in a three-day investigation where they observe the sun at two different times of the day to record where it is in the sky and the direction in which it appears to be moving (1-ESS1-1). The developing understanding of these phenomena in Lesson 1 prepares students for their work in Lesson 2, when they will expand their observation of the sun to include a year-round study of when the sun rises and sets in their part of the country.

Learning Progression: Lesson 1 builds on student understandings about sunlight from Kindergarten, such as K-ESS2-1: *Use and share observations of local weather conditions to describe patterns over time*. Lesson 1 also builds toward the Grade 1 target of 1-ESS1-2: *Make observations at different times of the year to relate the amount of daylight to the time of year.*

Guiding Phenomenon: Objects in the sky—such as the sun, the moon, and stars—seem to move and change position over time. These movements take place in patterns that can be studied and predicted to tell where the objects will be in the sky at any given time. Our main character, Lin, makes observations about daytime and nighttime in the storyline as an introduction to how the presence or absence of the sun makes a difference in what the sky looks like.

Learning Objectives

By the end of Lesson 1, students will do the following:

- Describe how the sun appears to move across the sky.
- Identify patterns in where the sun is located in the sky throughout the day.
- Make predictions about daytime and nighttime.

NGSS Standards and Dimensions

Performance Expectation: 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
4 Analyzing and Interpreting Data Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**ESS1.A The Universe and Its Stars** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	**1 Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 1.1

What Are Daytime and Nighttime?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: When and where can you see the sun in the sky?

Today's Question: What are daytime and nighttime?

Tie to the Anchoring Phenomenon: Students learn about daytime and nighttime to understand the objects they see in the sky at different times of the day, as Lin does when he wakes up and gets ready to go to school. This will help students explain why the day is light and the night is dark.

At a Glance

Learning Objectives

✓ Identify the sun as the predominant space object visible in the sky during the day.

✓ Define day and night relative to the appearance of the sun.

Instructional Activities

- student observation
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 1 Patterns

Students ask questions and identify patterns in the appearance of our star—the sun—and the moon.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

daytime **moon** **nighttime** **sky**
star **sun**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **notice** **observe**

Instructional Resources

Activity Page

AP 1.1.1

Activity Page
The Sun (AP 1.1.1)

Materials and Equipment

- globe (or ball)
- flashlight
- question board

Advance Preparation

Identify an outside location where students can observe the sky.

The Core Lesson 1.1

1. Introduce students to Lesson 1.

NGSS Elements

SEP 1
CCC 1
DCI ESS1.A

Ask a volunteer to state the **Big Question** that you'll be answering in this unit, which is posted somewhere in the room—**How do the sun, the moon, and stars appear to change position in the sky?**

Tell students that, before they can answer the unit's Big Question about objects in the sky, they first need to be able to describe the difference between daytime and nighttime. In Lesson 1, they will learn about the rising and setting of the sun and its positions in the sky to apply their understanding to the Big Question. Write the **Lesson 1 Guiding Question** where students can see it:

When and where can you see the sun in the sky?

Tie to the Anchoring Phenomenon

As students work through Lesson 1, they will learn how daytime and nighttime are marked by the presence or absence of the sun, just as Lin observes. Students will also learn why the sun changes positions throughout the day.

2. Observe the sky.

- Lead students on a walk outside (or if available, look out the window of the classroom). Point out that when it is daytime, we do not need to use extra lights outside, like streetlights, to see. This is because the sun gives us enough light so that we can get around and do things.

NGSS Elements

DCI ESS1.A
SEP 1

SAFETY NOTE: Caution students against looking directly at the sun.

- When outside, **ask the following questions:**
  - What can we see outside because of the sun's light?
    - » trees, buildings, cars, people walking
  - What can we do outside because of the sun's light?
    - » play games, garden, swim, run around, and take walks
  - What can you see in the sky?
    - » the sun, clouds
  - Sometimes we can't see the sun, but it is light outside. Why?
    - » Clouds are covering the sun, but the light comes through.
  - What happens at night? Do we need to use lights to be able to see outside? How come?
    - » Yes, we need to use lights outside to see, because it is dark out.
  - What happens to the sun at night?
    - » It goes down or away.

Differentiation

CHALLENGE—Challenge students to pantomime they are the morning sun. Suggest that students also describe other activities that happen once the sun comes out that are not seen when the sun is not out.

EXTEND—Have students keep a log of when they see the sun, moon, and stars. Have them do this at three different times (morning, afternoon, and night).

3. Guide a demonstration.

NGSS Elements

SEP 1
CCC 1
DCI ESS1.A

- Prepare for a demonstration. (See **Know the Standards 1** and **2**.)
- Call two volunteers to come to the front of the class. Hand one volunteer a flashlight. Hand the other volunteer the globe (or ball).
- Show the class the globe. Explain that this represents Earth. Point to the United States on the globe. Tell students that this is the United States, where they live.
- Explain that the flashlight represents the sun in the sky. Now have the volunteer shine the flashlight on the United States and hold it in place while the other volunteer holds the globe still. **Ask the class the following questions:**
  - What do you notice about where the sun is shining?
    - » The light is shining on the United States.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students observe that it is daytime when the sun is shining and nighttime when a place on Earth is not getting any light from the sun.

2. SEP 1 Asking Questions: Ask students what else they wonder about the sun. Add their questions to the question board.

- If this were real, do you think it would be daytime or nighttime in the United States? Why?
  - » daytime because the sun shines during the day

- Now draw students' attention to the other side of the globe. Point out that the opposite side of the globe is not getting any light from the flashlight. **Ask,** Do you think it is daytime or nighttime in that part of the world? Why?
  - » nighttime because it is not getting any light from the sun

- Now prompt the volunteer holding the globe to spin it around horizontally (not up and down) so the United States faces away from the flashlight. **Ask the class the following questions:**
  - What happened to Earth?
    - » It turned.
  - Is it daytime or nighttime in the United States now? How do you know?
    - » nighttime because the United States is facing away from the sun and not getting any of the sun's light

- Ask students what questions they have about the demonstration.

4. Check for understanding.

Activity Page

AP 1.1.1

- Distribute The Sun (AP 1.1.1) to each student. Tell the class that Activity Page 1.1.1 is for helping them summarize what they learned about daytime and nighttime.
- Give students a few minutes to complete Activity Page 1.1.1, and then have students present their drawings and determine if they understand whether the presence or absence of the sun and its light makes it daytime or nighttime.
- Review student responses on Activity Page 1.1.1 to determine student understanding of the following concepts:
  - The sun's light can be seen during the daytime.
  - The sun's light cannot be seen during the nighttime.

Monitor Progress

- Review questions on the question board and any answers. Encourage students to suggest additional questions for the board.

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In learning about daytime and nighttime, students understand that the presence of the sun—and its light—is what determines what time of day it is. From here, they can start to notice patterns of where the sun is in the sky at different times of the day and in different seasons. Lin remembers that the sky was light out at certain times of the year in the morning and dark at other times of the year. Students will explore this further in the unit using the foundational information about the sun.

LESSON 1.2

Sunrise, Sunset

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: When and where can you see the sun in the sky?

Today's Question: When does the sun rise and set?

Tie to the Anchoring Phenomenon: Lin wakes up in the morning before the sun has risen, and he notices that the sky is dark like it was before he went to sleep for the night. Students will make firsthand observations to learn about the time of day that the sun rises and sets to understand that the sun changes position in the sky throughout the day.

At a Glance

Learning Objectives

- ✓ Observe and record the locations of sunrise and sunset.
- ✓ Observe and record the position of the sun in the sky during various times of day.

Instructional Activities (3 Days)

- student observation
- student investigation
- data collection
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students ask and discuss questions about patterns of the sun.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

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east **sun** **west**

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change **direction** **identify** **move**
notice **observe** **position**

Instructional Resources

Activity Page

AP 1.2.1

Activity Page
Where Is the Sun? (AP 1.2.1)

Materials and Equipment

- compass
- question board

Advance Preparation

Identify an outside location where students can observe the sky on a series of sunny or partly cloudy days.

The Core Lesson 1.2

1. Day 1: Focus student attention on Today's Question.

NGSS Elements

DCI ESS1.A

When does the sun rise and set?

Start a discussion about whether it was light or dark outside when students arrived at school this morning. **Ask students if they could see the sun outside on their way to school.**

» Accept reasonable answers. Students may not have seen the sun because of cloud cover but could see sunlight.

2. Preview the investigation.

NGSS Elements

CCC 1
DCI ESS1.A

Activity Page

AP 1.2.1

- Tell students that for the next three days they will observe where the sun is in the sky at the beginning of school and at the end of school.
- Explain that the sun rises in the morning and sets in the evening. For this investigation, exact times of sunrise and sunset will not be used or recorded, but students should understand the direction in which these events occur (east and west).
- Distribute Where Is the Sun? (AP 1.2.1). Explain that Activity Page 1.2.1 has three drawing boxes, one for each of the three days.
- Tell students that they will draw where the sun is in the sky. You will lead them outside—or have them look out a window or doorway—to locate the sun. Continue to remind students to never look directly at the sun.

- Show students the compass. Explain how and why a compass is used. Tell them what is meant by north, south, east, and west. Tell students that you will bring the compass outside with them so that they can know what direction the sun is in the sky.
- Pass the compass around. Let students stand up and turn around and watch how the needle moves around, too.

Differentiation

SUPPORT—If needed, give students additional practice with identifying directions for north, east, south, and west. Play a game that uses a compass and involves students standing east of one object or south of another object.

CHALLENGE—Provide pairs with one-inch graph paper. Students will put an *X* on a square close to the middle of the paper and lable the margins *north, south, east,* and *west*. Each student will call out a direction, such as "south three squares." The other student will start from the *X* and then color the square he or she lands on based on the direction given. Pairs will continue taking turns until each student has given directions three times.

3. Facilitate the morning investigation.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

Activity Page

AP 1.2.1

- Take students outside to make their first observations of the sun. Prompt students to bring Activity Page 1.2.1, along with a pencil and something to write on (like a notebook or clipboard). Bring the compass. As you go outside, ask students to point to where the sun is. They found the sun!
- Have students stand facing south. Use the compass to guide you in this direction.
- Guide students to identify a point of reference that is in the middle of the view. Then tell them to draw as a line on the bottom of the box that point of reference as they are facing south, such as a tree, building, mountain, playground, and so on for their horizon. Make sure to explain that a point of reference is something that is permanent and will be there each day. Give some examples of good and poor reference marks to help students choose the best point of reference. Students will draw the same points of reference for each box. This is because you will have them facing the same direction (south) every time. This ensures that they record the location of the sun relative to the same thing each time they make their observations. Remind students that the point of reference should be drawn in the middle of each drawing box.
- Now have students label the left side of their horizon pictures "east" and the right side "west."
- Finally, tell students to draw the sun in the sky. Have them label the sun "morning" to show that it is the sun in the morning.
- **Ask,** Is the sun to the left or right of the reference point?
  - » left

4. Repeat the investigation in the afternoon.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt them to bring Activity Page 1.2.1 with writing utensils and something to write on.
- Explain that in the morning the sun might be to the left of you but in the afternoon or evening it might be to the right of you.
- **Ask,** Where do you see the sun *now*?
  - » It is to the right of the reference point.

Activity Page

AP 1.2.1

- Prompt students to look at their first drawing on Activity Page 1.2.1 from this morning.
- **Ask,** What do you notice about the sun?
  - » It seems to have moved; it changed positions.
- Tell students to draw the sun in the afternoon in the picture. Have them label the sun "afternoon." Now prompt them to study the two positions of the sun in their two drawings. (See **Know the Standards 1**.)

Differentiation

SUPPORT—Alternatively, make a class drawing (visual representation) of what students observe with the position of the sun. Use poster board or large sheets of butcher paper to draw the horizon. Label the horizon "east" and "west," and draw a point of reference in the middle of the paper. Then draw the sun based on where students tell you to put it. You might also make this interactive by having the sun drawn on a separate sheet of tagboard for the students to move on the horizon drawing based on the time of day.

CHALLENGE—Have students work in small groups for this activity. Give each group a compass, and allow them to find the directions of east and west so that they can draw their horizons on Activity Page 1.2.1 correctly.

EXTEND—With parent support to return students to the same point of reference, have students continue to observe and draw the position of the sun after school as a take-home activity. They can add the third drawing of the sun onto Activity Page 1.2.1 and compare the position of the sun at three points during the day, instead of two.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students observe that the sun appears to change position in the sky throughout the day. Students will build on this observation to later form patterns and make predictions about the location of the sun compared to Earth.

- **Ask the following questions:**
  - What direction in the sky did the sun start at?
    - » east
  - What direction does the sun appear to be moving in?
    - » It appears to be moving to the west.

1. Day 2: Refocus student attention.

When does the sun rise and set?

- Remind students that they are going to study the position of the sun in the sky again today (and tomorrow).
- Summarize what students noticed the previous day about the sun in the sky. Have students take out Activity Page 1.2.1. **Ask students the following:**
  - What direction in the sky was the sun in the morning?
    - » the east
  - What direction was the sun later in the day?
    - » in the west

2. Facilitate the morning investigation.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

Activity Page

AP 1.2.1

- Plan to bring students back to the same location outside at the same time as yesterday. Prompt them to bring Activity Page 1.2.1 with them, as well as a writing utensil and something to write on. Make sure to bring the compass. Although if a good point of reference was chosen, students should be able to locate which direction is south from that marker point.
- Have students stand facing south. Tell them to draw the same points of reference in the middle of the drawing box. For instance, if they drew a specific tree and a mountain yesterday, they should draw the same things today. Let students know that their pictures do not need to be a perfect match for all three days but that they should be very similar.
- Now have students label the left side of their horizon pictures "east" and the right side "west." Guide students with prompts on which side of the paper is the left and which is the right.
- Now have students locate the sun in the sky, again, always with the caution of not looking directly at the sun. **Ask,** What direction is the sun right now?
  - » east
- Tell students to draw the sun on their pictures and label the sun "morning." Remind students that later in the afternoon they will add a second sun drawing to the picture.

3. Repeat the investigation in the afternoon.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

Activity Page

AP 1.2.1

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt them to bring Activity Page 1.2.1 with writing utensils and something to write on.
- **Ask,** What direction is the sun *now*?
  - » It is to the west.
- Prompt students to look at their drawing on Activity Page 1.2.1 from this morning.
- **Ask,** What do you notice about the sun?
  - » It seems to have moved; it changed positions.
- Tell students to draw the sun in the afternoon on their pictures. Have them label the sun "afternoon." Now prompt students to study the two positions of the sun on their two drawings. (See **Know the Standards 2**.)

4. Check for understanding.

- When you get back to the classroom, tell students to look at the pictures from yesterday and today. They should compare the pictures. Remind them that to compare means to look at what is similar and different between them. (See **Know the Standards 3**.)
- **Ask the following questions:**
  - What direction in the sky did the sun start at on both days?
    - » east
  - What direction does the sun appear to be moving in on both days?
    - » It seems to be moving west.

Monitor Progress

- Circulate around the room, and review students' drawings to check for proper understanding of how to draw the sun's orientation in the sky according to objects of reference on the horizon.

1. Day 3: Refocus student attention.

When does the sun rise and set?

- Remind students that they are going to study the position of the sun in the sky again today, just as they did yesterday and the day before.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 4 Analyzing and Interpreting Data: Students examine the two drawings of the suns on AP 1.2.1 to see that the sun is in the east during the morning and in the west during the afternoon.

3. CCC 1 Patterns: Students notice that for the second day in a row, the sun appears to have moved in the same direction. Students can use this information to notice a pattern.

2. Make a prediction.

NGSS Elements

ESS1.A
CCC 1

- Before going outside, make a class prediction about where the sun will be in the sky.
- Draw the horizon on the board, and include an object or two in the middle of the horizon for orientation. Label the left side "east" and the right side "west."
- **Ask students,** Where do you think the sun will be this morning? Why do you think so?
  - » It will be in the east, because it was in the east yesterday morning and the morning before.
- Write the prediction on the board.
- **Ask students,** Where do you think the sun will be this afternoon? Why do you think so?
  - » It will be more in the west, because it was in the west yesterday afternoon and the afternoon before.
- Write the prediction on the board.

3. Facilitate the morning investigation.

Activity Page

AP 1.2.1

- Plan to bring students back to the same location outside at the same time. Prompt them to bring Activity Page 1.2.1 with them, as well as a writing utensil and something to write on. Bring the compass.
- Have students stand facing south. Tell them to draw the same points of reference in the middle of the third drawing box on Activity Page 1.2.1.
- Now have students label the left side of their horizon pictures "east" and the right side "west."
- Tell students to point to the sun in the sky. **Ask,** Do you know what direction the sun is in right now?
  - » east
- **Ask,** Was our first prediction correct?
  - » yes
- Tell students to draw the sun on their pictures and label the sun "morning." Remind students that later in the afternoon they will add a second drawing of the sun to the picture.

4. Repeat the investigation in the afternoon.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt students to bring Activity Page 1.2.1 with writing utensils and something to write on.

- **Ask,** Where do you see the sun now?
  - » It is to the right, or the west.

Activity Page

AP 1.2.1

- Prompt students to look at their drawing on Activity Page 1.2.1 from this morning.
- **Ask,** What do you notice about the sun?
  - » It seems to have moved; it appears to have changed positions.
- **Ask,** Was our second prediction correct?
  - » yes
- Tell students to draw the sun from the afternoon in the picture. Have them label the sun "afternoon."

5. Check for understanding.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Bring the class together, and summarize their findings over the past three days. Have students look at all three of their drawings.
- **Use the following questions to gauge student understanding:**
  - Does the sun appear to move in a pattern?
    - » yes
  - What direction does the sun rise in the morning?
    - » in the east
  - What direction does the sun move during the day?
    - » to the west
  - Do you think it does this same thing every day?
    - » yes
  - How could you be sure it does this every day?
    - » take more data
  - What direction will the sun be tomorrow morning? What direction will it be later in the day?
    - » It will be in the east in the morning and in the west later in the day.

Activity Page

AP 1.2.1

Review students' drawings on Activity Page 1.2.1 to see that students understand that the direction of the sun is in the east in the morning and in the west later in the day. Listen for their responses to your questions to determine student understanding of the following concepts:

- The sun appears to move along a repeated path from east to west.
- The sun is in the east in the morning and the west in the afternoon.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how collecting data about the location of the sun at different times during the day might answer or relate to any of those questions.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In observing how the sun appears to move across the sky from east to west, students understand that the sun follows a repeated path, which is a pattern in nature that can be predicted. This information can help Lin figure out when the sky will get light in the morning and dark for the evening.

LESSON 1.3

The Sun Changes Positions

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: When and where can you see the sun in the sky?

Today's Question: How does the position of the sun in the sky appear to change?

Tie to the Anchoring Phenomenon: Students hear the teacher read about how the sun appears to change positions in the sky throughout the day. This accounts for the lightness and darkness that Lin observes during the day.

At a Glance

Learning Objective

✓ Summarize changes in the sun's apparent position.

Instructional Activities

- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Crosscutting Concept: 1 Patterns

Students read about patterns in the appearance and disappearance of the sun every day.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

daytime	**direction**	**east**	**moon**
nighttime	**north**	**pattern**	**south**
star	**sun**	**west**	

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change	**dark**	**identify**	**light**
move	**notice**	**observe**	**position**
rise	**set**		

Instructional Resources

Student Book

Ch. 2

Activity Page

AP 1.3.1

Student Book, Chapter 2
"What Causes Night and Day?"

Activity Page
Day and Night Activities
(AP 1.3.1)

Materials and Equipment

- scissors (1 per student)
- question board

The Core Lesson 1.3

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.A

How does the position of the sun in the sky appear to change?

Ask students if anyone looked out their window last night. If so, **ask,** What did you notice? Was it light or dark out? Did you see the moon? The stars? The sun?

» Accept all reasonable answers.

Ask students to describe the different ways the sun has appeared to them.

» It is bright against a clear blue sky, red at night or in the morning, behind clouds, not visible on a cloudy day.

2. Turn and talk.

NGSS Elements

CCC 1
DCI ESS1.A

- Have students team up with a partner.
- Distribute Day and Night Activities (AP 1.3.1), and go over the instructions together. Explain that students will cut out the cards with the pictures. Then they will sort them into two piles: one pile for things we do during the day and another pile for things we do at night.

Activity Page

AP 1.3.1

- Circulate around the room as students cut and sort the pictures. Encourage them to discuss each activity on the cards with their partner before deciding whether it's a daytime or nighttime activity.
- When students complete sorting, bring the class back together, and go over the activities—one by one—to give students a chance to tell whether they sorted them as daytime or nighttime activities.

As you circulate around the room, listen to student conversations and glance at their two piles to see that students understand the difference between the things we do at night and the things we do during the day. Some of this is firsthand knowledge that students have, but they are also starting to understand that daytime is marked by the presence of the sun and nighttime is marked by the absence of the sun. Certain activities revolve around the presence or absence of the sun.

Differentiation

SUPPORT—Limit the number of picture cards that you give to students so that they do not have as many to sort.

SUPPORT—If necessary, meet your students at their level of comprehension by doing the sorting activity on Activity Page 1.3.1 together as a class. Invite students to give their input about how to sort each picture.

CHALLENGE—Have students research animals that are more active at nighttime. Tell them to draw a picture and label each of the animals they have discovered in their research.

EXTENSION—Have students keep a log of all the activities they do during the day, from morning to night. Then, have them draw those activities and tell why they do them at certain times throughout the day.

3. Read together: "What Causes Night and Day?"

Student Book

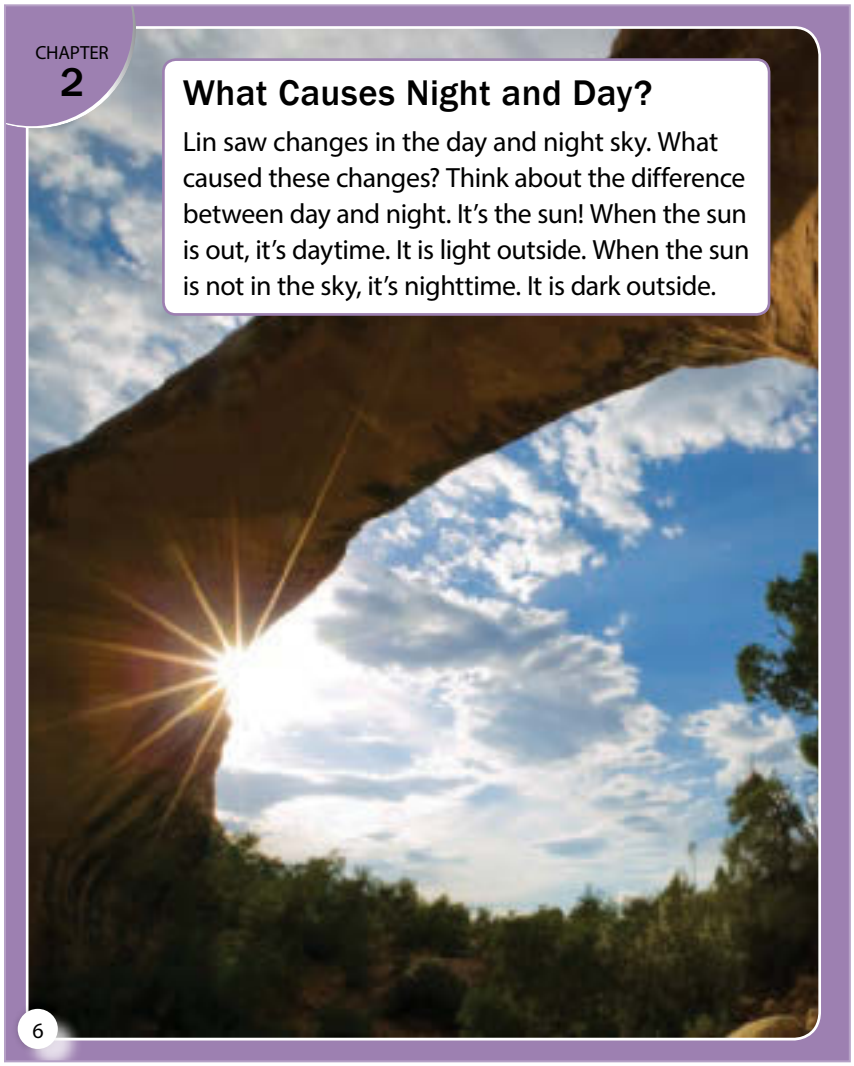
Ch. 2

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 6

Ask students to turn to page 6 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is "What Causes Night and Day?" and tell them to pay special attention to the pictures of the sky and whether it is light or dark as you read. (See **Know the Standards 1**.)



CHAPTER 2

What Causes Night and Day?

Lin saw changes in the day and night sky. What caused these changes? Think about the difference between day and night. It's the sun! When the sun is out, it's daytime. It is light outside. When the sun is not in the sky, it's nighttime. It is dark outside.

6

Ask students to look at the picture on page 6. Have students describe what they see in the picture. Students should be able to identify a blue sky and the presence of the sun.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students should start to notice that they are not able to see the moon in the picture or in real life during the daytime. Students should come to expect that the moon is usually not visible when the sun is also out.

LITERAL—Do you see the moon or the sun?

» the sun

CORE VOCABULARY—Discuss the differences between the words **daytime** and **nighttime**. They are both compound words. In daytime it is light out, but at nighttime it is dark. This difference changes the types of activities people do during those times.

SUPPORT—Compare the picture on page 6 to real life. Have students look outside and describe what they see. Continue to remind students to never look directly at the sun. **Ask students what they notice about the sky today.** Have students make comparisons between the real sky and the sky in the picture. **Ask,** What is similar? What is different? Students may notice that the sun is shining in the picture and it is also shining in the sky outside. Or they may notice that there are clouds in the picture and no clouds in the sky outside. Guide them to recognize that they cannot see the moon in the picture and probably not in the real sky today. (See **Know the Science 1**.)

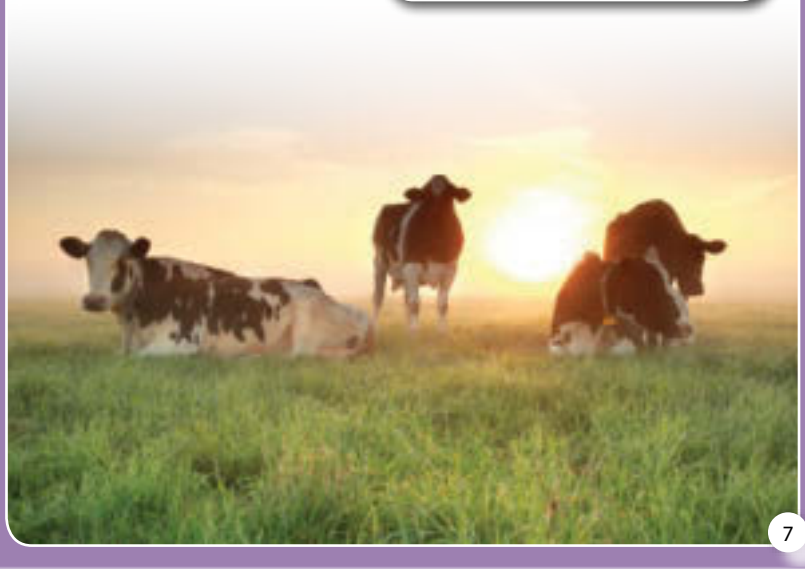
Know the Science

TEACHER DEVELOPMENT

1. When Can You See the Moon During the Day? The moon doesn't give off light of its own. It reflects light from the sun. During the day, the sun's light is so bright that it can hide the moon from view. But you can see a daytime moon when the moon is in certain phases. While Earth is spinning and the moon is orbiting, the lit part of the moon is seen in different parts of the sky and at different times of the month.

Page 7 **Ask students to look at the top picture on page 7.**

To learn about day and night, we first need to understand some things about Earth, the planet we live on. Earth gets light from the sun. The sun is a star! It looks much bigger and brighter than stars you see in the night sky. That is because it is much closer to Earth. Many other stars are larger and brighter than the sun. They just seem tiny because they are so far away.



7

CORE VOCABULARY—Explain that the **sun** is a star and that a **star** is an object in the sky that gives off light.

Explain that the sun is very bright and very hot. The light from the sun lights up our planet and gives us heat.

LITERAL—Do you see any stars at night when you look up at the sky?

» yes, if it's not cloudy

SUPPORT—Explain that there are many stars that are in the sky during daytime, even if we cannot see them during the day. The sun is a star that we see during the day. (See **Know the Science 2**.)

SUPPORT—Help students understand the concept of proximity in terms of how stars appear (larger or smaller) depending on their distance from Earth. Have students line up against the front wall of the classroom. Call on a volunteer to stand in front of the line of students. Hand that student a ball. Tell the rest of the class to watch the ball closely. Prompt the student to continue holding the ball as the student backs up farther and farther away from the class. **Ask students what they notice about the size of the ball.** (See **Know the Science 3**.)

» The ball looks smaller as it goes away from us.

Now have the volunteer with the ball bring the ball back to where the students are standing in a line. **Ask them if the size of the ball really changed or if it just looked like it changed.**

» The ball is the same size. It looked like it became smaller, but it did not really change.

Conclude by telling students that this is a lot like how objects, like airplanes or birds, in the sky work.

Ask students to look at the bottom picture on page 7. Explain that all animals and plants need the sun to live.

INFERENTIAL—How do you know that this picture of the animals is during the daytime?

» The sunlight is shining, so you can see the animals.

EVALUATIVE—Which time of the day do you prefer, daytime or nighttime? Explain your choice.

» Accept reasonable answers. Invite students to give reasons for their opinions.

Know the Science

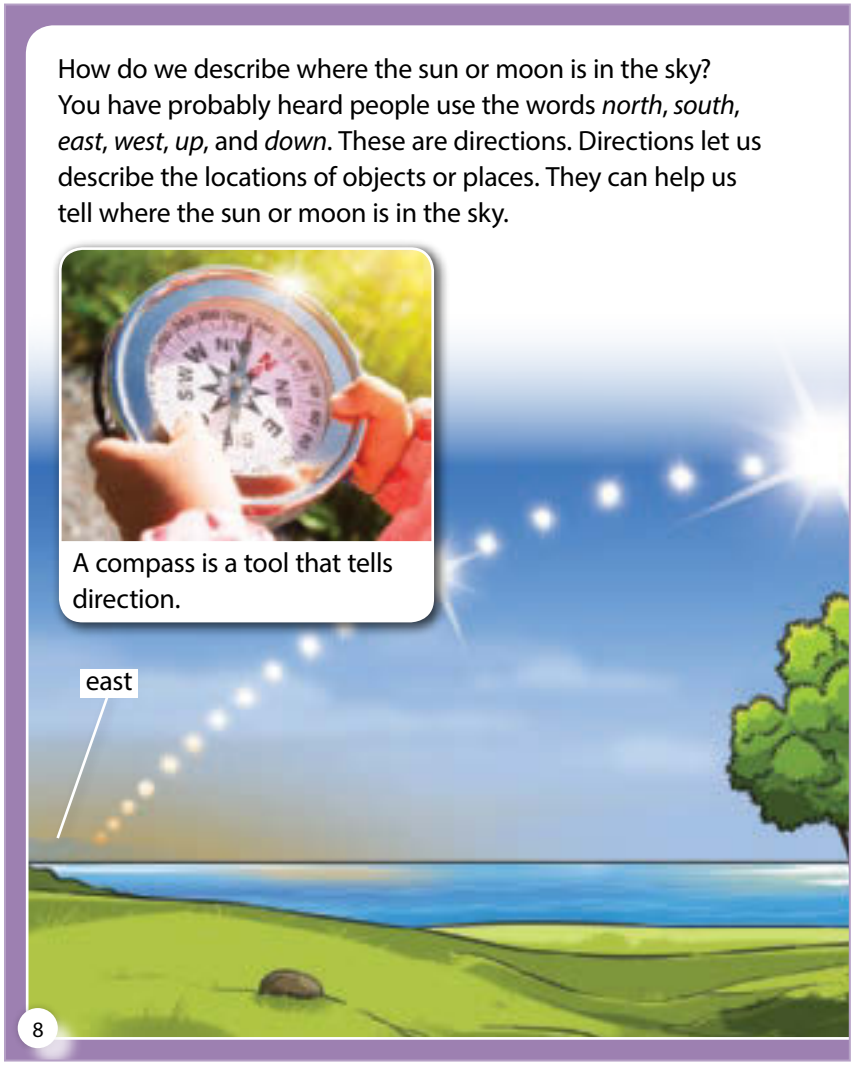
TEACHER DEVELOPMENT

2. Stars: Stars other than the sun are usually not visible to us during the daytime because sunlight is spread across the sky and the light from other stars we see at nighttime becomes too dim to notice. The light from other stars starts to blend in with the background of the bright sky.

3. Size of the Sun: The sun is a star that is closer to our planet, so it looks bigger than other stars in the sky. This is because the other stars are farther away. Other distant stars may be brighter or dimmer and larger or smaller than our star, the sun. All these factors play a role in a star's brightness, but students do not need to learn about measuring the brightness of stars until later grades.

Pages 8–9

Ask students to look at the pictures on pages 8 and 9. Explain that students used or saw a compass during their investigation of the sun. Invite students to share what they know about a compass and how it works.



CORE VOCABULARY—Explain that **directions** help us tell where things are located. We use the words **north**, **south**, **east**, and **west** for directions. Directions can also be *left*, *right*, *up*, and *down*.

Prompt students to recall the three-day investigation in which they observed the sun in the sky at different times throughout the day.

LITERAL—What direction word can we use to tell the location of the sun in the morning?

» east

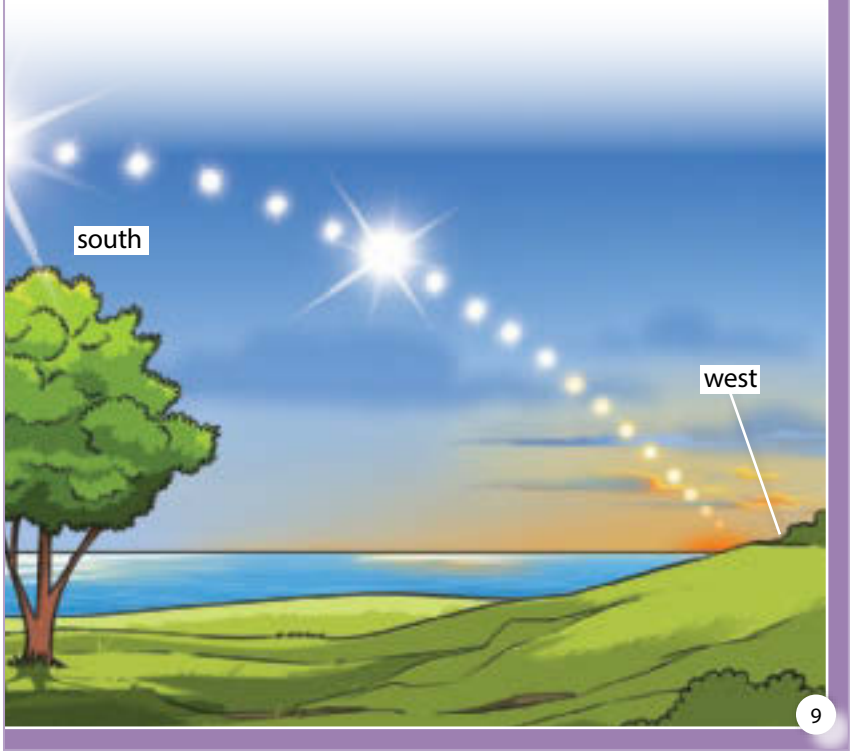
LITERAL—What direction word can we use to tell the location of the sun in the afternoon or evening?

» west

Explain that one twenty-four-hour period includes all the things that students do when they first wake up, do throughout the day, and even do at night. Clarify that even when students are asleep at night, that time still counts as part of the twenty-four-hour day.

The sun always rises in the east. It appears to move across the sky during the day. Then it sets in the west. One daytime plus one nighttime make one Earth day. An Earth day is twenty-four hours long. Where Lin lives, the sun rises and sets once in every period of twenty-four hours.

Look at the labels for east and west. Can you point to where the sun rises and sets?



9

SUPPORT—Have students compare their observations from the three-day investigation to the picture across the two pages. Have the students use their finger to move over the path of the sun during a twenty-four-hour time period. Make sure to explain any misconceptions of thinking that there are many suns due to the time-lapse nature of the illustration.

INFERENTIAL—What is the name of the shape of the path that the sun takes as it moves through the sky in a day?

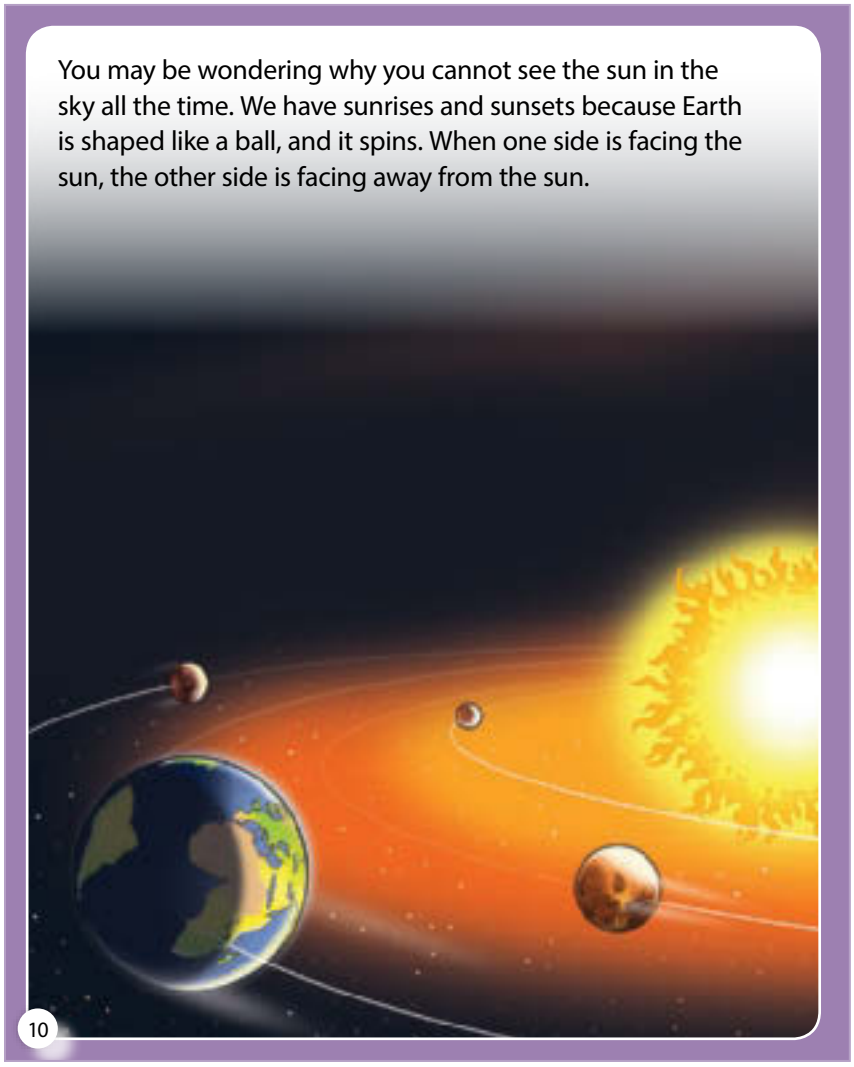
» It appears to move like an arc or a half circle; it appears to move like a rainbow shape.

INFERENTIAL—Look at the direction words of *east* and *west* on the picture. What direction would a person looking toward the tree and the water be facing?

» The viewer is facing south, because east is on the left and west is on the right.

Page 10

Ask students to look at the picture on page 10. Remind students of the demonstration they saw when the student shone a flashlight onto one side of a globe and the opposite side of that globe was dark. Explain that this page describes what they observed from that demonstration. (See **Know the Standards 2**.)



Explain that the sun always stays in the same place. It does not move or spin. You may need to clarify for students that when they see the sun set (or "go down") at night, what really is happening is that part of Earth is very slowly spinning away from the sun for that part of the twenty-four-hour day. Then, when the sun rises (or "comes up"), Earth is slowly spinning toward the sun again.

Know the Standards

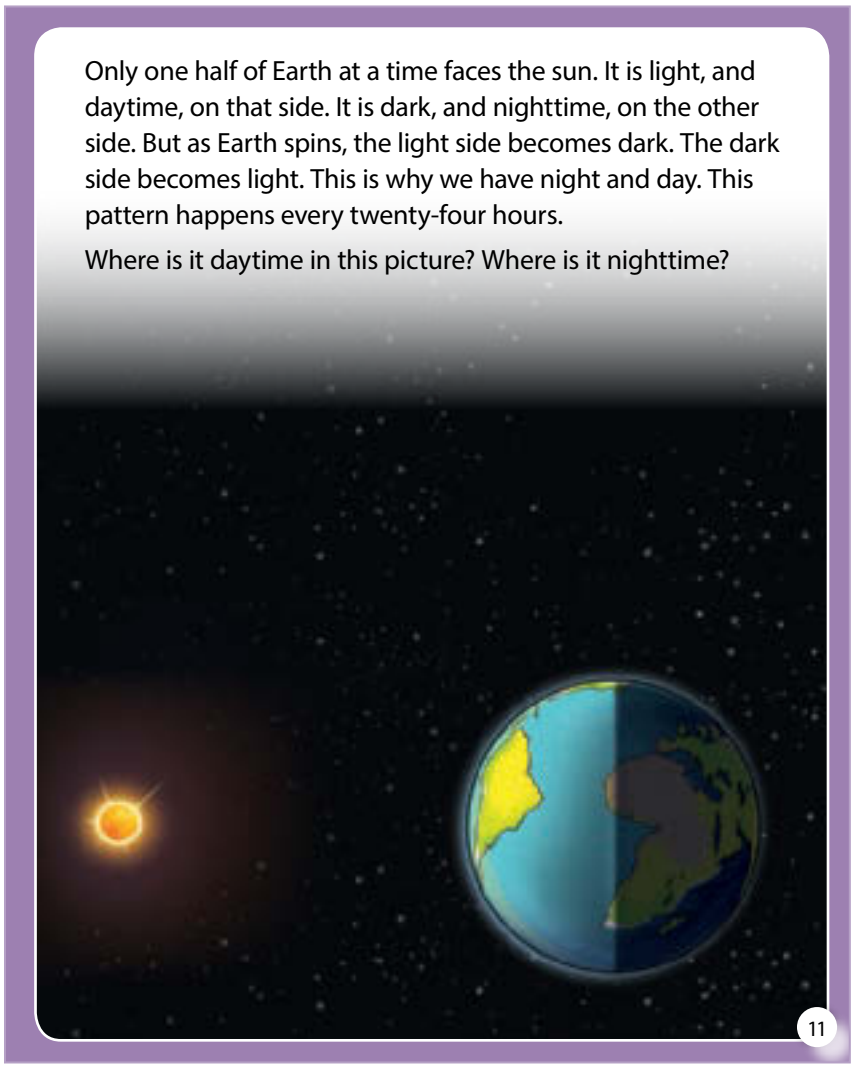
TEACHER DEVELOPMENT

2. DCI ESS1.A The Universe and Its Stars: Students may be able to predict when and where the sun will rise and when and where the sun will set.

SUPPORT—Help students understand how Earth rotates. Show them a demonstration of how Earth rotates using a globe (or a ball). You may wish to also rotate while holding the globe. Students will learn more about the revolution of Earth in later grades.

Page 11

Ask students to look at the picture on page 11. Explain that a pattern is something that is repeated over and over. The sun rising in the morning and setting at night is a pattern. This is because the same thing happens every day.



LITERAL—When will the sunrise happen tomorrow?

» in the morning

LITERAL—When will the sunset happen tomorrow?

» in the evening

SUPPORT—Have students form partners and talk to each other about all the things they do in a twenty-four-hour day, from the time they wake up to the same time the next day.

4. Check for understanding.

NGSS Elements

CCC 1

DCI ESS1.A

Activity Page

AP 1.3.1

Monitor Progress

Look at the piles that the students sorted from the Activity Page 1.3.1 picture cards to see if students understand what kinds of activities happen during the daytime and what kinds of activities happen at nighttime.

Review the picture cards that students sorted from Day and Night Activities (AP 1.3.1) to determine students' understanding of the following concepts:

- We see the sun's light during daytime.
- We do not see the sun's light during nighttime.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading about day and night might answer or relate to any of those questions. Add additional questions to the question board.

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In observing how the sun appears to move across the sky from east to west, as well as when it rises and sets, students understand that there is a repeated path, which is a pattern in nature that can be predicted. Such information will be useful to Lin, who wonders why the sky is dark when he wakes up.

LESSON 1.4

Lesson 1 Roundup: The Sun in the Sky

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: When and where can you see the sun in the sky?

Today's Question: When and where can you see the sun in the sky?

Tie to the Anchoring Phenomenon: Just as Lin observes the presence and absence of the sun at different times of day, students use their firsthand observations of the sun and how it appears to move across the sky to make a class visual that represents the sun's apparent motion and pattern.

At a Glance

Learning Objectives

- ✓ Conclude the direction of the sun's apparent motion in the sky throughout a day.
- ✓ Predict patterns of the sun's presence in the sky.
- ✓ Chart the apparent movement of the sun.

Instructional Activities

- modeling
- class discussion
- working with data
- making predictions

NGSS References

Performance Expectation: 1-ESS1-1

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students use their data and observed patterns to create a model of the sun's apparent movement.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

daytime	**direction**	**east**	**moon**
nighttime	**north**	**pattern**	**predict**
south	**star**	**sun**	**west**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change	**dark**	**identify**	**light**
move	**notice**	**observe**	**position**
rise	**set**		

Instructional Resources

Activity Pages

AP 1.2.1
AP 1.4.1

Student Book

Ch. 2

Activity Pages
Where Is the Sun? (AP 1.2.1)
What Is the Pattern? (AP 1.4.1)

Student Book, Chapter 2
Revisit "What Causes Night and Day?"

Materials and Equipment

- large sheet of butcher paper or poster paper (or a large area of space on the board)
- marker
- question board

The Core Lesson 1.4

1. Focus student attention on Today's Question.

When and where can you see the sun in the sky?

Activity Page

AP 1.2.1

- Remind students that they observed the sun in the sky for three days.
- Redistribute the completed Where Is the Sun? (AP 1.2.1) from Lesson 1.2, and place students in small groups of mixed ability.
- Tell students to review and compare their observations with the other students in their group. Prompt them to talk about the horizons and points of reference that they used to make their observations. Then cue them to talk about where the sun was in the sky in the morning and where the sun was in the sky in the afternoon for all three days. (See **Know the Standards 1** and **2**.)

Know the Standards

TEACHER DEVELOPMENT

1. SEP 4 Analyzing and Interpreting Data: Students use the firsthand observations they made of the sun to draw a conclusion as a team about where to locate the sun in the sky at different times throughout the day.

2. Language Arts Connection: Students work in groups to recall and discuss the observations they made from their three-day investigation on how the sun appeared to move across the sky (W.1.8).

NGSS Elements

CCC 1
DCI ESS1.A
SEP 4

- Use the following question prompts to initiate group discussion:
  - What direction was the sun at in the morning?
    - » east
  - What direction was the sun at in the afternoon?
    - » west
  - Where would the sun be at night?
    - » on the other side of Earth
- Explain that students are making one diagram to represent all three days of observations. So, students need to look carefully at the patterns that they notice for the three days to come up with one important way to tell where the sun appears to be in the sky.
- Give groups time to come to an agreement about the directions the sun is in the sky (east or west) at the two given times during the day.

2. Make a class diagram.

NGSS Elements

CCC 1
DCI ESS1.A
SEP 4

- Tell students that now they are going to use the information they have from their groups about the sun in the sky to make a class diagram.
- Explain that the first thing that needs to be done is to draw the horizon and a point of reference in the middle of the horizon.

Ask students to tell you what some of the points of reference are that they drew.

» Students may name mountains, trees, buildings, lights, or other points that they used for their own drawings.

- Draw in the middle of the large sheet of paper or the board the chosen point of reference.
- Now explain that direction labels need to be placed on the diagram. **Ask students to tell you where to label the direction for east and where to label the direction for west.** Remind students that they were facing south when they went outside. This means the left side of the horizon is east and the right side is west.
- Tell students that now their diagram is set up and ready for them to draw where the sun is in the sky during different times of the day.
- Invite one group at a time to come up to the diagram. Give one of the students a marker. When they are at the diagram, provide the following instructions:
  - Draw a picture of where the sun is in the sky during the morning.
  - Draw a picture of where the sun is in the sky during the afternoon.

- Then have the group sit down. Repeat this process with the rest of the groups in the class, until they have all had a chance to draw on the diagram. (See **Know the Standards 3**.)
- If groups want to draw the sun in the same location on the diagram as another groups' sun, tell them to draw it next to that sun.

3. Analyze the class diagram.

NGSS Elements

CCC 1
DCI ESS1.A
SEP 4

- When all the groups have had a chance to draw on the class diagram, there should be a cluster of suns drawn on the east side of the diagram and a cluster of suns drawn on the west side of the diagram. Students will then analyze the information on the diagram to determine that a pattern can be established in how the sun appears to move across the sky during the day.
- **Ask students to describe what they notice about the diagram.**
  - » All the suns during the morning are on the east side of the diagram. All the suns during the afternoon are on the west side of the diagram.
- Guide the students to verbalize that they can conclude that the sun during the morning is on the east side of the diagram. Then guide the students to verbalize that the sun during the afternoon is on the west side of the diagram. (See **Know the Standards 4**.)

4. Identify a pattern and make predictions.

NGSS Elements

CCC 1
DCI ESS1.A
SEP 4

- **Ask students if they can see a pattern.** Remind students that a pattern is something that is repeated over and over. (See **Know the Standards 5**.)
  - » The pattern we see is that the sun starts in the east in the morning and appears to move to the west later in the day.
- Have students look at the image on pages 8 and 9 of the Student Book. Then draw a line (in the shape of an arc) on the diagram that connects the morning sun to the afternoon sun. Guide students to realize that the image in the Student Book shows the sun's location throughout the day in one image. This is like the whole-class diagram showing the suns in the morning and afternoon.

Know the Standards

TEACHER DEVELOPMENT

3. DCI ESS1.A The Universe and Its Stars: Students describe where to locate the sun at different times of the day by drawing on a whole-class diagram.

4. SEP 4 Analyzing and Interpreting Data: Students study the diagram to see that the morning suns are on the eastern side of the sky and the afternoon suns are on the western side of the sky. From this they can interpret the pattern of how the sun appears to move across the sky during the day.

5. CCC 1 Patterns: Students discern from the data in their diagram that the sun rises in the east and sets in the west.

Student Book

Ch. 2

Activity Page

AP 1.4.1

- **Ask students what they think happens to the sun after the afternoon.**
  - » It sets at night.
- Continue drawing the arc from the afternoon sun and down to represent the sun setting on the diagram.
- Distribute What Is the Pattern? (AP 1.4.1) to students. Go over the directions together as a class. For the first section, explain that students will circle the correct word for each sentence. Then students will draw the sun to make a prediction. For the prediction, tell students that they should think about the pattern of the sky being dark and light. Without giving students the answer, remind them of the three-day observations and whole-class diagram that they completed in this lesson.
- Allow students to work in their groups to complete Activity Page 1.4.1.
- Circulate around the room as students work on Activity Page 1.4.1. Listen for evidence of understanding as students discuss their answers in groups. Review students' work on Activity Page 1.4.1 to ensure proper understanding of the concepts covered in this lesson.
- Remind students that a prediction is like a guess that you make. But it's a guess that is made based on evidence, like what you observe or what you know to be true. (See **Know the Standards 6**.)

Differentiation

SUPPORT—Instead of using Activity Page 1.4.1 to give students practice with patterns and predictions, do an activity where students act out the movement of the sun in the sky. Clear an area of the room where students will do their demonstrations of the sun. Label one side of the room "east" and the other "west." Prepare cardboard cutouts of the sun for students to use. Remind students to stand on the correct side of the room, east or west, based on the time of day they will be acting like the sun. Have students act out different scenarios that you give them. For example, "Maria, pretend you are a morning sun. Where are you in the sky?" or "Patrick, pretend you are an afternoon sun. Where are you in the sky?" Repeat this until all students have had a chance to act out being the sun.

EXTEND—Challenge students to make a prediction of where the sun will be in the sky for the next week. Set them up with a table that has the days of the week written on the rows in the first column. In the second column, write "Morning Sun." In the third column, write "Afternoon Sun." Then have students write the words *east* or *west* in the table under each column, according to where they predict the sun will be in the sky on those days.

Know the Standards

TEACHER DEVELOPMENT

6. DCI ESS1.A The Universe and Its Stars: Students use what they know about the pattern of the sun's apparent movement to describe where it will be located in relationship to Earth in the future.

Days of the Week	Morning Sun (east or west)	Afternoon Sun (east or west)
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

CHALLENGE—Give each student a time of day. Have students line up by hour from east to west in position as the sun moves across the sky.

5. Check for understanding.

Activity Page

AP 1.4.1

- Look at students' responses on Activity Page 1.4.1 to see that students understand the relationship between the sun and Earth's sky and that they can use the identified patterns of apparent motion of the sun to tell where it will be in the future.
- Review students' responses on What Is the Pattern? (AP 1.4.1) to determine student understanding of the following concepts:
  - The sun is located, in relationship to Earth, in different locations at different times of the day.
  - The sun will always rise in the morning in the east and set at night in the west.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how diagramming how the sun moves across the sky answers or relates to any of those questions. Add additional questions to the question board.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

In observing how the sun appears to move across the sky from east to west, as well as when it rises and sets, students understand that the sun appears to follow a repeated path in relationship to Earth. The pattern in nature that can be predicted will be an ongoing observation that students will continue to develop throughout their science adventures. Such information will be useful to Lin, who wonders why the sky is dark when he wakes up.

LESSON 2

Annual Patterns of Sunrise and Sunset

Overview

Guiding Question: How does the amount of daylight change during the year?

Lesson 2 Segments	Segment Questions	Advance Preparation
2.1 What Are Sunrise and Sunset? Students set up a long-term investigation in which they will track and record the sunrise and sunset times throughout the school year.	What are sunrise and sunset?	Gather materials for the demonstration. See Materials and Equipment.
2.2 What Time Does the Sun Rise and Set? Students present their data on sunrise and sunset times every Monday throughout the school year. The information is tracked on a cumulative data table.	What time does the sun rise and set throughout the year?	Gather materials for the investigation. See Materials and Equipment.
2.3 How Can We Present Our Sunrise and Sunset Data? (2 Days) Students put together a graph that charts the sunrise and sunset data, which they will use to analyze patterns and make predictions.	How can you tell how long daylight is in a day?	Gather materials for class graph. See Materials and Equipment.
2.4 What Sunrise and Sunset Patterns Do We See? Students read about how the sun rises and sets at different times throughout the year.	How does the amount of daylight change in a pattern?	Read Chapter 3 in the Student Book.
2.5 Lesson 2 Roundup: Daylight Changes Through the Year Students use their data graphs to make predictions about the sunrise and sunset times on future dates.	How does the amount of daylight change during the year?	Gather materials for class activity. See Materials and Equipment.

What's the Story?

Summary: In Lesson 2 (Segments 1–5), students explore when the sun rises and sets at different times throughout the year. They participate in an investigation that takes place over the course of the school year, in which they observe the sunrise and sunset times to discern that the sun rises and sets at different times throughout the year and that those times affect how much daylight hours there are in a twenty-four-hour period (1-ESS1-2). The developing understanding of these phenomena in Lesson 2 prepares students for their work in Lesson 3, when they will expand their observation to that of the moon, where they will investigate the moon's phases for two months.

Learning Progression: Lesson 2 builds on student understandings about the sun and its apparent movements, 1-ESS1-2: *Make observations at different times of year to relate the amount of daylight to the time of year.*

Guiding Phenomenon: Objects in the sky—such as the sun, the moon, and stars—seem to move and change position over time. These movements take place in patterns that can be studied and predicted to tell where the objects will be in the sky at any given time. Our main character, Lin, observes that the amount of daylight changes at different times throughout the year. In Lesson 2, students participate in an investigation that supports his observation to give students firsthand experience in witnessing how the rising and setting of the sun affects whether it is light or dark outside.

Learning Objectives

By the end of Lesson 2, students will do the following:

- Identify sunrise and sunset times throughout the year.
- Identify patterns in when the sun rises and sets.
- Describe how the amount of daylight changes in different seasons.
- Make predictions about sunrise and sunset times for future dates.

NGSS Standards and Dimensions

Performance Expectation: 1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
3 Planning and Carrying Out Investigations Make observations (firsthand or from media) to collect data that can be used to make comparisons.	**ESS1.B Earth and the Solar System** Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	**1 Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 2.1

What Are Sunrise and Sunset?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the amount of daylight change during the year?

Today's Question: What are sunrise and sunset?

Tie to the Anchoring Phenomenon: Lin knows that the sun rises in the morning and sets at night, but he notices that it is still dark in the morning when he wakes up, when it used to be much lighter out at other times in the year. This segment sets students up to learn about sunrise and sunset and prepares them for their year-long investigation of sunrise and sunset times.

At a Glance

Learning Objectives

✓ Define *sunrise* and *sunset*.

✓ Plan an investigation of sunrise and sunset times.

Instructional Activities

- student observation
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.B Earth and the Solar System

Science and Engineering Practices: 1 Asking Questions; 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students plan and carry out an investigation of the times of sunrise and sunset.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

sunrise **sunset**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **investigate** **notice** **observe**

Instructional Resources

Activity Pages

AP 2.1.1
AP 2.1.2

Activity Pages
Sunrise, Sunset Sheet (AP 2.1.1)
Take-Home Letter (AP 2.1.2)

Materials and Equipment

- assortment of sunrise pictures
- assortment of sunset pictures
- internet access and the means to project images/video for whole-class viewing
- question board

Advance Preparation

- Search for an assortment of sunrise and sunset pictures on the internet. Put together a slideshow of the pictures in a random order that you will present to the class.
- For this lesson, students collect data on the sunrise and sunset times in real time over the course of several months. This can be recorded during a morning routine review of the weather and temperature.
- The intent is that students collect data on the sunrise and sunset times in real time. However, if this is not possible, there are substitute data in the Teacher Resources section of this book. This way students can discern patterns from the supplied data and use it to make their predictions about when the sun will rise and set and when the days will get longer and shorter.

- Alternatively, although it is valuable to have students observe sunrise and sunset, the times can be found online or in the newspaper. The point is to have students recognize patterns from the data and use it to make their predictions about when the sun will rise and set and when the days will get longer and shorter. (See **Know the Science 1**.)

The Core Lesson 2.1

1. Introduce students to Lesson 2.

NGSS Elements

CCC 1

Ask a volunteer to state the **Big Question** that you'll be answering in this unit, which is posted somewhere in the room—**How do the sun, the moon, and stars appear to change position in the sky?**

Tell students that, before they can answer the unit's Big Question about objects in the sky, they will first figure out how the amount of daylight changes during the year. In Lesson 2, they will plan and carry out a year-long investigation where students observe the sunrise and sunset times throughout the year, and notice how they change, to apply their understanding to the Big Question. Write the **Lesson 2 Guiding Question** where students can see it:

How does the amount of daylight change during the year?

Tie to the Anchoring Phenomenon

As students work through Lesson 2, they will learn how the amount of daylight changes during the year, just as Lin observes.

- **Ask,** What is daytime?
  - » It's when the sun is shining on Earth.
- **Ask,** What is nighttime?
  - » It's when the sun is not shining on Earth.
- Remind students that in Lesson 1 they learned about daytime and nighttime and how they are marked by the presence or absence of the sun. Students also learned that the sun comes up in the east and starts to go down in the west.

Know the Science

TEACHER DEVELOPMENT

1. Daylight Saving Times: At two points throughout the school year—November and March—you may have a switch between standard time and daylight saving time. If you live in an area that changes its clocks, you will need to account for this in the data, as students will suddenly see an hour difference in the time that the sun rises and sets. If you are using sample data instead of having students collect the data in real time, the time has already been adjusted as if the time change had not happened at all. This will help eliminate any skewed data.

- Explain that daytime starts once the sun is present. Daytime ends once the sun is not present. **Ask students to describe the sunrises and sunsets they have seen.**
  - » Some may have seen the sunrise or sunset over water, a field, or a mountain. Some may have seen spectacularly beautiful colors in the sky at sunset or sunrise. Some may never have noticed the sunrise or sunset. Accept all answers.

Online Resources

- Show students a slideshow of sunrise and sunset pictures. Pause when showing each picture. **Ask students if they think the sun is coming up or going down and why.**
  - » Observations will likely reveal that, without a distinct point of reference to determine direction, it is difficult to distinguish sunrise from sunset.

See the Online Resources Guide for a link to the recommended images:

www.coreknowledge.org/cksci-online-resources

2. Plan an investigation.

NGSS Elements

DCI ESS1.B
CCC 1

- Tell students that the sun rises and sets at different times throughout the year. Explain that these times are never the exact same. (See **Know the Science 2**.)
- **Ask,** How do you think we could find out what time the sun rises and sets?
  - » We can go outside and watch the sun come up or go down and look at the time. (Times are also published in the newspaper and online.)
- Show the time-lapse video of a sunrise and sunset. Stop the video when the sunrise first breaks the horizon and again when the sunset vanishes from the horizon. Explain that that is the exact time of the sunrise and sunset.

Online Resources

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

Discuss the difficulty of seeing the sunrise and sunset on cloudy days.

Know the Science

TEACHER DEVELOPMENT

2. Sunrise and Sunset Times: As Earth revolves around the sun, the tilt of Earth results in different amounts of daylight at any specific spot as the year progresses. This is reflected in the fact that the sun does not rise or set at the same time every day. Sunrise and sunset are based on when the edge of the sun appears to touch the horizon.

- Guide students as they work out the plans for the sunrise and sunset investigation. Explain to students that for the rest of the school year, they will take turns recording the sunrise and sunset times. Then they will look at the times that the sun rises and sets to see how the amount of daylight hours changes during the year. (See **Know the Standards 1**.)

3. Preview the investigation.

NGSS Elements

DCI ESS1.B
SEP 1
SEP 4
CCC 1

- Review the following important details with the class:
  - One student will collect the sunrise and sunset times on Sunday each week. Assign the student on a Friday afternoon. It might be helpful to prepopulate the dates for the student to use on Activity Page 2.1.1 so that the correct dates are recorded.
  - On Monday mornings, use class time to have that student present the sunrise and sunset times to the rest of the class.
  - Make sure to assign another student every Friday.
  - Continue doing this for the entire school year. Depending on the size of your class, some students may have a chance to collect the sunrise and sunset times twice. You may wish to make the recordings yourself for any extended holiday times away from school.

Activity Pages

AP 2.1.1
AP 2.1.2

- Distribute Sunrise, Sunset Sheet (AP 2.1.1) to students. Explain that this is the form students will use to collect the sunrise and sunset times. Review it together as a class. Make sure students understand that the sunrise (a.m.) times are the morning times and the sunset (p.m.) times are the evening times.
- Tell students that they will need to have a watch or a clock nearby each time they check the sunrise or sunset time. Model for students how to collect the sunrise and sunset information. Act out how you would go outside, look up at the sky, check your watch, and then write down the time. Remind the students again to never look directly at the sun. (See **Know the Standards 2**.)
- Remind students that it is important to be as exact or precise as possible when it comes to the time. It also produces a better data set if students try to observe the sun at the horizon with no buildings or trees, or buildings/trees far off in the distance.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Students plan an investigation in which they will observe the sunrise and sunset times over the course of the school year and then put the data together to compare and contrast the parts (seasons) of the year that have the most or least daytime hours.

2. ESS1.B Earth and the Solar System: Students plan an investigation where they will observe the sunrise and sunset over different seasons to identify patterns in the amount of daylight hours.

- Distribute Take-Home Letter (AP 2.1.2) to students. Let them know that this is a letter for their parents. The letter explains what students need to do for their sunrise and sunset observations. This way parents can help students with the sunrise and sunset observations.
- Every Monday between now and the end of the school year, the student of the week will present his or her sunrise and sunset times to the class, and then the class will all fill out a class table that has all the sunrise and sunset times for each week of the whole year. Make sure students understand that this does not have to be a report or a full-on presentation. All the student needs to do is talk about the times and what they notice about the days (i.e., are they getting longer or shorter?).

Differentiation

SUPPORT—Some students may not understand how to use the table on Activity Page 2.1.1. Provide an alternate system for recording the sunrise and sunset data, such as a different type of graphic organizer or no graphic organizer at all. Students can keep a list of the dates and times in a journal if that makes more sense for them.

CHALLENGE—Challenge students to calculate the number of daytime hours for the week that they are assigned. Then they can share this information on Monday when they present their data to the class.

EXTEND—Have students describe in a few words or draw which they prefer, the sunrise or the sunset.

4. Make student assignments.

NGSS Elements

SEP 4

- Use a system that works for your class to determine the order in which students will carry out their observations. You might want to start with students who volunteer, or you may wish to assign the weeks in alphabetical order. It is a good idea to have at least two or three students scheduled ahead of time so that they can prepare and know when they are going to collect the data.
- Use a board or other visual where students can see their names next to their assigned week.
- Tell students that they will hold on to Activity Page 2.1.1 until they are ready to use it for their week.

5. Answer questions.

NGSS Elements

SEP 1

- Ask students what questions they have about the investigation or about sunrises and sunsets. (See **Know the Standards 3**.)
- Review the following scenarios with students:
  - If students are unable to go outside to look at the sunrise and sunset, they can look out a window instead.
  - If you elect to make observations together on school days, and the sun does not rise until after they get to school, they can look outside or through the classroom window during class time to collect the data.
  - If any after-school activities prevent students from collecting the sunset data, tell them to let you know, and together an alternative can be worked out.

6. Check for understanding.

NGSS Elements

CCC 1

- Listen for student responses to your questions to ensure they have proper understanding of sunrises and sunsets.
- Ensure student understanding of the year-long investigation they will be doing. **Ask students the following:**
  - Does the sun rise in the morning or at night?
  - Does the sun set in the morning or at night?
  - How can you record the sunrise time?
  - How can you record the sunset time?

Call attention to the question board. Revisit the questions recorded there so far, and ask students how learning more about sunrise and sunset times answers or relates to any of those questions. Add additional questions to the question board.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses.

Tie to the Anchoring Phenomenon

Lin remembers that the sky was light out at certain times of the year in the morning and dark at other times of the year. Students will explore this phenomenon further through their investigation of sunrise and sunset times. They will use the times to establish how the amount of daylight hours changes in different seasons.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 1 Asking Questions: Ask students what else they wonder about the investigation, sunrises, or sunsets. Add students' questions to the question board.

LESSON 2.2

What Time Does the Sun Rise and Set?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the amount of daylight change during the year?

Today's Question: What time does the sun rise and set throughout the year?

Tie to the Anchoring Phenomenon: Students record the sunrise and sunset times throughout the school year and present their findings to the class on a weekly basis. In doing so, the class will track the data, and students will see when the amount of daylight gets longer and shorter during the year, just as Lin notices that days used to be longer in the storyline for this unit.

At a Glance

Learning Objective

✓ Make weekly observations of sunrise and sunset times over an extended period (the entire school year).

Instructional Activities

- student presentation
- class discussion

NGSS References

Performance Expectation: 1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

Disciplinary Core Idea: ESS1.B Earth and the Solar System

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students carry out an investigation to identify the patterns in hours of daytime and nighttime.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

sunrise **sunset**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **investigate** **notice** **observe**

Materials and Equipment

- large sheet of paper
- markers (in 4 assorted colors)
- question board

Advance Preparation

- Design and prepare a cumulative data table where students will record the data that they collect on Activity Page 2.1.1 for their weekly observations. The table should be made on a large sheet of paper and consist of four columns: (1) Date, (2) Sunrise, (3) Sunset, and (4) Length of Day. Use the concept as shown below:

Date	Sunrise	Sunset	Length of Day (hours and minutes)

- Use a different color of marker for each column, to differentiate the data.
- Hang the data table somewhere in the classroom where students can easily see it.

The Core Lesson 2.2

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.B

What time does the sun rise and set throughout the year?

- Set aside time every Monday for the student of the week to report their data of sunrise and sunset times.
- See the Special Pacing note on pages 2–3 for a sample calendar on when to schedule the weekly reporting days.
- On reporting days, introduce the student who has been collecting the sunrise and sunset time data for the week. Let the class know that today that student will present the information.

2. Present the data.

NGSS Elements

CCC 1
SEP 3
DCI ESS1.B
Differentiation

- Have the student talk about the sunrise and sunset times for the week. The student can read from the data tables on Activity Page 2.1.1. The student should also include the date, the sunrise time, and the sunset time.
- As the student tells the sunrise and sunset times, write those times on the cumulative data table where all the students can see it. (See **Know the Standards 1**.)

  SUPPORT—Some students may not feel comfortable speaking in front of the class or may have a difficult time being understood when using the English language. Give students alternatives to how they can present their information using visual displays or graphic organizers. For instance, offer these students an opportunity to put together a poster chart with the data, or the students could work with another student who might not be able to do the times. One student can do the times, and the other student can do the presentation.

  CHALLENGE—Challenge students to calculate the number of daytime hours for the cumulative data table after you update the table with the weekly data.

  EXTEND—Have students discuss why knowing the sunrise and sunset times can help them plan their day.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Students make observations for during week of the sunrise and sunset times and present those data to the rest of the class.

3. Calculate and discuss the data.

NGSS Elements

CCC 1
SEP 3
DCI ESS1.B

- Since finding elapsed time is a concept that students will learn in later grades, calculate the daytime hours for each day. Write down those numbers in the last column on the table. Explain that this is how many hours of sunlight there were on each of the days. (See **Know the Standards 2**.)
- Draw student attention to the cumulative data table. Talk about what students notice. Use the following questions to prompt a discussion:
  - Is the sun rising later or earlier in the day?
  - Is the sun setting later or earlier in the day?
  - Is the number of daylight hours getting greater or lesser?
- For the first week of data, there will not be any previous data to compare it to. But once more data are filled in on the table, discuss how the new week's data compare to the previous weeks' data.

4. Make predictions.

NGSS Elements

CCC 1
DCI ESS1.B

- Have students work with a partner to make predictions about next week's data. Use the following questions to prompt their discussion:
  - Do you think the sun will rise later or earlier in the day next week? What makes you think so?
  - Do you think the sun will set later or earlier in the day next week? What makes you think so?
  - Do you think the days will get longer or shorter next week? What makes you think so?
- Circulate around the room, and listen for students' responses to the questions.
- Bring the class back together, and discuss the predictions as a group. Write down the predictions somewhere on the board, and revisit them each Monday to see if the students' predictions were correct or not. (See **Know the Standards 3**.)
- If necessary, leave a few minutes at the end of class to make new assignments for the students who will be recording the sunrise and sunset times for the upcoming weeks.

Know the Standards

TEACHER DEVELOPMENT

2. DCI ESS1.B Earth and the Solar System: Students observe and then describe the data they collect on the sunrise and sunset times.

3. CCC 1 Patterns: Students make predictions based on their observations of the sunrise and sunset times that are collected and recorded on the cumulative data table.

3D Learning

3D Learning: Students use the observations they have made and data they collected from the week to compare the sunrise and sunset times across the span of a school year. In doing so, they recognize that there are seasonal patterns of sunrise and sunset times and that these patterns can help them predict the amount of daylight hours in the winter, spring, and fall.

5. Check for understanding.

NGSS Elements

CCC 1
SEP 3
DCI ESS1.B

Listen for student responses and comments about the sunrise and sunset times to ensure that they are on track to understanding that the amount of daylight hours decreases as it gets closer to winter and increases as it gets closer to spring and summer. Ensure understanding of the following concepts:

- The sun rises earlier in the morning as it gets closer to spring or summer.
- The sun rises later in the morning as it gets closer to winter.
- The sun sets earlier in the evening as it gets closer to winter.
- The sun sets later in the evening as it gets closer to spring or summer.

These are true for the Northern Hemisphere. In the Southern Hemisphere, the seasons are reversed. December is summer in Australia or South Africa, for example.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses.

Activity Page

AP 2.1.1

Call attention to the question board. Revisit the questions recorded there so far, and ask students how learning more about predicting sunrise and sunset relates to any of those questions. Add additional questions to the question board.

Tie to the Anchoring Phenomenon

Lin remembers that the sky was light at certain times of the year in the morning and dark at other times of the year. Students observe this phenomenon firsthand by making their weekly observations of the sunrise and sunset times. Thus, they can identify how the amount of daylight hours changes in different seasons.

LESSON 2.3

How Can We Present Our Sunrise and Sunset Data?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the amount of daylight change during the year?

Today's Question: How can you tell how long daylight is in a day?

Tie to the Anchoring Phenomenon: Students have recorded the sunrise and sunset times throughout the school year and presented their findings to the class on a weekly basis. In doing so, the class tracked the data on a collective chart in the classroom. Now they will put the data together in a visual way to see when the amount of daylight gets longer and shorter during the year, just as Lin notices that days used to be longer in the storyline for this unit.

At a Glance

Learning Objective

✓ Relate sunrise and sunset times to length of daylight in a day.

Instructional Activities (2 Days)

- working with data
- graphing
- class discussion

NGSS References

Performance Expectation: 1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

Disciplinary Core Idea: ESS1.B Earth and the Solar System

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Students identify patterns as they analyze the results of their investigation into the amount of daylight in each day.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

sunrise **sunset**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

data **graph** **identify** **investigate**

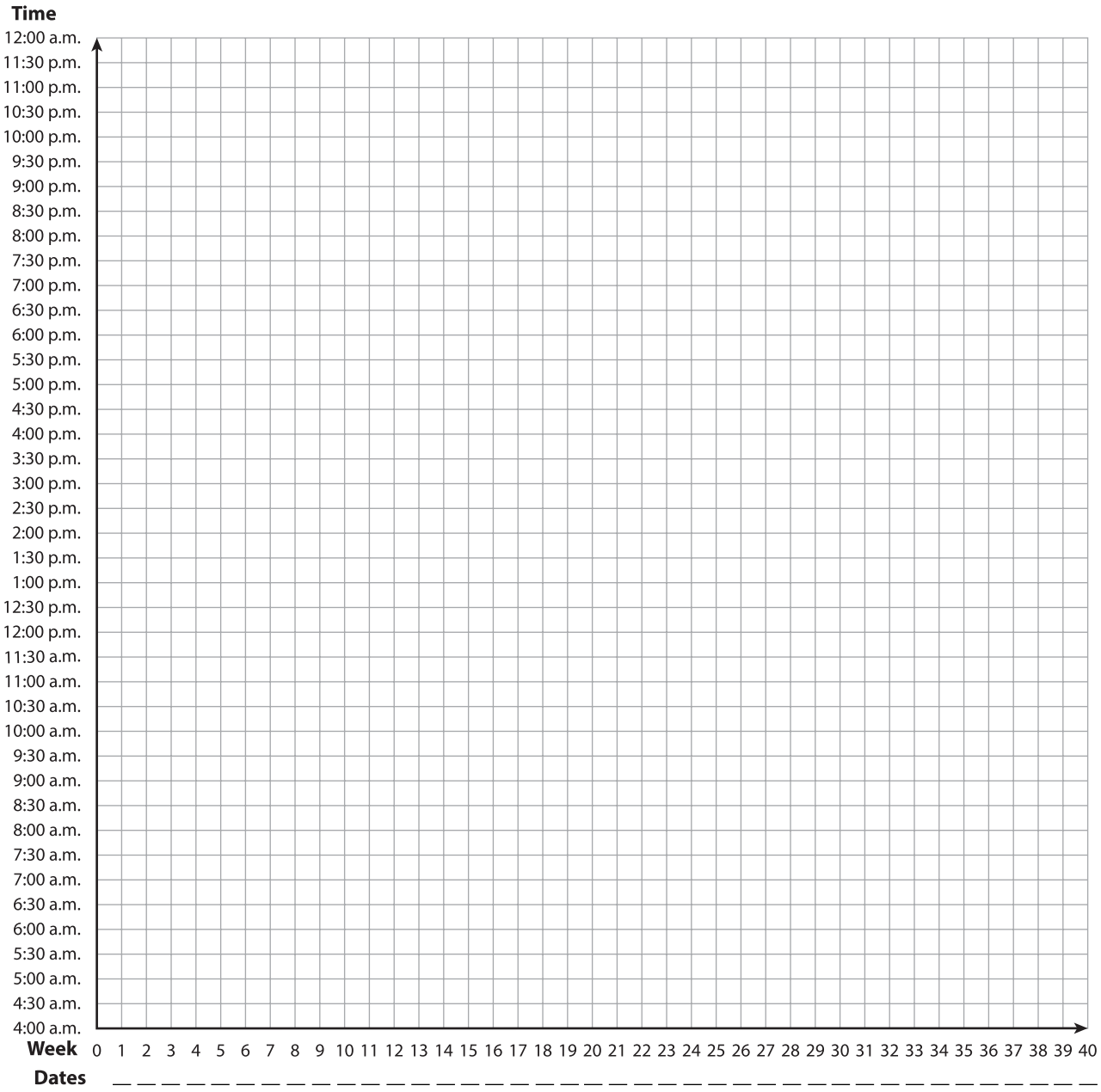
notice **observe**

Materials and Equipment

- roll of butcher paper (white or a light color)
- markers (in assorted colors, 2 of each color)
- question board

Advance Preparation

Using a marker, draw the graph as shown below onto roll paper. The horizontal axis will be for the weeks. The vertical axis will be for the time of day. Do not fill in any of the data yet. You may have as many as 40 weeks of data on the horizontal axis. You may also wish to create this graph using spreadsheet software if you have this resource available.



The Core Lesson 2.3

1. Day 1: Focus student attention on Today's Question.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.B

How can you tell how long daylight is in a day?

- Draw students' attention to the cumulative data table that you started in Lesson Segment 2.2. By now, all the data have been collected for the school year or the period of time you determined, and students have had at least one opportunity to record and present on the sunrise and sunset times.
- Remind students of what the data table tells them. It shows the sunrise times, the sunset times, and the number of hours in each day. Go over how many weeks they collected the data. Summarize the months that were captured.
- Review what students learned by collecting the daily data:
  - The sun rises and sets at slightly different times every day.
  - Over several weeks, the amount of time in daylight or nighttime changes.
- Explain that today they are going to look at the data more closely and together make a graph to help them visualize the data. (See **Know the Science**.)

2. Preview the graph.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.B

- Show students the graph that you prepared on the roll paper. Draw their attention to the vertical axis. Explain that this is the time of day. It goes up in half-hour increments, starting with four o'clock in the morning and ending with midnight, or twelve o'clock at night. Then draw their attention to the horizontal axis. Explain that these are the weeks. There is one week for each week of sunrise/sunset data that was collected for this investigation.
- Explain that each week will have two points on the graph: one point for sunrise time and one point for sunset time. Explain to students that the space between the two points represents daylight time. This is when the sun is shining. This is what students will shade in.
- Model for students how to add the data into the graph by doing the first week yourself. Talk out loud about your process for figuring out the weekly data and drawing and shading in the bars on the graph. You will need to use the data from the cumulative data table to tell what to put on the graph for the sunrise and sunset times for each week.

Know the Science

TEACHER DEVELOPMENT

Graphing the Data: The sunrise and sunset times for each day of the week may vary slightly, but not enough to make a difference for the graph. You will be taking an approximate time of the weekly sunrise and sunset times, since this graph will be measured on week-to-week increments, rather than daily increments.

- Because you will record only one sunrise and sunset time for each week, choose the same day of the week for each of the weeks that data is collected, for example, Monday. Round up or down to the nearest half hour to plot the sunrise and sunset times. Then shade the space between the sunset and sunrise.
- Tell students that you will work as a class to complete this graph with all the weeks of data. Students will go up to the graph in pairs to shade in the data for the week.

3. Complete the graph.

NGSS Elements

SEP 3
CCC 1
DCI ESS1.B

- Call on the first pair of students to come up to the graph. Hand them each a marker of the same color.
- Facilitate the process. Read the cumulative data table, and round the sunrise and sunset time to the nearest half hour. Tell one student to mark the sunrise time on the graph for that week. Tell the other student to mark the sunset time on the graph for that week. Assist students in finding the correct place on the graph to make the marks for the week. Guide them with prompts such as "Look at the left side of the graph to see the time, and follow that line all the way across to your week." Since this graphing is a concept that will develop in later grades, you might wish to draw the lines for the times on the graph. (See **Know the Standards 1**.)
- Once students have marked the sunrise and sunset times on the graph for that week, tell them to shade it in. Remind students that the shaded part of the graph is what represents the daylight time.
- When the students are done, have the next pair of students come up. Give them a different color marker to use. Repeat this process until all the weeks with data are marked on the graph. It is possible that some pairs of students will have two or more opportunities to come up to the graph. You can continue working on this graph on Day 2.

Differentiation

SUPPORT—Some students may not have strong fine motor skills to shade in the graph. In these cases, you may choose for them to work with you to shade the graph together. You might also use a colored low-stick tape for them to use to mark the daylight times instead of shading.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Students put the data together on a graph to make comparisons between seasons and identify patterns.

1. Day 2: Refocus student attention on Today's Question.

How can you tell how long daylight is in a day?

Remind students that they started making a class graph to show the data from sunrise and sunset times. If you did not finish the graph in the previous class, finish it at the start of this day.

2. Turn and talk.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.B

- Draw student attention to the graph. Have students turn to a neighbor and talk about what they observe. Give students the following prompts to talk about:
  - When do the days get longer?
  - When do the days get shorter?
  - What happens to the days when there are earlier sunrises and later sunsets?
  - What happens to the days when there are later sunrises and earlier sunsets?
- Circulate around the room, and listen to see that students are using the graph, trying to make sense of the data from it, and able to relate the length of longer daylight periods to earlier sunrises and later sunsets. (See **Know the Standards 2**.)

3. Analyze the data.

NGSS Elements

SEP 4
CCC 1
CCC 2
DCI ESS1.B

- Bring the class back together, and hold a discussion about what the graph shows.
- Ask students if they notice any patterns in the data. They may be able to tell that earlier sunrises and later sunsets lead to longer days. However, if they need help noticing the pattern, point out the sunrise and sunset times, and relate those to the amount of daylight. Tell students to look at the shaded bars of the graph and notice where the shaded bars are longer or shorter. Shorter shaded bars mean shorter days. Longer shaded bars mean longer days. (See **Know the Standards 3**).
- Guide students toward concluding that earlier sunrises and later sunsets lead to longer days (more daylight hours in a twenty-four-hour period).

Know the Standards

TEACHER DEVELOPMENT

2. DCI ESS1.B Earth and the Solar System: Students start describing the data that they see on the graph, which allows them to visually interpret the sunrise and sunset patterns throughout the year.

3. SEP 4 Analyzing and Interpreting Data: Students analyze the data on the graph and talk about what it means as they try to relate sunrise and sunset times to the amount of daylight in a twenty-four-hour period.

4. Check for understanding.

Monitor Progress

Listen for student responses and comments about the sunrise and sunset data on the graph to ensure that they are on track to understanding that the amount of daylight hours depends on when the sun rises and sets.

Ensure understanding of the following concepts:

- Earlier sunrises and later sunsets lead to longer days.
- Later sunrises and earlier sunsets lead to shorter days.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how learning more about predicting sunrise and sunset relates to any of those questions. Add additional questions to the question board.

Tie to the Anchoring Phenomenon

Lin remembers that the sky was light at certain times of the year in the morning and dark at other times of the year. Students now understand how sunrise and sunset times affect the amount of daytime or daylight hours in the day.

LESSON 2.4

What Sunrise and Sunset Patterns Do We See?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the amount of daylight change during the year?

Today's Question: How does the amount of daylight change in a pattern?

Tie to the Anchoring Phenomenon: Students have recorded, graphed, and analyzed the sunrise and sunset data. Now they will read about what Lin notices about the sun and daylight and apply it to what they discovered through their firsthand investigations.

At a Glance

Learning Objective

✓ Summarize patterns of periods of daylight.

Instructional Activities

- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.B Earth and the Solar System

Science and Engineering Practices: 1 Asking Questions; 6 Constructing Explanations

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Students ask questions and construct explanations about the patterns of sunrise and sunset.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

pattern **predictable** **sunrise** **sunset**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **notice** **observe** **predict**

Instructional Resources

Student Book

Ch. 3

Student Book, Chapter 3
"Longer and Shorter Times of Daylight"

Activity Page

AP 2.4.1

Activity Page
What Did We Learn? (AP 2.4.1)

Materials and Equipment

- question board
- internet access and the means to project video for whole-class viewing

The Core Lesson 2.4

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1

How does the amount of daylight change in a pattern?

- Talk to students about what they noticed this morning about the sun. Ask students if it was light out when they arrived at school. Remind students that when they first started this lesson (back in the fall), the daylight was getting shorter. There were fewer and fewer daylight hours. It was possible that sometimes the sun was not out by the time they arrived at school in the morning.
- **Ask students,** Are the days getting longer, now that we are getting closer to the summer?
  - » yes

2. Show a video.

- Replay the time-lapse video of a sunrise and sunset. Tell students to pay attention to the lightness of the sky as the sun goes up and goes down. (See **Know the Science 1**.)

Know the Science

TEACHER DEVELOPMENT

1. Time Lapse: A time-lapse video is one that captures images at a low frame rate, but when it is played back, it looks like a fast-motion movie. The process of the sun rising and setting throughout the day takes many hours, but the video speeds up this process to show it in just a couple of minutes.

See the Online Resources Guide for a link to the recommended video.

Online Resources

www.coreknowledge.org/cksci-online-resources

- **Ask students when the sky is the brightest, or lightest.**
  - » when the sun is high in the sky

3. Read together: "Longer and Shorter Times of Daylight."

Student Book

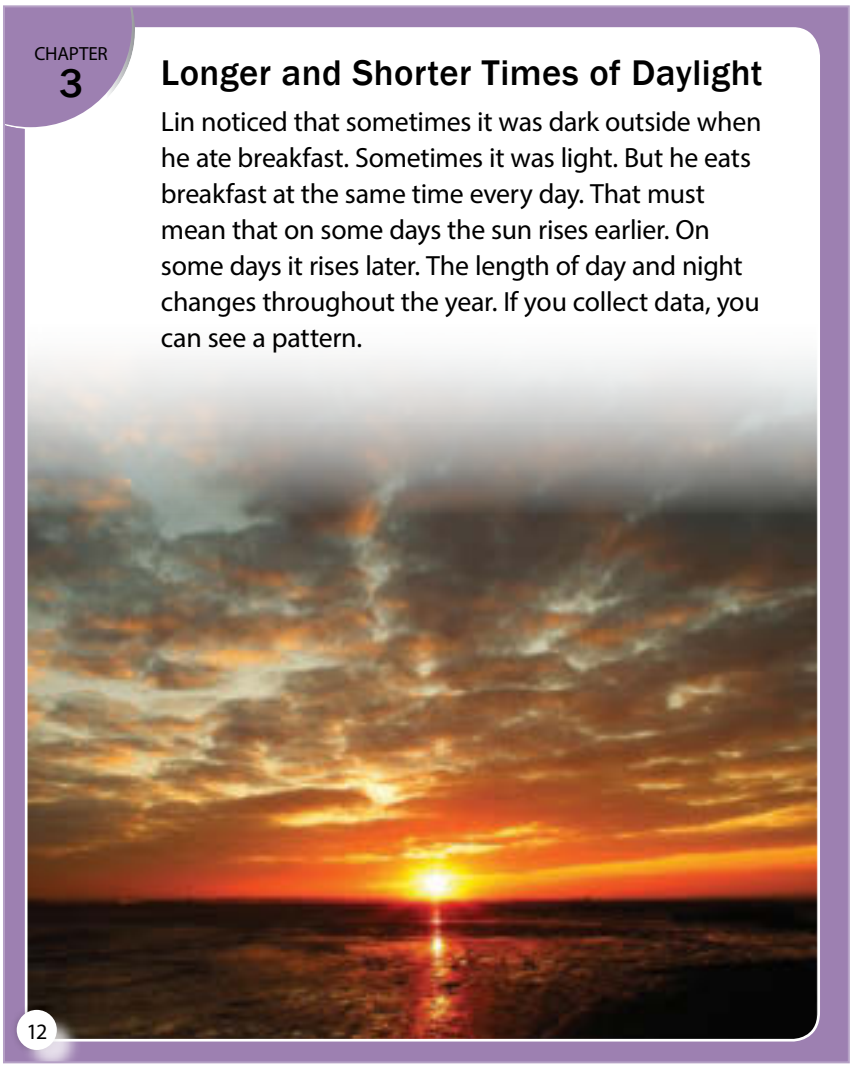
Ch. 3

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 12

Quickly reread Chapters 1 and 2 to students to refresh memory about the storyline, then proceed with Chapter 3. Ask students to turn to page 12 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is "Longer and Shorter Times of Daylight," and tell them to pay special attention to where the sun is in the sky as you read.



CHAPTER 3

Longer and Shorter Times of Daylight

Lin noticed that sometimes it was dark outside when he ate breakfast. Sometimes it was light. But he eats breakfast at the same time every day. That must mean that on some days the sun rises earlier. On some days it rises later. The length of day and night changes throughout the year. If you collect data, you can see a pattern.

12

Ask students to look at the picture on page 12. Explain that this is a picture of the morning sun that is just starting to come up for the day. (See **Know the Standards 1**.)

LITERAL—What do you notice about the colors of the sky?

» They are orange and yellow at the bottom. They are blue up at the top.

INFERENTIAL—What do you think will happen to the sun in this picture?

» It will appear to go up and up into the sky until it is high. Then it will appear to go back down again.

CORE VOCABULARY—Explain that a **pattern** is something that happens over and over.

INFERENTIAL—Why is this an example of a pattern?

» It is something that happens in the sky every day.

EVALUATIVE—Explain which you prefer more, a sunrise or a sunset.

» Accept reasonable answers. Invite students to give reasons for their preferences.

SUPPORT—Relate this phenomenon to students' long investigation of sunrise and sunset times. Remind them of the data they recorded and graphed and how it showed that some days they saw the sunrise earlier and some days they saw the sunrise later.

Ask students to tell what happens to daylight if the sun rises earlier.

» The daytime is longer.

Then ask them to tell what happens to daylight if the sun rises later.

» The daytime is shorter.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.B Earth and the Solar System: Students use pictures in combination with their own observations to describe what they see and know about the patterns of sunrises and sunsets.

Page 13

Direct student attention to page 13, and revisit the storyline of Lin and his observations of the morning and evening skies. Discuss students' responses to the questions on the page. Invite students to give reasoning for their responses, but do not correct incorrect conclusions or guesses. Students will examine evidence to draw more sound conclusions.

Think about the changes Lin noticed. Then think about what you have learned about Earth and the sun. What time of year do you think it was when it was dark outside in the morning? What time of year do you think it was when he could walk his dog before bedtime?

13

Page 14

Ask students to look at the picture on page 14. Explain that this picture shows how light it is at 5:30 p.m. on a summer day.

By collecting data, you will see that the sun rises and sets at predictable times. The times change a little bit each day. You can play outside much later in the summer than you can in the winter. That is because the sun rises very early and sets very late in the summer. Summer has the most daylight.

14

LITERAL—What can you do outside at 5:30 p.m. on a summer day?

» You can play outside for longer.

EVALUATIVE—Do you prefer longer days or shorter days? Why?

» Some may say they like longer days so they can play outside. Some may say shorter days so they can be inside.

CORE VOCABULARY—Explain that **predictable** means something can be expected.

SUPPORT—Hold a brief discussion about things that are predictable. Use everyday examples that students are familiar with, such as their school schedule (they will get their recess or lunch break at predictable parts of the day, because they get them at the same time every day). Relate the concept of predictability to the sunrise and sunset investigation that students did. **Ask students,** How do you know that the sun is going to rise?

» because it rises every day

- Play a video of the Robert Louis Stevenson poem "Bed in Summer." Discuss the different routines of summer and winter life because of the amount of daylight. (See **Know the Science 2**.)

Online Resources

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

(See **Know the Standards 2**.)

SUPPORT—Bring out the class graph with the sunrise and sunset times. Unroll the paper so that the students can see most of the data. Talk about the amount of daylight hours during the weeks. Focus on the fact that the daylight hours became shorter and shorter as it became winter. Then, the daylight hours became longer and longer again the closer it became to summer.

INFERENTIAL—Do you think the daylight hours will get even longer in the summer? Or will they get shorter?

» longer (Teacher Note: until the solstice)

CORE VOCABULARY—Compare and contrast **sunrise** and **sunset** by asking these questions.

- Which happens in the morning?
  » sunrise
- Which takes longer?
  » It takes the same amount of time for the sun to appear and disappear on the horizon.

Know the Science

TEACHER DEVELOPMENT

2. Daylight: The difference between the longest and shortest days of the year depends on a location's latitude. In Barrow, Alaska, on the longest day, the sun never goes below the horizon. On the shortest day, the sun never gets above the horizon. In Raleigh, North Carolina, there is almost five hours more daylight on the longest day than on the shortest.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 6 Constructing Explanations: Students use what they have learned about sunrises and sunsets throughout the course of the year to explain how appearance of the sky differs in the pictures of the Capitol Building, even though they are taken at the same time of the day.

Page 15

Ask students to look at the image on page 15. Explain that the picture shows the same time of day as on page 14 but at a different time of the year.

In the fall, days get shorter and shorter. Winter has the least amount of daylight. The shortest day of the year is in December where Lin lives. As winter turns to spring, the amount of time between sunrise and sunset slowly grows longer. The longest day of Lin's year is in June. Then the amount of the daylight slowly decreases as summer turns to fall. The days get shortest in December. This pattern repeats every year.

It is the same time of day in both pictures. Why is it bright daytime in one picture and getting dark in the other?

15

INFERENTIAL—Which picture do you think shows the sky in the winter?

» the picture with the dark sky

INFERENTIAL—Which picture do you think shows the sky in the summer?

» the picture with the light sky

4. Guide the discussion and activity.

Online Resources

- Play another time-lapse video for students. Pause the video at 0:30. Tell students they are going to predict a pattern. (See **Know the Standards 3**.)

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

NGSS Elements

SEP 1
CCC 1
CCC 2
DCI ESS1.B

- **Ask students what they think the sun is going to do next.** If necessary, use the following cues:
  - Do you think the sun is going to appear to get higher in the sky or lower in the sky?
    - » higher
  - Do you think the sun is going to appear to stay in the same spot in the sky or move?
    - » The sun is going to look like it is moving.
- Continue to play the video, and see if students' predictions are correct.
- Pause the video again at 0:38. **Ask students if their predictions were correct.**
  - » yes
- Guide students to make another prediction. **Ask them what they think the sun will do next.** If necessary, use the following cues:
  - Do you think the sun is going to appear to be higher in the sky or lower in the sky?
    - » We think the sun will look lower.
  - Do you think the sun is going to appear to stay in the same spot in the sky or move?
    - » The sun will appear to keep moving.
- Play the remainder of the video. Then discuss whether students' predictions were correct.

Activity Page

AP 2.4.1

- Distribute What Did We Learn? (AP 2.4.1) to students. Review it as a class. Explain that students will circle the correct answers for the four statements.
- Allow students to work with partners to complete Activity Page 2.4.1.
- Circulate around the room, and listen for students' understanding.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 4 Analyzing and Interpreting Data: Students use what they have learned so far from their firsthand observations, data analysis, and reading to make a prediction about how the sun will appear to move across the sky.

Differentiation

SUPPORT—Some students may have difficulty reading the text but may still understand the scientific concepts covered throughout this lesson so far. Make this activity more accessible to these students by reading the statements on Activity Page 2.4.1 out loud and together as a class. Provide time to do the assessment with these students orally.

CHALLENGE—Challenge students to draw pictures that represent the same concepts that are covered on Activity Page 2.4.1. For example, students can draw two pictures of the morning, at different times of the year. Their pictures should show how the amount of light in the sky is different.

EXTEND—Have students research the sunrise and sunset times for your area for the remaining days of the school year or for the upcoming summer months. Have them record the data and continue the investigation to look for predictable patterns.

5. Check for understanding.

NGSS Elements

CCC 2
DCI ESS1.B
Monitor Progress

- Students should be able to recognize that there is a cause-and-effect relationship between sunrise and sunset times and the amount of daylight that is present in a twenty-four-hour period. They should be able to tell that certain times of the year have more daylight than others.
- Review student responses in the reading questions and on What Did We Learn? (AP 2.4.1) to ensure understanding of the following concepts:
  - The sunrise and sunset times affect the amount of daylight in a day.
  - Daylight is longer in the summer and shorter in the winter.

Activity Page

AP 2.4.1

Call attention to the question board. Revisit the questions recorded there so far, and ask students how learning more about predicting sunrise and sunset relates to any of those questions. Add additional questions to the question board.

Tie to the Anchoring Phenomenon

Lin concludes that the sky is lighter or darker at different times of the year. Students can make the same conclusions based on their firsthand observations of the sunrise and sunset times.

LESSON 2.5

Lesson 2 Roundup: Daylight Changes Through the Year

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the amount of daylight change during the year?

Today's Question: How does the amount of daylight change during the year?

Tie to the Anchoring Phenomenon: Lin from the storyline now understands that daylight is different at different times throughout the year. Students have learned this same phenomenon by doing a year-long investigation of sunrise and sunset times. Now, students will describe the patterns they notice and make predictions.

At a Glance

Learning Objectives

✓ Determine and describe patterns from collected sunrise and sunset data.

✓ Predict patterns of future sunrise and sunset times.

Instructional Activities

- making predictions
- class discussion
- drawing

NGSS References

Performance Expectation: 1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

Disciplinary Core Idea: ESS1.B Earth and the Solar System

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Students analyze and interpret data to predict the amount of daylight at different times of the year.

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www.coreknowledge.org/cksci-online-resources

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data **daylight** **predict** **sunrise**
sunset

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

graph **identify** **investigate** **notice**
observe **predict**

Instructional Resources

Activity Page

AP 2.5.1

Activity Page
Draw the Future (AP 2.5.1)

Materials and Equipment

- coloring utensils (crayons, colored pencils, markers)
- question board

The Core Lesson 2.5

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.B

How does the amount of daylight change during the year?

- Review what students have learned about how much daylight there is at different times of the year.
  - » The sun rises and sets at different times every day. The days grow longer with more daylight beginning in late December, and they grow shorter with less daylight beginning in the middle of June. The least amount of daylight is in winter, and the most is in summer.
- **Ask students if they would like to be able to know the future.**
  - » Most will probably say yes.

- **Ask,** If you could know the future, what would you want to know? Encourage a lively discussion about all the things students would do if they could know the future.
  - » Some students may want to know if they will grow up to be what they want to be, if they will get something desired, if they will get rich, or if they will have a baby sibling.
- Explain that scientists do their best to tell certain things about the future. They do this to keep people and our planet safe. They also do this to study patterns. Talk about some of the things that would be helpful for scientists to know about the future. (See **Know the Science**.)

2. Facilitate the activity.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.B

- Tell students that today they are going to look for patterns in the sunrise and sunset data and make predictions (or try to know the future) about when daylight will be shorter and longer on future dates. Explain that they will work as a class to make these predictions.
- Display the graph of sunrise and sunset data where students can see it and where you can refer to it throughout the activity.
- Walk through the data together on the graph. Focus on the length of the days, rather than the sunrise and sunset times. Students should be able to easily visualize whether daylight is longer or shorter based on the length of the shaded bars on the graph.
- For each week on the graph, point to the shaded bars, and **ask students if the days are getting longer or shorter**. Do this for all of the weeks on the graph for which there is data.
- **Ask students what happens to the amount of daylight as it gets closer to winter.**
  - » There is less daylight time.
- **Ask students what happens to the amount of daylight as it gets closer to summer.**
  - » There is more daylight time.

Know the Science

TEACHER DEVELOPMENT

Scientists and Predictions: Scientists cannot really tell the future, per se, but they can make predictions based on certain pieces of evidence, observations, and patterns that they know to be true in nature. Predictions are more than just guesses. They are based on facts and data, which makes them quantifiable, or measurable. In a way, this is sort of like knowing the future. Scientists may predict things like the weather, seismic activity, seasons, time, and sun and moon patterns. They use this information to become better informed about how nature works and ways to keep people safe.

- Tell students that now they will make a class prediction about future sunrise and sunset times. (See **Know the Standards 1** and **2**.)
- Pick a future date in the fall, around the time in which the sunrise and sunset data collection investigation began, such as a date in September or October. Call on a volunteer to come up to the graph. **Ask the student to tell what time they think the sun will rise and set next year at the same time of the year.** Have the student look at the graph while thinking about the answer.
  - » The student should say that the sun will rise and set around the same time next year as it did this year.
- **Ask the class if they agree with the prediction, telling why or why not.**
- Repeat this with various other times of the year. Invite students, one by one, to come up to the graph and make predictions for the sunrise and sunset times for future dates in the summer, fall, winter, or spring.
- After the predictions are made, summarize the activity by asking students how they were able to predict what the sunrise and sunset times would be for the future. Students should be able to explain that they made their predictions according to the current data they have for this past year about sunrise and sunset times.

3. Summarize with a visual.

Activity Page

AP 2.5.1

- Distribute Draw the Future (AP 2.5.1) with coloring utensils, and go over it together as a class. Explain that students will draw two pictures of what eight o'clock in the morning looks like and what eight o'clock in the evening looks like on the date that you give them. (Choose a date that has either an early sunrise and late sunset or a late sunrise and an early sunset.) (See **Know the Standards 3**.)
- Direct students to write down the date on Activity Page 2.5.1 so they can refer to it and remember it while they draw.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.B Earth and the Solar System: Students use the data on the graph to make predictions about when the sun will rise and set in the future.

2. SEP 4 Analyzing and Interpreting Data: Students use the data from the sunrise and sunset graph to make predictions about the amount of daylight on future dates.

3. DCI ESS1.B Earth and the Solar System: Students use what they know about patterns in what appears to be movement of the sun to draw what the sky will look like on future dates, based on whether the sun will be rising or setting.

- Tell students that the morning and evening pictures should show the sky and whether it is light out or dark out, depending on if the sunrise and sunset have already happened.

Differentiation

SUPPORT—If necessary, tell students whether the date that you give them will have an early or late sunrise and sunset. If students still require more support than this, tell them to draw pictures that show the morning when it is light or dark and the evening when it is light or dark.

CHALLENGE—Challenge students to select their own date and draw pictures of what they think the sky will look like in the morning and evening in the future.

EXTEND—Have students form pairs or small groups and discuss why it is helpful for scientists to find ways to make predictions. Prompt them to talk about how predictable information can help keep people and the planet safe.

4. Check for understanding.

Monitor Progress

- Check for students' responses and comments during the prediction activity to ensure that they are on track to understanding that patterns repeat themselves and that they can use existing data to tell information about the future.

Activity Page

AP 2.5.1

- Review student drawings on Draw the Future (AP 2.5.1) to ensure understanding of the following concept:
  - Patterns can be used to make predictions about the amount of daylight on future dates.

Review answered and unanswered questions on the question board. Discuss how to find answers to the unanswered questions. Add any additional questions students have to the question board.

Tie to the Anchoring Phenomenon

Lin remembers that the sky was light at certain times of the year in the morning and dark at other times of the year. Students now understand how sunrise and sunset times affect the amount of daytime or daylight hours in the day, and they can use the sun's patterns to make predictions about whether it will be light or dark out at different times of the year.

LESSON 3

The Moon and Its Predictable Patterns

Overview

Guiding Question: How does the moon's appearance in the sky change?

Lesson 3 Segments	Segment Questions	Advance Preparation
3.1 What Is the Moon? Students learn about the moon and plan for a three-day investigation in which they track and record where the moon is at different times during the day.	When can you see the moon in the sky?	Gather materials for the demonstration. See Materials and Equipment.
3.2 The Moon on the Move (3 days) Students carry out an investigation in which they track and record where the moon is in the sky at different times of the day.	When and where does the moon rise and set?	Gather materials for the investigation. See Materials and Equipment.
3.3 What Is the Motion of the Moon? Students read about how the moon rises, sets, and moves across the sky. Students also read about the moon's phases.	How does the position of the moon in the sky change?	Read Chapter 4 in the Student Book.
3.4 What Are the Moon's Phases? Students set up a two-month investigation in which they observe and record the phases of the moon over two cycles.	What does the moon look like at different times in a month?	Gather materials for the investigation. See Materials and Equipment.
3.5 Why the Moon's Appearance Changes Students reread about the moon's phases to relate the reading to their firsthand observations.	How does the moon's appearance vary?	Reread Chapter 4 in the Student Book.
3.6 Lesson 3 Roundup: Patterns of the Moon Students use data from their investigation to make predictions about the moon phases on future dates.	How does the moon's appearance in the sky 133 change?	Gather materials for class activity. See Materials and Equipment.

What's the Story?

Summary: In Lesson 3 (Segments 1–6), students explore how the moon moves across the sky (moonrise and moonset) and how its phases change to make the moon look different to us on Earth. Students participate in two different investigations in which they observe how the moon moves across the sky and identify the moon phases to discern that the moon goes through a cycle. Students investigate how it appears to change shape and how these shapes (or phases) occur in the same order for each cycle (1-ESS1-1). The developing understanding of these phenomena in Lesson 3 prepares students for their work in Lesson 4, when they will expand their observation to that of the stars.

Learning Progression: Lesson 3 builds on student understandings about the sun and its apparent movements, 1-ESS1-1: *Use observations of the sun, moon, and stars to describe patterns that can be predicted.*

Guiding Phenomenon: Objects in the sky—such as the sun, the moon, and stars—seem to move and change position over time. These movements take place in patterns that can be studied and predicted to tell where the objects will be in the sky at any given time. Our main character, Lin, makes observations about the fact that the moon changes its position in the sky and can even be seen during the daytime. In Lesson 3, students participate in an investigation that supports this observation.

Learning Objectives

By the end of Lesson 3, students will do the following:

- Identify the moon as an object in the sky.
- Identify patterns in when the moon appears to move across the sky.
- Describe the different phases of the moon.
- Make predictions about what the moon will look like in the sky in the future.

NGSS Standards and Dimensions

Performance Expectation: 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
4 Analyzing and Interpreting Data Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**ESS1.A The Universe and Its Stars** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	**1 Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Advance Planning for Lesson 3.2

The goal for this lesson segment is for students to discern a pattern from where the moon rises or sets (or both). Ideally, students will make direct observations to see for themselves where the moon is rising or setting to then discern the pattern. For them to do this, you must select a three-day period to teach Lesson 3.2 during which the moon rises or sets at times that are appropriate for student viewing.

To select favorable dates, visit an online moonrise and moonset calculator, and enter your location.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

If you want students to make their observations with you while they are at school, choose days with three consecutive moonrises or moonsets that will occur during school hours. If you prefer to have students make their observations at home and report their findings, choose days with three consecutive moonrises or moonsets that will occur in the evening but appropriately before students' likely bedtime.

For example, based on the following example chart, March 26–28 would provide an opportunity for possible school-day observations of three consecutive moonrises. March 22–25 would provide the opportunity for reasonably timed at-home observations of three or four consecutive moonsets.

2020	**Moonrise/Moonset**	
Mar	**Moonrise**	**Moonsets**
20	6:11 a.m.	4:21 p.m.
21	6:44 a.m.	5:20 p.m.
22	7:12 a.m.	6:19 p.m.
23	7:39 a.m.	7:17 p.m.
● **24**	8:03 a.m.	8:14 p.m.
25	8:27 a.m.	9:12 p.m.
26	8:52 a.m.	10:10 p.m.
27	9:18 a.m.	11:09 p.m.
28	9:47 a.m.	-
29	-	12:09 a.m.
30	-	1:09 a.m.
31	-	2:09 a.m.

LESSON 3.1

What Is the Moon?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: When can you see the moon in the sky?

Tie to the Anchoring Phenomenon: Lin has wondered about the darkness of the sky in the morning and why he is sometimes able to see the moon when he wakes up. Students will discover what the moon is and what its patterns are in the sky.

At a Glance

Learning Objectives

- ✓ Identify the moon as one object visible in the sky, during the day or night.
- ✓ Plan an investigation of the moon's appearance (apparent location).

Instructional Activities

- class discussion
- student investigation

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 1 Asking Questions

Crosscutting Concept: 1 Patterns

Students plan an investigation to look for patterns of the apparent movement of the moon.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

daytime	**moon**	**nighttime**	**sky**
star	**sun**		

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **notice** **observe**

Materials and Equipment

- poster paper
- marker
- question board
- internet access and the means to project images/video for whole-class viewing

The Core Lesson 3.1

1. Introduce students to Lesson 3.

Ask a volunteer to state the **Big Question** that you'll be answering in this unit, which is posted somewhere in the room—**How do the sun, the moon, and stars appear to change position in the sky?**

Tell students that, before they can answer the unit's Big Question about objects in the sky, they need to understand more about the moon. In Lesson 3, students will launch their learning of how the moon appears to move in the sky and identify patterns through a series of investigations. Write the **Lesson 3 Guiding Question** where students can see it:

How does the moon's appearance in the sky change?

Tie to the Anchoring Phenomenon

As students work through Lesson 3, they will learn about the moon during the day or only at night and will determine how the moon seems to change over the course of a two-month investigation.

2. Guide a discussion.

NGSS Elements

SEP 1
CCC 1
DCI ESS1.A

- **Ask students when they see the moon.**
  - » at night
- Have students turn and talk to a partner about what they know about the moon. Use question prompts to initiate their discussion, such as the following:
  - What color is the moon?
    - » white or gray

- What shape is the moon?
  - » round, half circle, crescent shape
- How big is the moon?
  - » as big as or bigger than the sun

- Circulate around the room, and listen for students' understanding of the moon. They should demonstrate some prior knowledge about the moon based on firsthand experiences.
- Bring the class back together, and invite a volunteer to come to the front of the room and make a drawing of the moon on the poster paper.
- **Ask the class if the moon has any other shapes besides the one that the student drew.** If anyone answers "yes," invite that student up to the sheet of paper to draw the shape of the moon that they have seen. Repeat this once or twice. It's possible that some students will be able to draw a crescent or gibbous moon, based on what they remember seeing in the sky or from media.

3. Show videos.

NGSS Elements

SEP 1
CCC 1
DCI ESS1.A

Online Resources

- **Ask students if the moon appears to move across the sky.**
  - » yes
- **Ask students if the moon can be seen during the daytime.** (See **Know the Science**.)
  - » yes
- Show students a video of the moon moving across the sky during the daytime.
- **Ask students what they notice about the video.**
  - » The moon is moving. It is daytime. You can see the moon in the daytime.
- Then show students a second video of a crescent moon moving across the sky during the nighttime.

See the Online Resources Guide for a link to the recommended videos:

www.coreknowledge.org/cksci-online-resources

Know the Science

TEACHER DEVELOPMENT

The Moon and the Daytime: It is possible to see the moon during the day because the sun reflects light off of the moon. There are a few factors that make it possible for us to see the moon during the daytime. The best time to see a daytime moon is right after a full moon. This is because it is low on the horizon, appears big and brighter. When the moon is closer to the sun—such as just before or after a new moon—it becomes harder to see. During this point in the moon phase, the moon is in a crescent shape.

- **Ask students what they notice about the video.**
  - » The moon is moving. It is nighttime. The moon is a different shape.
- Talk about the different shapes of the moon that students saw in the two videos.

4. Plan an investigation.

NGSS Elements

SEP 3

- Explain that the moon appears to move across the sky in a way that is like how the sun appears to move across the sky.
- Tell students that they are going to plan an investigation about the moon and where it is in the sky. In the next class segment, students will carry out a three-day investigation to observe the position of the moon at different times during a day. The purpose of this investigation is for students to discern that the moon moves in an east-to-west path and that the moon follows this path in a repeating pattern but seemingly at different times.
- Guide students to plan the investigation. Use question prompts to get students to come up with a way to investigate the moon. For example, **ask students what they can do to study where the moon rises and sets.** (See **Know the Standards 1** and **2**.)
  - » We can look at the moon in the sky every night. We can record the time it rises and sets. We can draw pictures to show where the moon is in the sky at different times.
- As students come up with the plan for the investigation, write the details down on the board so students can see the parts of their plan. Explain that students do not have to memorize the parts of the plan. You will put the information together for them.

Differentiation

SUPPORT—Provide more structure to students when discussing the three-day investigation on the moon. A stronger and narrower framework can help keep students on track with and focused on the goals of the investigation. Use question prompts that lead students toward the right ideas, or provide students with the plan for the investigation entirely.

CHALLENGE—Challenge students to come up with individualized plans for how they will study the moon's path on multiple days.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students learn that the moon appears to move across the sky and has different positions, similar to the sun.

2. SEP 3 Planning and Carrying Out Investigations: Giving students the freedom to think of ways to plan their investigation allows them to act like scientists and encourages them to think about the connections between the goals of the investigation and the actions they can take to reach those goals.

EXTEND—Have students relate the movement of the moon to the movement of the sun, to see whether there are any similarities in terms of their path or position in the sky.

- Ask students what questions they have about the investigation so far. Remind students that you will give them more details on how to carry out the investigation in the next class segment.

5. Check for understanding.

Monitor Progress

Monitor students' discussions and responses throughout the class segment to see what students already know and understand to be true about the moon. After watching the videos and participating in the discussions, students should understand the following:

- The moon appears to take different shapes.
- The moon is usually best seen at nighttime.
- The moon appears to move across the sky.

Call attention to the question board. Ask students what questions they have about the moon, and add them to the question board.

Tie to the Anchoring Phenomenon

Lin discerns daytime and nighttime. But he still notices that the moon can sometimes be seen when it is light out. Students will use this concept as a springboard for their investigation to find out where the moon is in the sky during the day.

LESSON 3.2

The Moon on the Move

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: When and where does the moon rise and set?

Tie to the Anchoring Phenomenon: Lin notices that the moon can be seen in the morning, but isn't the moon only supposed to be out at night? Students will make firsthand observations or use media to learn about how the moon moves across the sky during the day.

At a Glance

Learning Objectives

- ✓ Observe and record the locations of moonrise and moonset.
- ✓ Observe and record the position of the moon in the sky during various times of day.
- ✓ Conclude the direction of the moon's apparent motion in the sky throughout a day.

Instructional Activities (3 days)

- student observation
- student investigation
- data collection
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students carry out an investigation of the patterns of moonrise and moonset.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

east **moon** **rise** **set**
west

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change **direction** **identify** **move**
notice **observe** **position**

Instructional Resources

Activity Page

AP 3.2.1

Activity Page
Moon on the Move (AP 3.2.1)

Materials and Equipment

- compass
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- The intent for this investigation is for students to observe the changes with the presence of the moon and the patterns themselves. A simple search will provide optimal times and dates for observing the moonrise and moonset during the school day. If observations in real time are possible, a time frame has been suggested in the Lesson 3 Overview. Since it is more difficult to locate the moon in the sky than it is to locate the sun, knowing where the moon is in advance can help you guide students toward finding its position.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

The Core Lesson 3.2

1. Day 1: Focus student attention on Today's Question.

When and where does the moon rise and set?

- Elicit a discussion about how we can see the moon in the sky at night. Talk about how sometimes it looks big and sometimes it looks small. Sometimes the moon is round, and other times it has a different shape.
- **Ask students if they saw the moon on their way to school this morning.**
  - » Accept reasonable answers based on the date and your area.
- Explain that we usually only think of the sun when we think of things in the sky rising and setting. But what about the moon? **Ask students if they think the moon rises and sets.**
  - » Accept all reasonable answers.

2. Preview the investigation.

NGSS Elements

SEP 3
CCC 1
DCI ESS1.A

Online Resources

Activity Page

AP 3.2.1

Differentiation

- Show a moonrise and moonset time-lapse video. Discuss how it is like a sunrise and sunset.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

- Tell students that for the next few days they will observe where the moon is in the sky at the beginning of school and at the end of school to find out how it appears to move when it rises and sets.
- For this investigation, you will not be recording the exact times of moonrise and moonset, but students should understand the direction in which these events occur—east to west.
- Distribute Moon on the Move (AP 3.2.1). Explain that Activity Page 3.2.1 has three drawing boxes, one for each of the three days they will observe the moon.
- Tell students that they will draw where the moon is in the sky. You will lead them outside—or have them look out a window or doorway—to find the moon.
- Show students the compass. **Ask students to tell what a compass does, based on their observations of the sun.** Tell students that you will bring the compass outside with them so that they can know what direction the moon is in the sky.

SUPPORT—If needed, give students additional practice with identifying directions for north, east, south, and west. Play a game that uses a compass and involves students standing east of one object or south of another object in the classroom.

3. Facilitate the morning investigation.

Activity Page

AP 3.2.1

- Take students outside to make their first observations of the moon. Prompt students to bring Activity Page 3.2.1, along with a pencil and something to write on (like a book or clipboard). Bring the compass. As you go outside, **ask students to find the moon in the sky and point to it**. (See **Know the Science**.)
- Have students stand facing south. Use the compass to guide you in this direction. (See **Know the Standards 1**.)

Know the Science

TEACHER DEVELOPMENT

Moon During the Day: It may be difficult to see the moon during the day, depending on the weather and moon phase. After determining when the moonrise or moonset will occur during the day on a clear day, help students locate the moon by guiding them to look in a certain direction.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Students participate in the morning session of their three-day investigation to identify where the moon is in the sky throughout the day.

NGSS Elements

SEP 3
CCC 1
DCI ESS1.A

- Tell students to draw in the middle of the first box a point of reference that they see around them, such as a tree, building, mountain, playground, et cetera, for their horizon, facing south. (Students will draw the same points of reference for each box. This is because you will have students facing the same direction [south] every time. This ensures that students record the location of the moon relative to the same thing each time they make their observations.)
- Now have students label the left side of their horizon pictures "east" and the right side "west."
- Finally, tell students to draw the moon into the sky on their pictures. Have them label that moon "morning" to distinguish it from the afternoon moon.
- **Ask students if the moon is on the east or west side of the sky.**
  - » east
- Bring the class back inside.

4. Repeat the investigation in the afternoon.

Activity Page

AP 3.2.1

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt them to bring Activity Page 3.2.1 with writing utensils and something to write on. (See **Know the Standards 2**.)
- **Ask,** Where do you see the moon *now*?
  - » It's more west.

NGSS Elements

SEP 3
SEP 4
CCC 1
DCI ESS1.A

- Prompt students to look at their first drawing on Activity Page 3.2.1 from this morning.
- **Ask,** What do you notice about the moon?
  - » It seems to have changed positions.
- Tell students to draw the afternoon moon into the picture. Have them label the afternoon moon "afternoon." Now prompt them to study the two positions of the moon on their drawing. (See **Know the Standards 3**.)

Differentiation

SUPPORT—Alternatively, take this part of the activity inside the classroom. Make a class drawing (visual representation) of what students observe about the position of the moon. Use poster board or large sheets of paper, and have volunteers draw the horizon, label the horizon "east" and "west," and add the picture of the moon based on where students tell you to put it from

Know the Standards

TEACHER DEVELOPMENT

2. DCI ESS1.A The Universe and Its Stars: Students observe that the moon appears to change position in the sky throughout the day. Students will build on this observation to later form patterns and make predictions about where and how the moon appears to move.

3. SEP 4 Analyzing and Interpreting Data: Students compare the two drawings of their moon on Activity Page 3.2.1 to see that the moon appears to move from the east to the west across the horizon.

their observations. Making this visual representation as a class—rather than independently—can help students who may be struggling with understanding concepts with east and west directions.

CHALLENGE—Have students work in small groups for the morning and afternoon investigations outside. Give each group a compass and allow them to find the directions of east and west so that they can draw their horizons (and the moon) on Activity Page 3.2.1.

EXTEND—Have students continue to observe and draw the position of the moon after school as a take-home activity. They can add a third or fourth drawing of the moon on AP 3.2.1 and compare the position of the moon at three or four points during the day, instead of two.

- **Ask the following questions:**
  - What side of the sky did the moon appear to rise in?
    - » east
  - What side of the sky did the moon appear to move toward?
    - » It appeared to move west.

1. Day 2: Refocus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.A

When and where does the moon rise and set?

- Remind students that they are going to study the position of the moon in the sky again today (and tomorrow).
- Summarize what students noticed the previous day about the moon in the sky. Have them take out Activity Page 3.2.1. **Ask students the following:**
  - Where in the sky was the moon in the morning?
    - » east
  - Did the moon appear to move during the day? Where did it go?
    - » yes, to the west

2. Facilitate the morning investigation.

Activity Page

AP 3.2.1

- Plan to bring students back to the same location outside at the same time as yesterday. Prompt them to bring Activity Page 3.2.1 with them, as well as a writing utensil and something to write on. Bring the compass.
- Have students stand facing south. Tell them to draw the same points of reference in the middle of the next drawing box. For instance, if they drew a tree and a mountain yesterday, they should draw the same things today. Let students know that their pictures do not need to be a perfect match for all three days but should be close.

NGSS Elements

SEP 3
SEP 4
CCC 1
DCI ESS1.A

- Now have students label the left side of their horizon pictures "east" and the right side "west."
- Now have students find the moon in the sky. **Ask,** Do you know what direction the moon is in right now?
  - » east
- Tell students to draw the moon into their pictures and label their moon "morning." Remind them that later in the afternoon they will add a second moon drawing to the picture.

3. Repeat the investigation in the afternoon.

Activity Page

AP 3.2.1

NGSS Elements

SEP 3
SEP 4
CCC 1
DCI ESS1.A

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt them to bring Activity Page 3.2.1 with writing utensils and something to write on.
- **Ask** Where do you see the moon *now*?
  - » to the right of where it was in the morning
- Prompt students to look at their drawing on Activity Page 3.2.1 from this morning.
- **Ask,** What do you notice about the moon?
  - » It seems to have moved.
- Tell students to draw the afternoon moon into the picture. Have students label the afternoon moon "afternoon." Now prompt students to study the two positions of the moon on their drawing from today. (See **Know the Standards 4**.)

4. Check for understanding.

- When you get back to the classroom, tell students to look at the pictures from the two days. They should compare the pictures. Remind them that to compare means to look at what is similar between them. (See **Know the Standards 5**.)
- **Ask the following questions:**
  - What side of the sky did the moon start in on both days?
    - » east

Know the Standards

TEACHER DEVELOPMENT

4. SEP 4 Analyzing and Interpreting Data: Students observe that the moon appeared to change position in the sky throughout the day, for the second day in a row. They will use this information to identify patterns and make predictions about where and how the moon will appear to move tomorrow.

5. CCC 1 Patterns: Students notice that for two days, the moon has appeared to move in the same direction. They can use this information to notice a pattern.

- What direction does the moon appear to be moving on both days?
  - » west

Monitor Progress

- Circulate around the room, and review student drawings to check for proper understanding of how to draw the moon's orientation in the sky according to objects of reference on the horizon.

1. Day 3: Refocus student attention on Today's Question.

When and where does the moon rise and set?

- Remind students that they are going to study the position of the moon in the sky again today, just as they did for two other days.

2. Make a prediction.

NGSS Elements

CCC 1
DCI ESS1.A

- Before going outside, make a class prediction about where the moon will be in the sky. Start by drawing the horizon on the board, and include an object or two for orientation. Label the left side "east" and the right side "west." (See **Know the Standards 6**.)
- **Ask students,** Where do you think the moon will be this morning? Why do you think so?
  - » It will be in the east, because it was in the east for the other two days we saw it.
- Write their prediction on the board.
- **Ask students,** Where do you think the moon will be this afternoon? Why do you think so?
  - » It will be more in the west, because it was in the west for the other two days we saw it.
- Write their prediction on the board. Tell students that you will come back to their predictions later in the day to see if they are correct.

3. Facilitate the morning investigation.

Activity Page

AP 3.2.1

- Plan to bring students back to the same location outside at the same time. Prompt them to bring Activity Page 3.2.1 with them, as well as a writing utensil and something to write on. Bring the compass. (See **Know the Standards 7**.)

Know the Standards

TEACHER DEVELOPMENT

6. CCC 1 Patterns: Students use their observations from the investigation to make a prediction about where the moon will be in the sky. Students notice patterns from Days 1 and 2 of the investigation and apply it to tell where the moon will be on Day 3.

7. SEP 3 Planning and Carrying Out Investigations: Students carry out the final day of their investigation of the moon. They use their morning observations of the moon to tell whether their predictions were correct.

- Have students stand facing south. Tell them to draw the same points of reference in the third drawing box on Activity Page 3.2.1.
- Now have students label the left side of their horizon pictures "east" and the right side "west."

NGSS Elements

SEP 3
SEP 4
CCC 1
DCI ESS1.A

- Tell students to point to the moon in the sky. **Ask,** Do you know what direction the moon is in right now?
  - » east
- **Ask,** Was our first prediction correct?
  - » yes
- Tell students to draw the moon into their pictures and label their moons "morning." Remind them that later in the afternoon they will add a second moon drawing to the picture.

4. Repeat the investigation in the afternoon.

NGSS Elements

SEP 3
SEP 4
CCC 1
DCI ESS1.A

Activity Page

AP 3.2.1

- Repeat this observation in the afternoon. Lead students back to the same location, facing south. Prompt them to bring Activity Page 3.2.1 with writing utensils and something to write on. (See **Know the Standards 8**.)
- **Ask,** Where do you see the moon *now*?
  - » to the right or west
- Prompt students to look at their drawing on Activity Page 3.2.1 from this morning.
- **Ask,** What do you notice about the moon?
  - » It seems to have moved.
- **Ask,** Was our second prediction correct?
  - » yes
- Tell students to draw the afternoon moon into the picture. Have them label the afternoon moon "afternoon."

Know the Standards

TEACHER DEVELOPMENT

8. SEP 4 Analyzing and Interpreting Data: Students use their morning and afternoon observations of the moon to describe patterns that they notice about the moon, such as that the moon starts out on the east side of the sky in the morning and appears to move to the west side of the sky in the afternoon.

5. Check for understanding.

- Bring the class together, and summarize their findings over the three days. Have students look at all three drawings to see that students understand that the moon can be viewed in the morning in the east and later in the afternoon in the west.
- Use the following questions to gauge student understanding:
  - Does the moon appear to move along the same path every day?
    - » yes
  - Where does the moon appear to rise in the morning?
    - » in the east
  - Where does the moon appear to set?
    - » in the west
  - Do you think the moon always rises and sets in these directions?
    - » yes
  - Where will the moon be tomorrow morning? Where will it move later in the day?
    - » It will be in the east in the morning, and it will be in the west later in the day.

Activity Page

AP 3.2.1
Monitor Progress

Review students' drawings on Activity Page 3.2.1, and listen for their responses to your questions to determine student understanding of the following concept:

- The moon appears to move along a repeated path from east to west.

See the Activity Page Answer Key for correct answers and sample student responses.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the moon after their observations.

Tie to the Anchoring Phenomenon

In observing how the moon moves across the sky from east to west, students understand that the moon follows a repeated path, which is a pattern in nature that can be predicted. This information can help Lin figure out where he can see the moon at different times throughout the day or night.

LESSON 3.3

What Is the Motion of the Moon?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: How does the position of the moon in the sky change?

Tie to the Anchoring Phenomenon: Lin could see the moon in different places in the sky. Today, students will read about why the moon seems to move.

At a Glance

Learning Objective

✓ Summarize the pattern of the moon's apparent motion.

Instructional Activities

- teacher Read Aloud
- class discussion
- teacher demonstration

NGSS Standards and Dimensions

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students read about and analyze the patterns of the apparent motion of the moon.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

moon **pattern** **predictable**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

bright **east** **visible** **west**

Instructional Resources

Student Book

Ch. 4

Student Book, Chapter 4
"Why Does the Moon Seem to Move?"

Activity Page

AP 3.3.1

Activity Page
Moon Models (AP 3.3.1)

Materials and Equipment

- clay (4 small balls per student, plus extra)
- paper plates (1 per student)
- plastic dull or play dough knife (1 per student)
- question board

The Core Lesson 3.3

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.A

How does the position of the moon in the sky change?

- **Ask students if anyone looked at the sky last night.** If so, **ask,** What did you see? Could you see the moon?
- Invite students who saw the moon last night to come up to the board and draw a picture of the moon that they saw.
- Remind students that sometimes the moon looks like it has a different shape when we see it. Tell students that today they will read about why the moon has different shapes.

2. Read together: "Why Does the Moon Seem to Move?"

Student Book

Ch. 4

NGSS Elements

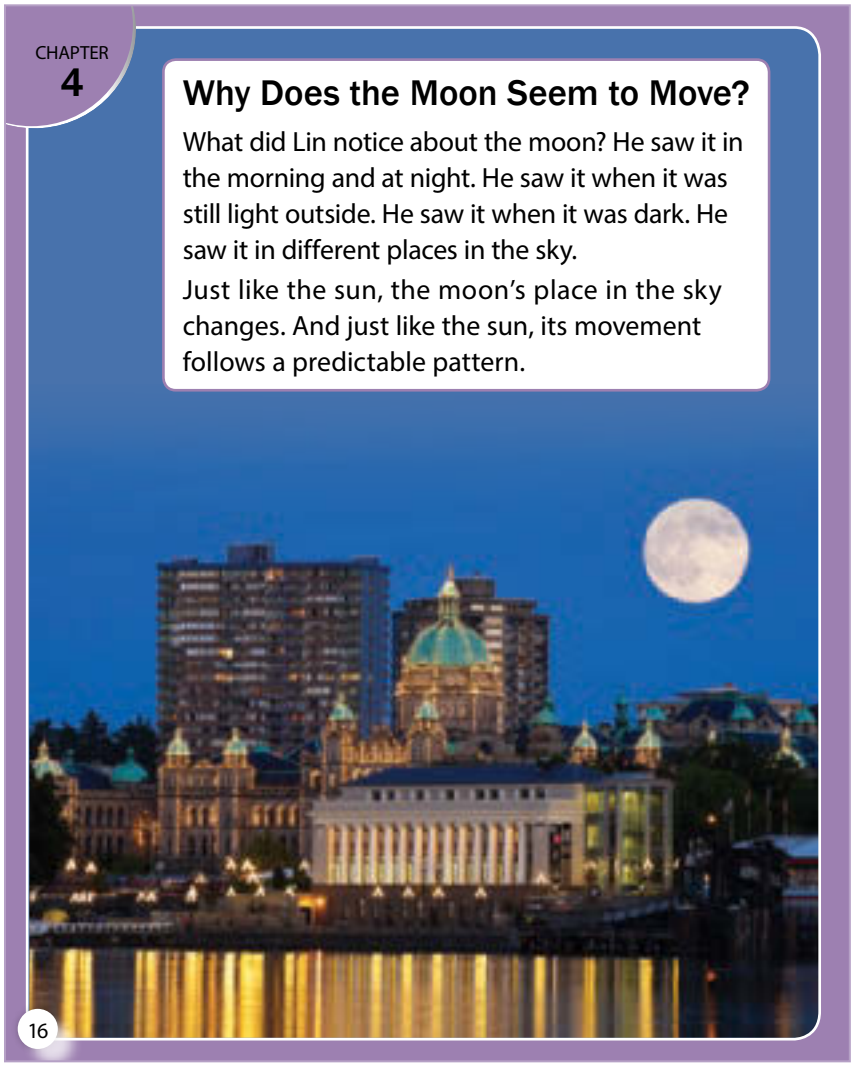
SEP 4
CCC 1
DCI ESS1.A
Differentiation

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 16

Ask students to turn to page 16 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is "Why Does the Moon Seem to Move?" and tell them to pay special attention to the pictures of the moon and where it is in the sky as you read.



CHAPTER 4

Why Does the Moon Seem to Move?

What did Lin notice about the moon? He saw it in the morning and at night. He saw it when it was still light outside. He saw it when it was dark. He saw it in different places in the sky.

Just like the sun, the moon's place in the sky changes. And just like the sun, its movement follows a predictable pattern.

16

Ask students to look at the picture on page 16.

CORE VOCABULARY—Explain that **predictable** means something that you know will happen. This is because it is usually the same or has a repeated pattern. Remind students that this is a little bit like knowing the future.

CORE VOCABULARY—Explain that a **pattern** is something that happens over and over. Tell students that scientists use patterns to predict what will happen.

LITERAL—Do you see the moon?

» yes

LITERAL—What shape is it?

» round; a circle

INFERENTIAL—What time of day do you think it is in the picture and why?

» I think it is nighttime, because you can see the moon and the sky is dark blue.

Page 17

Ask students to look at the bottom picture on page 17. Emphasize that the moon is not just a night sky object. Remind students that they learned this firsthand when they made observations of the moon in the sky during the daytime.

The moon is very bright against the dark night sky. But it is not only a night sky object. The moon appears in the sky both during the day and at night. The sun's bright light sometimes makes the moon harder or even impossible to see during the day.

17

LITERAL—Can you see the moon in the picture?

» yes

LITERAL—What shape is it?

» round; a circle

INFERENTIAL—What time of day do you think it is in the picture and why?

» I think it is daytime, because the sky is lighter blue in color.

Ask students to look at the top picture on page 17 and compare the two pictures on the page. (See **Know the Standards 1**.)

LITERAL—Which moon seems brighter between the two pictures?

» The moon in the top picture seems brighter.

INFERENTIAL—Why do you think the moon seems brighter in the top picture?

» Because it looks brighter against the dark sky.

INFERENTIAL—What time of day do you think it is in the top picture and why?

» I think it is nighttime, because the sky is very dark.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students observe pictures of the moon in the sky during the daytime and nighttime to see how the brightness of it changes against light and dark sky backgrounds.

Page 18

Ask students to look at the two pictures on page 18. Explain that the moon rises and sets, just like the sun.

Like the sun, the moon rises and sets. It rises in the eastern sky. Then it sets in the west. During the time that the moon is visible, it appears to move across the sky. Unlike the sun, the moon actually moves! It moves in a path around Earth. Earth also spins. So the moon's place in the sky changes.

Can you tell if the moon is rising or setting here? Not unless you know which direction the picture is facing. If the picture shows a view to the east, which is it?

Can you tell if the moon is rising or setting here? If the picture shows a view to the west, which is it?

18

Ask students to look at the first picture on page 18. Explain that the picture shows a view to the east.

LITERAL—What is the moon doing in this picture? Is it rising or setting?

» It is rising.

INFERENTIAL—How do you know?

» because we know that the moon rises in the east

Ask students to look at the second picture on page 18. Explain that the picture shows a view to the west. (See **Know the Standards 2**.)

LITERAL—What is the moon doing in this picture? Is it rising or setting?

» It is setting.

INFERENTIAL—How do you know?

» because we know that the moon sets in the west

INFERENTIAL—Do you think you would be able to tell if the moon were rising or setting without knowing the direction of east or west?

» No, we need to know the direction of east or west to tell if the moon is rising or setting.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 4 Analyzing and Interpreting Data: Students use what they learned from their firsthand observations to tell that the moon rises and sets in the sky, just like the sun. They also call on their observations to discuss the apparent movement of the moon across the sky.

Page 19

Ask students to look at the four pictures on page 19. Explain that all four of the pictures show the moon but that the moon looks like it has different shapes. (See **Know the Science**.)

The moon has the shape of a round ball. Because we see only one side of the moon, it sometimes looks like a circle. But sometimes its shape looks different. The moon's shape changes over the course of one month. These changes happen in a predictable pattern. The changes in shape are called the moon's phases.

The full moon has a complete circle shape.

The quarter moon is a half-circle shape.

The crescent moon looks like the shape of the white part of a fingernail.

During the new moon phase, the moon is hard to see. The whole circle is dark.

19

SUPPORT—Clarify for students that the moon is always a round, ball-shaped object. Its shape does not actually change. However, its shape can look different to us from Earth. Its shape appears to change because of its phases.

Know the Science

TEACHER DEVELOPMENT

The Shape of the Moon: The moon is always a round object in the sky, but the shape of it from our viewpoint on Earth changes to make it look like the moon is changing its shape. This has to do with how the light from the sun reflects off the moon. The phases are the result of the relative positions of Earth, the moon, and the sun. The phases of the moon go as follows: new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter, and waning crescent.

Hint: If you can grab the hollow part of the moon with your left hand, the moon is waxing; with the right, it is waning.

LITERAL—The moon's shape appears to change over the course of how long?

» about one month

LITERAL—What are the changes in the moon's shape called?

» phases

Ask students to compare the moon in the four pictures on page 19.

LITERAL—What does a full moon look like?

» It has a complete circle shape.

LITERAL—What does a quarter moon look like?

» It looks like a round ball or circle that is cut in half.

LITERAL—What does a crescent moon look like?

» It looks like a banana; it looks like the white part of a fingernail.

LITERAL—What does a new moon look like?

» a dark or black round ball or circle

CORE VOCABULARY—Discuss what students know about the **moon**. Explain that it is an object that moves around Earth, that is chiefly visible at night, and that reflects light from the sun, which makes it look like it has different shapes during its phases.

3. Guide a demonstration.

Activity Page

AP 3.3.1

NGSS Elements

SEP 4
CCC 1
DCI ESS1.A

- Pass out the clay, paper plates, and cutting utensils to students. Distribute Moon Models (AP 3.3.1), and review it together as a class. Tell students that they will press clay into a flat circle shape and then model the shape of the moon in its different phases. They can press each ball into a circle and trim its shape with the knife. The goal is for them to make each disc look like the phase of the moon. Then, they will set the shape onto the correct box on Activity Page 3.3.1. There is one box for each of the moon phases that they read about in the Student Book.
- Review safety rules when working with plastic or play dough knives.
- Have students form groups of two or three. Allow group members to work together, but each student should be responsible for their own moon shapes.
- Let students know that they can go back to page 19 of the Student Book to see what the phases of the moon look like.
- Circulate around the room, and check for student understanding that there is only one moon but that it can appear with just these portions visible at different times.

Differentiation

SUPPORT—For students without strong fine motor skills, provide cutouts from paper of the four moons that are showcased in the Student Book. Have students label each cutout.

CHALLENGE—Challenge students to make their moon models without looking at the pictures in the Student Book.

EXTEND—Have students research the gibbous phase, which was not covered in the Student Book on page 19. Have these students make a moon model for the gibbous moon phase.

4. Check for understanding.

Activity Page

AP 3.3.1

Monitor Progress

Review the models that students made and the boxes that they put them in for Moon Models (AP 3.3.1) to determine student understanding of the following concepts:

- The moon has different phases.
- The moon looks different when it is a full moon, a new moon, a half moon, and a crescent moon.

See the Activity Page Answer Key for correct answers and sample student responses.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the moon after their observations.

Tie to the Anchoring Phenomenon

In observing how the moon moves across the sky from east to west, as well as when it rises and sets, students understand that the moon follows a repeated path, which is a pattern in nature that can be predicted. Such information will be useful to Lin, who wonders why he can sometimes see the moon when he wakes up.

LESSON 3.4

What Are the Moon's Phases?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: What does the moon look like at different times in a month?

Tie to the Anchoring Phenomenon: Lin learns that the moon moves across the sky and changes position. This class session sets students up to perform an investigation that takes their exploration of the moon even further.

At a Glance

Learning Objective

✓ Compare and contrast the apparent shape of the moon during full, quarter, crescent, and new phases.

Instructional Activities

- student observation
- class discussion
- student investigation

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 1 Asking Questions

Crosscutting Concept: 1 Patterns

Students plan and carry out an investigation of moon phases over the course of two months.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

crescent moon **full moon** **moon** **new moon**
quarter moon

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **investigate** **notice** **observe**
phase **shape**

Instructional Resources

Activity Pages

AP 3.4.1
AP 3.4.2

Activity Pages
Moon Phase Sheet (AP 3.4.1)
Take-Home Letter (AP 3.4.2)

Materials and Equipment

- large sheet of paper
- markers
- ruler
- variety of pictures of the moon in the new moon, full moon, quarter moon, and crescent moon phases
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Prepare a slideshow of pictures for students. Collect pictures online of the moon in its four main phases (new moon, full moon, quarter moons, and crescent moons). You should have at least two pictures of each phase. The pictures should be different enough such that students must think about whether they are all pictures of the same moon. For instance, find the following pictures:
  - waxing crescent
  - waning crescent
  - first quarter moon
  - third quarter moon
  - full moon
  - new moon

Tell the students that if they can grasp the hollow part of the moon with their left hand then the moon is waxing (moving toward a full moon); with the right it is waning.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

- Prepare a moon phase chart where students will draw what the moon looks like each week for a period of two months. You can prepare this on a large sheet of paper using markers and a ruler.
- The chart should include a series of blank moons from Sunday to Saturday, for eight weeks. Leave a space at the bottom of each moon for students to write the date.

Moon Phases Calendar

Class Name: _____

Month: _____ **Year:** _____

Number the days of the month. For each day, observe the moon, and then draw its phase.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

- Plan for students to present their moon phase findings on report days (Mondays) between now and the end of November.
- Reserve a few minutes at the beginning of class time for the four students from the week to compare their observations of the moon phases and talk to the

class about what the moon looked like for that week. Then, allow students to update the moon phase chart.

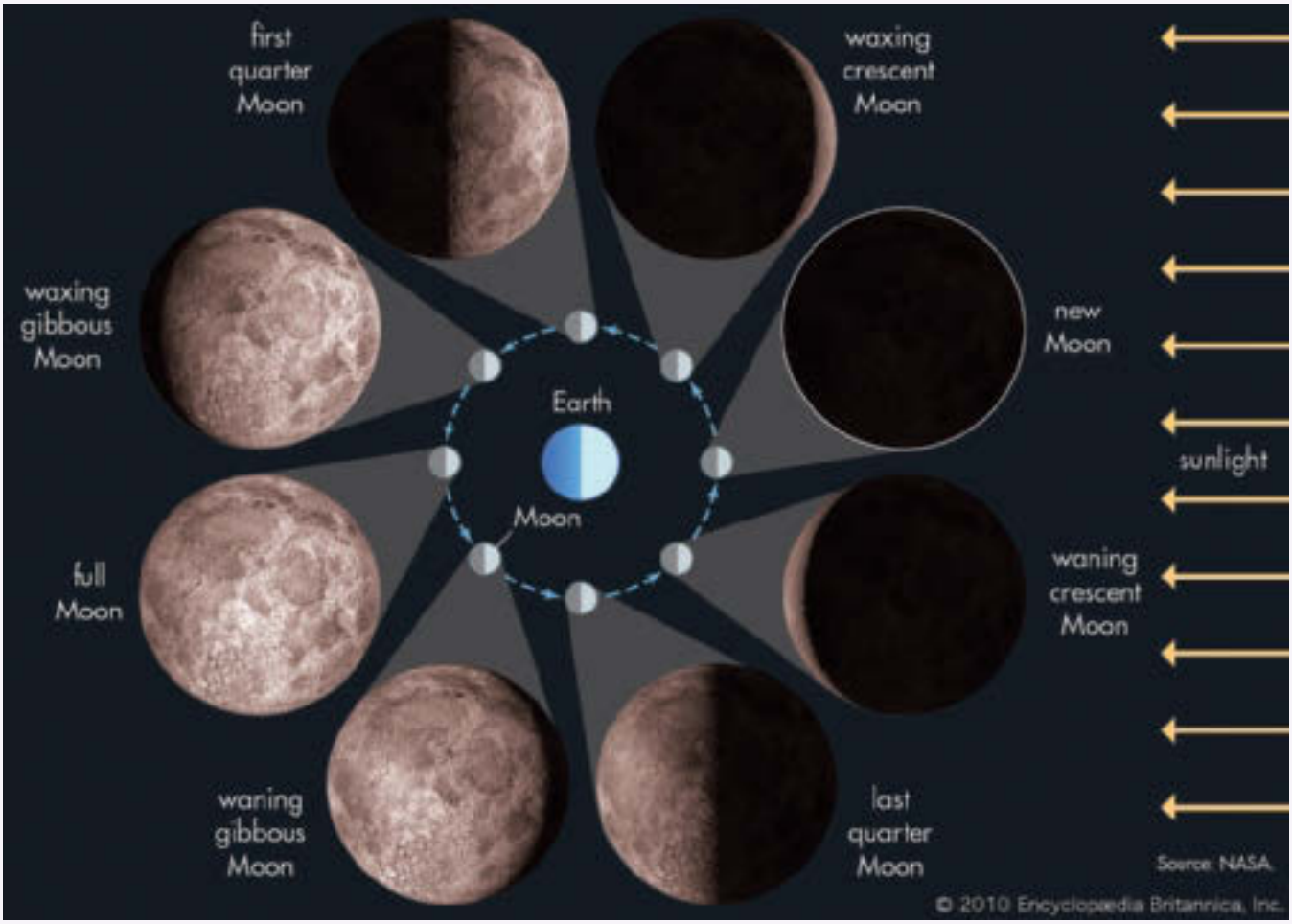
- It is intended that students collect data on the moon phases in real time. However, if this is not possible, substitute data is supplied to provide to students so that they can discern patterns from the data and use it to make their predictions about when there will be a new moon, full moon, crescent moon, and quarter moon. These substitute data can be found in the Teacher Resources section and at the end of this lesson segment. (See **Know the Science**.)

Know the Science

TEACHER DEVELOPMENT

Moon Phases: The moon's phases—or lunar phases—have to do with how much of the moon we can see from Earth. The part of the moon that we can see is lit by the sun. Since the moon orbits the Earth, we see different parts of it on different nights. It takes the moon 27.3 days to orbit around Earth. However, since Earth is also moving around the sun, it takes 29.5 days for the moon to go through its phases. In this investigation, students will observe and record the moon's phases for two months so that they can see the patterns of the moon through two complete phases.

The first quarter moon shows half of a circle. The last quarter moon shows the opposite half of the circle. The new moon is not visible. Then during the full moon, the full circle can be seen.



The Core Lesson 3.4

1. Focus student attention on Today's Question.

Online Resources

What does the moon look like at different times in a month?

- Remind students that in the previous Student Book chapter, they started to learn about the phases of the moon.
- Show students the slideshow. Show one picture of the moon at a time. For each picture, **ask students the following:**
  - Is this the moon?
  - What shape do you see?
- At the end of the slideshow, **ask,** "How can these ALL be the same moon, since they all look so different?" See how students respond and if they understand what they read from the Student Book.
- **Ask students if the moon is changing its shape or if it just looks like the moon is changing its shape.**
- Explain to students that the moon has different phases. This is why we see different shapes.

See the Online Resources Guide for a link to the recommended images:

www.coreknowledge.org/cksci-online-resources

2. Plan an investigation.

NGSS Elements

SEP 3

DCI ESS1.A

- Tell students that they will do an investigation for two months. For the next two months, they will look at the phases of the moon. (See **Know the Standards 1**.)
- **Ask students what they could do if they want to know when, during the month, there is a full moon, a new moon, a crescent moon, or a quarter moon.**
  - » We can go outside and look at the moon each night.
- **Ask students what they could do to record what the moon looks like on each night.**
  - » We can take a picture of the moon; we can draw a picture of the moon.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Guide students as they plan a two-month investigation in which they will observe the moon's phases and put the data together to be able to tell what the moon looks like at different times in a month.

3. Preview the investigation.

NGSS Elements

SEP 3
CCC 1
DCI ESS1.A

- Review the following important investigation details with the class:
  - The investigation will last for eight weeks.
  - Four students will record the moon phase for each week. Then a different set of four students will be assigned to record the moon phase for the next week. It will continue like this for eight weeks, until all students have had a chance to record the moon phases at least once.
  - Students will compare their observations within each group. Then they will present the moon phases to the rest of the class and update the class moon phase chart.

Activity Pages

AP 3.4.1
AP 3.4.2

- Distribute Moon Phase Sheet (AP 3.4.1) to students. Explain that this is the form students will use to record what the moon looks like for the week that they are assigned. Review it together as a class. Make sure students understand that they should draw the shape of the moon that they see for the week they are assigned. Some students in the class will start using Activity Page 3.4.1 right away, and others will not use it for several more weeks. (See **Know the Standards 2**.)
- Distribute Take-Home Letter (AP 3.4.2) to students. Let them know that this is a letter for their parents. The letter explains what students need to do for their moon phase observations. This way parents can help students be ready to look at the moon each night for the week they are assigned.

Differentiation

SUPPORT—Some students with decreased fine motor skills may not be able to make accurate drawings. If available and reasonable, have those students take digital pictures. Using the dates on the digital photos, help students place the photos on a digital version of Activity Page 3.4.1 or on another digital monthly calendar.

CHALLENGE—Challenge students to put on a pantomime of the moon's phases.

Online Resources

EXTEND—Have students access a lunar data website and use it to study data for the moon phases in your area. The duration data talk about the length of the cycle for the moon to go through all of its phases. Have students talk about what the data show and what they mean.

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

Know the Standards

TEACHER DEVELOPMENT

2. ESS1.A The Universe and Its Stars: Students will conduct an investigation in which they observe the pattern of the moon phases over two months to be able to describe what they see to make predictions about future moon phases.

4. Make student assignments.

NGSS Elements

SEP 3

DCI ESS1.A

- Use a system that works for your class to determine the order in which students will carry out their weekly investigations. You might want to start with students who volunteer or assign the weeks in alphabetical order.
- Use a board or other visual where students can see their names next to their assigned weeks.
- Remind students that they will hold on to Activity Page 3.4.1 until they are ready to use it for their week. If they lose their copy, you can give them another one.

Activity Page

AP 3.4.1

- Ask students what questions they have about the investigation or about moon phases.
- Review the following scenarios with students:
    - If students are unable to go outside to look at the moon, they can look out a window instead.
    - If any activities or schedules prevent a student from collecting the moon phase data, let the teacher know, and together you can work out a way around it.

5. Check for understanding.

Activity Page

AP 3.4.1

For the Monday report days in which students present their findings from the previous week, check for student understanding by reviewing their drawings on Moon Phase Sheet (AP 3.4.1) and listening to their explanations and descriptions of the moon's phase during their presentations to ensure they have proper understanding of the investigation and moon phases.

Students should exhibit understanding of the following concept:

- The moon appears to change shapes throughout the month.

Ask students to identify the type of moon they are describing based on their drawings and observations. See whether students identify the moon phase.

See the Activity Page Answer Key for correct answers and sample student responses.

Monitor Progress

Call attention to the question board. Ask students what else they wonder about the investigation or moon phases. Add their questions to the question board.

Tie to the Anchoring Phenomenon

Lin remembers that the moon was out in the morning, but he thought the moon was only out in the sky at night. Students will explore this phenomenon further through their investigation of moon phases to learn more about how the moon's apparent shape changes throughout the month.

Substitute Moon Phase Data

The goal of the *Sun, Moon, and Stars* unit is for students to make their own observations, record data, and discern patterns. If you cannot accommodate live observations and data collection over time, you can complete the unit presenting this supplied data for students.

The following substitute moon phase data is for Cincinnati, Ohio, from September 2020 through May 2021. The information below shows the moon phases for full moon, new moon, and quarter moons. Crescent moons are found between the new moon and the quarter moons.

Moon Phase Calendar

Sep	2: ○	10: ◑	17: ●	23 ◐	
Oct	1: ○	9: ◑	16: ●	23: ◐	31: ○
Nov	8: ◑	15: ●	21: ◐	30: ○	
Dec	7: ◑	14: ●	21: ◐	29: ○	
Jan	6: ◑	13: ●	20: ◐	28: ○	
Feb	4: ◑	11: ●	19: ◐	27: ○	
Mar	5: ◑	13: ●	21: ◐	28: ○	
Apr	4: ◑	11: ●	20: ◐	26: ○	
May	3: ◑	11: ●	19: ◐	26: ○	

Key

Full moon = ○ Quarter moon = ◑ New moon = ●

LESSON 3.5

Why the Moon's Appearance Changes

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: How does the moon's appearance vary?

Tie to the Anchoring Phenomenon: Lin noticed that he could see the moon in the morning and at night, even when it was still light outside. Today, students read about how the moon appears to cross the sky and follows a predictable pattern.

At a Glance

Learning Objective

✓ Describe moon phases.

Instructional Activities

- teacher Read Aloud
- class discussion
- drawing

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 2 Cause and Effect

Students read about and analyze the patterns of the apparent motion of the moon.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

circle **crescent moon** **phase**
quarter moon

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

bright **east** **shape** **visible**
west

Instructional Resources

Student Book

Ch. 4

Student Book, Chapter 4
Revisit "Why Does the Moon Seem to Move?"

Activity Page

AP 3.5.1

Activity Page
Moon Comic (AP 3.5.1)

Materials and Equipment

- coloring utensils
- question board

The Core Lesson 3.5

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.A

How does the moon's appearance vary?

- **Ask students to name the different phases of the moon.** Write the names of the phases on the board for new moon, full moon, quarter moon, and crescent moon.
- Now that the names of the moon phases are on the board, invite four students up to the board to draw a picture of the moons in each of their main phases.
- **Ask the rest of the class to describe what the moons look like in each main phase.** If necessary, use question prompts like "What shape do you notice in the quarter moon?" and "How much of the moon do you think you can see when the moon is full?"
- Show students the collected data from the two-month investigation that was drawn onto the class chart.
- **Ask students which phase the moon is in right now, based on the chart.**

2. Reread together: "Why Does the Moon Seem to Move?"

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 19

Student Book

Ch. 4

Ask students to turn to page 19 of the Student Book and remind them that you have already read these pages aloud, prior to them doing their investigation. However, today you want to reread them now that they know more about the moon's phases. Tell students to pay special attention to the shapes of the moon as you read.

The moon has the shape of a round ball. Because we see only one side of the moon, it sometimes looks like a circle. But sometimes its shape looks different. The moon's shape changes over the course of one month. These changes happen in a predictable pattern. The changes in shape are called the moon's phases.

The full moon has a complete circle shape.

The quarter moon is a half-circle shape.

The crescent moon looks like the shape of the white part of a fingernail.

During the new moon phase, the moon is hard to see. The whole circle is dark.

19

NGSS Elements

DCI ESS1.A

Ask students to look at the four pictures on page 19. Explain that all four of the pictures show the moon but that the moon looks like it has different shapes. (See **Know the Standards 1**.)

Before reading the page out loud, have students identify the four moons in the pictures. **Ask them which moon is the new, full, quarter, and crescent moon.**

» the fourth, first, second, and third moons on the page

Differentiation

SUPPORT—Refer to the two-month investigation that students just completed. **Ask students to raise their hands if they were assigned a week where they observed the following:**

- new moon
- full moon
- quarter moon
- crescent moon

Invite students to talk about the observations they made of those moons. **Ask students if their real-life observations of the moon in that phase looked like the moon in the pictures on the page.**

3. Draw a comic strip.

Activity Page

AP 3.5.1

NGSS Elements

DCI ESS1.A

- Distribute drawing utensils and Moon Comic (AP 3.5.1), and review it together as a class. Tell students that they are going to draw a comic strip of the moon and its phases.
- Draw student attention to the boxes. Read the headers of each box: Full Moon, Quarter Moon, Crescent Moon, and New Moon.
- Explain that in each box students will draw a picture of the moon. Then there are lines beneath the city skyline. Those lines are where students will write down words to describe the moon in that phase. They should base these words on what they observed firsthand, as well as what they read about in the Student Book.
- If necessary, model for students how to complete one of the boxes. Start by reading the header, such as Quarter Moon. Draw a quarter moon on the board. Then write some words that describe the quarter moon. Explain that students can get creative. For instance, they can write down something that the quarter moon reminds them of, such as half of a pancake or a circle folded in half. Remind students that they should write or draw what they can view for that moon phase.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students describe the phases of the moon that they see in the pictures and relate them to their real-life observations.

- Allow students to work together in groups of three or four. Encourage them to talk about the phases of the moon and help remind one another of the characteristics.
- Circulate around the room as students work on Activity Page 3.5.1. Listen for understanding of the moon phases. Assist if students need help remembering what the moon phase looks like or ways to describe it. For instance, students can turn back to page 19 of their Student Books to review the moon phases, or they can refer to the two-month investigation moon chart in the classroom. (See **Know the Standards 2**.)
- **Ask students how the moon looks different during its phases.**
  - » The amount of the moon that we can see makes the moon seem like different shapes.

Differentiation

SUPPORT—Limiting the number of moon phases that each student is responsible for drawing and writing about individually makes this activity more accessible to those who may have difficulty remembering or understanding the four phases. For students who might need more guidance, do a sample of one of the moon's phases as you state your thinking out loud. For another phase, do another drawing as the student is also drawing the same phase. Continue talking about your thought pattern as you are making the drawing. Guide with words only on the third drawing. Then have the student do the last drawing on his or her own.

CHALLENGE—Challenge students to write a sentence about moon phases.

EXTEND—After students have researched the gibbous phase, have them research the order in which the moon phases occur and make their own drawing of the moon in all of its phases. These students will end up covering more moon phases than the rest of the students in the class.

4. Check for understanding.

By now students have been exposed to the phases of the moons several times. Review their responses to Activity Page 3.5.1 to check for their progression in understanding that the moon does not actually change shape but that it looks like its shape changes based on the phase that it is in and how much of the moon we can see.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 2 Cause and Effect: Students explain what causes the moon to look different at different times of the month. The position of the moon relative to the sun and Earth causes us to see different shapes from Earth.

Activity Page

AP 3.5.1

Review the drawings and words students wrote on Moon Comic (AP 3.5.1) to determine student understanding of the following concepts:

- The moon has different phases.
- The moon looks different when it is a full moon, a new moon, a quarter moon, and a crescent moon.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the moon after their observations.

Tie to the Anchoring Phenomenon

In observing how the moon changes its apparent shape in the sky, students understand that the moon follows a cyclical phase that can be identified according to the specific shape. Such information will be useful to Lin, who wonders why the moon looks different and is seen in different parts of the sky.

LESSON 3.6

Lesson 3 Roundup: Patterns of the Moon

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How does the moon's appearance in the sky change?

Today's Question: How does the moon's appearance in the sky change?

Tie to the Anchoring Phenomenon: Lin understands that the moon moves through the sky and that it can be found in different positions. Students have learned about this same phenomenon by doing a two-month investigation of moon phases. Now, students can describe the patterns they notice and make predictions.

At a Glance

Learning Objective

✓ Use moon phase data to predict the future appearance of the moon's shape.

Instructional Activities

- making predictions
- class discussion
- drawing

NGSS References

Performance Expectation: 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students analyze and interpret data based on their observations to predict the patterns of moon phases.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

data **moon** **pattern** **phase**
quarter moon

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

graph **identify** **investigate** **notice**
observe

Instructional Resources

Activity Page

AP 3.6.1

Activity Page
What Will the Moon Look Like?
(AP 3.6.1)

The Core Lesson 3.6

1. Focus student attention on Today's Question.

How does the moon's appearance in the sky change?

- Remind students that they worked on a two-month investigation where they looked at the phases of the moon.
- Tell students that today they are going to look for patterns in the moon phase data and make predictions about the moon's phase in the next date of the cycle. Explain that they will work as a class to make these predictions.
- Display the moon phase chart with the data where students can see it and where you can refer to it throughout the activity.

2. Facilitate the activity.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Walk through the data together on the chart created in Lesson 3.4. Focus on the phase of the moon over the course of the eight weeks, going week by week.
- For each week on the chart, point to the drawing of the moon, and **ask students which phase the moon was in for that week**. Do this for all the weeks on the graph for which there is data.
- **Ask students where one cycle ends and the next cycle begins.** Students collected eight weeks of data, which is nearly two moon cycles. If students cannot identify the beginnings and endings of the moon cycles, guide them by showing them the beginning of the first moon cycle, and ask them to find the next time they see the same moon.
- **Ask students in which order the moon phases occur.** If students are unable to identify the order of the phases, talk them through it for each of the two cycles of data.
  - » The cycle includes a new moon and then goes to a crescent moon, then to a quarter moon, then a full moon, then another quarter moon, and then another crescent moon.

3. Make a prediction.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Tell students that now they will make a class prediction about future moon phases. (See **Know the Standards 1**.)
- Refer to the last moon phase where the data collection ends, to show where the last cycle left off.
- Call on a volunteer to come up to the moon chart. **Ask the student to tell what moon we will see in the sky next.** Prompt the student to refer to the moon phase data and look at it if they need to. Then have the student draw the shape of the moon that they will see next on the board.
- **Ask the class if they agree with the prediction, explaining why or why not.**
- Repeat this with the other weeks throughout the next cycle. Invite students, one by one, to come up to the moon chart and make predictions for the moon phase for the rest of the cycle (one month).

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.B Earth and the Solar System: Students use the data on the chart to make predictions about what the moon will look like on future dates.

4. Summarize and discuss.

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

Activity Page

AP 3.6.1
Differentiation

- After the predictions have been made for the moon phases in the next cycle, **ask students how they were able to tell what the moon would look like in the future.**
- **Ask,** Did you just guess what it would look like? Or did you use data?
  - » We used data.
- Encourage students to talk about and describe how they used the data to make the predictions. (See **Know the Standards 2**.)
- Distribute What Will the Moon Look Like? (AP 3.6.1), and ask students to draw the moon phases in its cycle. Tell students to begin with the circle at the top of the Activity Page and draw the phases clockwise in order from there. Allow them to refer to the chart or Student Book for reference.
- Summarize the activity by emphasizing that students used the information they collected from their investigations to make a prediction about what the moon phases would be in the future and in which order.

  SUPPORT—If necessary, have students work in groups to tell what the very next moon phase will be, based on where the investigation data left off. This activity will be more accessible to students that may have a difficult time identifying patterns or seeing the order in which the moon phases occur.

  SUPPORT—Giving students one thing to focus on—rather than several things—can make this activity more accessible and engaging for them, as well as less overwhelming.

  EXTEND—Have students form pairs or small groups and discuss why it is helpful to know what the moon phases will be in the future.

5. Check for understanding.

Listen for student responses and comments during the prediction activity to ensure that they are on track to understanding that patterns repeat themselves and that they can use existing data to tell information about the future.

Activity Page

AP 3.6.1
Monitor Progress

Review student drawings on What Will the Moon Look Like? (AP 3.6.1) to ensure understanding of the following concept:

- Patterns can be used to make predictions about what the moon will look like.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 1 Patterns: Students talk about how patterns in data helped them make predictions.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the moon after their observations.

Tie to the Anchoring Phenomenon

Lin knows that the moon can be seen from different places in the sky and that sometimes it looks different, too. Students now understand how the cycle of the moon can make the moon appear to look different.

LESSON 4

Stars and Their Predictable Patterns

Overview

Guiding Question: How do stars seem to move in the night sky?

Lesson 4 Segments	Segment Questions	Advance Preparation
4.1 What Are Stars? Students learn about the stars and constellations.	How can you identify stars in the sky?	Gather materials for the demonstration. See Materials and Equipment.
4.2 The Stars in the Sky Students carry out an investigation to observe where the Big Dipper is in the sky over the course of three nights.	Where does the same star appear in the sky at different times during the night?	Gather materials for the investigation. See Materials and Equipment.
4.3 How Do the Stars Move? Students read about stars and constellations and participate in an activity to learn about the apparent movement of these celestial objects.	How do stars seem to move in the night sky?	Read Chapter 5 in the Student Book.
4.4 Lesson 4 Roundup: Patterns of the Stars Students use data to predict where the Big Dipper will be in the sky at a future time.	How do stars seem to move in the night sky?	Gather materials for the data analysis and predictions. See Materials and Equipment.

What's the Story?

Summary: In Lesson 4 (Segments 1–4), students explore how the stars (namely the Big Dipper) appear to move across the sky at different times throughout the night. Students participate in an investigation in which they observe the Big Dipper in the night sky over three nights to discern whether it appears to move in a pattern that can be predicted (1-ESS1-1). The developing understanding of these phenomena in Lesson 4 depends on students' understanding from Lessons 1–3, in which they already had practice identifying the apparent movement of the sun and the moon.

Learning Progression: Lesson 4 builds on student understandings about the sun and moon and their apparent movements in the sky, 1-ESS1-1: *Use observations of the sun, moon, and stars to describe patterns that can be predicted.*

Guiding Phenomenon: Objects in the sky—such as the sun, moon, and stars—seem to move and change position over time. These movements take place in patterns that can be studied to predict where the objects will be in the sky at a given time. Our main character, Lin, makes observations about the fact that the sun and moon appear to change positions in the sky and can even be seen during the daytime. But what about stars? Stars can be seen at night, but they, too, seem to move in the sky. In Lesson 4, students observe what the night sky looks like.

Learning Objectives

By the end of Lesson 4, students will do the following:

- Identify the stars and constellations as objects in the sky that are seen at night.
- Describe how the Big Dipper appears to move in the sky.
- Predict where the Big Dipper will be viewed in the sky in the future.

NGSS Standards and Dimensions

Performance Expectation: 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
4 Analyzing and Interpreting Data Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**ESS1.A The Universe and Its Stars** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	**1 Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 4.1

What Are Stars?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How do stars seem to move in the night sky?

Today's Question: How can you identify stars in the sky?

Tie to the Anchoring Phenomenon: Lin notices when it is dark outside. This is when he cannot see the sun but can see the moon and stars. Today, students will learn about stars and why they see them at night.

At a Glance

Learning Objectives

- ✓ Identify stars as objects visible in the sky at night.
- ✓ Relate constellations to the ability to identify the same star or stars at different times during the same night or on different nights.

Instructional Activities

- class discussion
- teacher demonstration

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 1 Asking Questions

Crosscutting Concept: 1 Patterns

Students explore questions about the stars and patterns of stars.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

constellation **star**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

identify **notice** **observe**

Instructional Resources

Activity Page

AP 4.1.1

Activity Page
Connect the Dots (AP 4.1.1)

Materials and Equipment

- flashlight
- question board

The Core Lesson 4.1

1. Introduce students to Lesson 4.

Ask a volunteer to state the **Big Question** that you'll be answering in this unit, which is posted somewhere in the room—**How do the sun, the moon, and stars appear to change position in the sky?**

Tell students that, before they can answer the unit's Big Question about objects in the sky, they need to understand more about stars. However, there are too many stars in the sky to look up and know which one is which just by looking at a single star. But when you see a given constellation, you know you are looking at the same stars. In Lesson 4, students will learn about the stars and the constellations they make up to learn about how they appear to move in the sky. Write the **Lesson 4 Guiding Question** where students can see it:

How do stars seem to move in the night sky?

Tie to the Anchoring Phenomenon

As students work through Lesson 4, they will learn about whether they can see the stars during the day or at night and will determine how the position of stars in the sky changes.

- **Ask students if they have ever seen a star at night.**
  - » yes
- Have students turn and talk to a partner to discuss what a star looks like. Use question prompts to initiate their discussion, such as the following:
  - What color are stars?
  - Are stars bright and shiny?
  - How big does a star look in the sky?
  - What shape are stars?
- Circulate around the room, and listen for students' understanding of stars. Students should demonstrate some prior knowledge about stars based on firsthand observations.

2. Do a demonstration.

NGSS Elements

SEP 1

DCI ESS1.A

- **Ask a volunteer to help you with the demonstration.** Hand the volunteer a flashlight. Tell the student to shine the flashlight up at the ceiling, but keep the lights in the classroom on.
- **Ask students in the class to look up at the ceiling and tell what they notice.** Is it hard for them to see the light from the flashlight on the ceiling?
  - » Yes, we cannot see the light on the ceiling.
- Have the volunteer turn off the flashlight.
- Now turn the classroom lights off so the classroom is as dark as you can make it. **Ask the volunteer to shine the flashlight at the ceiling again.**
- **Ask students in the class to look up at the ceiling and tell what they notice.** Is it easier for them to see the light on the ceiling now?
  - » Yes, we can see the light from the flashlight.
- Explain that this is how we see stars. We can see the stars in the sky at night when it is dark, but we cannot see them during the day, even though the stars are still there. (See **Know the Science 1**.)

Know the Science

TEACHER DEVELOPMENT

1. The Stars in the Sky: Stars are objects in the sky that can been seen at nighttime, against a dark sky. The stars are in the sky during the daytime, but the sun's light makes the sky too bright to be able to see the light coming from the stars during the day.

3. Connect the dots.

Activity Page

AP 4.1.1

Differentiation

- Distribute Connect the Dots (AP 4.1.1). Tell students that they will use their pencils to draw lines between the dots to make pictures. Explain that there is no right or wrong picture for students to draw. Students should draw whatever pattern, picture, or shape they think they see.
- Allow students to work in groups of two or three for this activity.
- Circulate around the room, and see what kinds of patterns students find in the box of dots. Assist if necessary.
- Give students a few minutes to work on their drawings. When they are done, ask students to share what they drew with the class.

SUPPORT—Some students may have a difficult time visualizing patterns or pictures from a series of dots on a page. For these students, draw dotted lines between the dots on Activity Page 4.1.1, and tell students to trace the pictures with their pencils.

CHALLENGE—Have students research one specific star of their choosing. Ask them to make a star card for the star. The star card will have a drawing of the star on the front and any important information about the star on the back.

EXTEND—Have students write about how they can tell which star is which in the sky, among all the other stars.

4. Discuss constellations.

NGSS Elements

SEP 1
CCC 1
DCI ESS1.A

- Ask students if they have ever looked up at the sky and saw the clouds and thought that the clouds looked like they were in the shape of something, like a tree-shaped cloud or a cloud that was shaped like an elephant. Explain that the same thing can be done with the stars in the sky.
- Tell students that a long time ago people drew imaginary lines between the stars to make pictures. We call these star pictures *constellations*. Some constellations have a lot of stars in them, and some have only a few stars. (See **Know the Science 2**.)
- People long ago used to look up at the sky and wonder what stars were and why they were there. They used the North Star—called Polaris—to find their way around at night. It was the one star that seemed to not move in the night. It was always in the north part of the sky. Other stars did move, but they stayed in

Know the Science

TEACHER DEVELOPMENT

2. Constellations: Constellations are groups of stars that form imaginary outlines or pictures or shapes. Historically, people came up with constellations and named them according to stories or mythology. Different cultures have different constellations.

the same place relative to each other. Eventually, people invented constellations. Greek myths, or stories, played a role in naming some of the constellations as we know them today. (See **Know the Standards 1** and **2**.)

- Ask students what questions they have about stars or constellations so far. Let students know that in the next class session they will plan and carry out an investigation on one of the most well-known constellations: the Big Dipper.

5. Check for understanding.

Monitor Progress

Monitor student discussions and responses throughout the lesson segment to see what students already know and understand to be true about the stars and constellations.

After participating in the activities and discussions, students should understand the following:

- The sky is full of stars.
- Stars can be seen at night.
- Groups of stars make up constellations.

See the Activity Page Answer Key for correct answers and sample student responses.

Call attention to the question board. Ask students what else they wonder about the stars and constellations. Add students' questions to the question board.

Tie to the Anchoring Phenomenon

Lin discerns daytime from nighttime. Nighttime is when the stars are out. Students will continue to learn more about stars and constellations and how they appear to move in the sky.

Know the Standards

TEACHER DEVELOPMENT

1. Language Arts Connection: Related content about stars and constellations can be found in Lessons 3 and 4 of the Grade 1 Language Arts book *Astronomy Tell It Again! Read-Aloud Anthology*. Students may have already learned about the Mesopotamians, the Maya and Aztec people, and the Egyptians. In Kindergarten, students learned about the Native Americans. Discuss with students how some of these people used the stars to tell stories or to serve as pictures of things they believed in (SL.1.2).

2. DCI ESS1.A The Universe and Its Stars: Students learn that constellations are made up of stars and look like pictures in the sky. Students will build on their knowledge of constellations throughout this lesson.

LESSON 4.2

The Stars in the Sky

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How do stars seem to move in the night sky?

Today's Question: Where does the same star appear in the sky at different times during the night?

Tie to the Anchoring Phenomenon: Do the stars really move? Or do they just appear to be moving? Lin observes that the moon really does move and that the sun does not. Students will learn about where the stars are in the sky by looking at visuals of the night sky over the next three days.

At a Glance

Learning Objectives

✓ Illustrate the Big Dipper.

✓ Observe and record the position of the Big Dipper in the night sky at different times of night.

Instructional Activities

- student observation
- student investigation
- data collection
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students investigate the patterns of a star constellation.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

Big Dipper **constellation** **Polaris (North Star)** **star**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

change	**direction**	**identify**	**move**
notice	**observe**	**point of reference**	**position**

Instructional Resources

Activity Pages

AP 4.2.1
AP 4.2.2

Activity Pages
The Big Dipper (AP 4.2.1)
Big Dipper Investigation (AP 4.2.2)

Materials and Equipment

- 2 pictures of a starry sky
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Find two pictures of a starry sky that you can present to students.
- Print Activity Page 4.2.2, and have it ready to display to the whole class.

The Core Lesson 4.2

1. Focus student attention on Today's Question.

Online Resources

NGSS Elements

DCI ESS1.A

Where does the same star appear in the sky at different times during the night?

- Open the lesson segment by showing students a picture of a starry sky at night. **Ask students if anyone can count how many stars there are in the picture.** Explain that there are too many to count, or else students would be counting for a very long time. (See **Know the Science 1**.)

See the Online Resources Guide for a link to the recommended resources:

www.coreknowledge.org/cksci-online-resources

Know the Science

TEACHER DEVELOPMENT

1. Constellations: Scientists go to great lengths to locate, number, and name specific stars. Constellations were designed in ancient times and used since for storytelling, as well as for directions and navigation. They provide a way for people to look up at the sky and identify where they are in the world, based on where they see the North Star (Polaris). Related content about stars and constellations can be found in Lessons 3 and 4 of the Grade 1 Language Arts book *Astronomy Tell It Again! Read-Aloud Anthology*.

- Tell students to pick one star in the picture to focus on. Maybe it's a star that is shining the brightest or that looks the biggest. Have them remember that star.
- Now display the second picture of the starry sky at night. **Ask students if they can find the same star in the sky.** Some students might say "no." Others might say "yes," thinking that the stars are the same. Explain that there are far too many stars in the sky to be able to identify one single star just by looking at these pictures. This is one of the reasons that people came up with constellations—to help them find the stars. Emphasize that wherever and whenever you see a given constellation, you know you are looking at the same stars.

2. Draw the Big Dipper.

NGSS Elements

CCC 1
DCI ESS1.A

- Tell students that for this investigation, they will observe and record the position of a constellation in the sky to see if it changes or stays in the same place over three nights. They will be looking at the Big Dipper.
- Explain that a big dipper is a big spoon or scoop. The Big Dipper constellation looks like a big dipper.
- Distribute The Big Dipper (AP 4.2.1). Tell students that they will connect the large stars beginning nearest to the number 1 and progressing toward the number 2 to illustrate the constellation.

Differentiation

SUPPORT—Modify this activity by distributing a different Activity Page to students who may have a harder time visualizing how the dots should be connected. Give students a picture of the Big Dipper to trace or copy, such as the following:

CHALLENGE—To make this activity more challenging, remove or cover the labels for section 1 and section 2 on Activity Page 4.2.1, and allow students to connect the dots on the page to make the Big Dipper.

EXTEND—Have students draw the shape of the Big Dipper on a blank piece of paper, including the position of the seven stars that make up this constellation.

- Circulate around the room as students draw their Big Dippers. Provide support as needed.
- When students are done, invite a volunteer to share their drawing with the class.

3. Preview the investigation.

- Tell students that this investigation will be different than the others they have done so far. Remind students that for the sun investigation, they went outside to look at the sky. However, explain that the stars can only be seen at night. So, they cannot do this investigation during the day while they are at school. Also, it can be difficult to find the Big Dipper in the night sky unless you have a well-trained eye.
- Let students know that for this investigation they will be observing pictures of where the Big Dipper is in the sky for three nights.

4. Facilitate the investigation.

Activity Pages

AP 4.2.1
AP 4.2.2

NGSS Elements

CCC 1
DCI ESS1.A
SEP 3

- Using a projector or other means, show students the three-panel picture from Big Dipper Investigation (AP 4.2.2).
- **Ask who can see the Big Dipper in the three pictures.** Prompt students to look at Activity Page 4.2.1 if they need to remind themselves of what the Big Dipper looks like.
- Tell students that if they can see the Big Dipper, then they can also find Polaris. Explain that Polaris is the North Star. Show students how they can find Polaris based on where the Big Dipper is in the sky. (See **Know the Science 2**.)
- Invite one volunteer to come up and point to Polaris in the first picture. Invite a second volunteer to come up and point to Polaris in the second picture. And repeat this for the third picture.
- Explain that Polaris serves as a point of reference for telling where the Big Dipper is in the sky and whether it has moved.

Know the Science

TEACHER DEVELOPMENT

2. Polaris: The Big Dipper is made up of seven stars. There are two outer stars that look like they make up the end of the scoop of the dipper. Their names are Dubhe and Merak. These stars always point to Polaris.

- Now have students compare the position of the Big Dipper in the sky for all three nights, by looking at the three pictures in the panel. Explain that the pictures were all taken at different times. (See **Know the Science 3**.)
  - The picture on the top was taken earliest in the evening on the first night.
  - The picture in the middle was taken a little later on the second night.
  - The picture on the bottom was taken even later on the third night.
- **Ask students if it looks like the Big Dipper changed positions in the sky.** (See **Know the Standards 1**.)
  - » Yes. It looks like the Big Dipper has moved.
- **Ask students to tell in what direction it looks like the Big Dipper is moving.**
  - » It looks like the Big Dipper is moving counterclockwise around Polaris.

Online Resources

- Show a video to demonstrate the movement.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

5. Check for understanding.

NGSS Elements

CCC 1
DCI ESS1.A
SEP 4
Monitor Progress

- Students build on what they learned about stars and constellations from Lesson 4.1 to understand that these objects appear to move in the sky.
- Use the following questions to gauge student understanding:
  - **Ask students what they notice about the position of the Big Dipper in the sky.**
    - » The Big Dipper seems to move.

Know the Science

TEACHER DEVELOPMENT

3. The Big Dipper and Polaris: The Big Dipper moves in a counterclockwise direction around Polaris, making a full circle around Polaris in one twenty-four-hour day.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 3 Planning and Carrying Out Investigations: Students investigate where the Big Dipper is in the sky by using media to make observations.

- **Ask students how they know that the Big Dipper changed its position.** Students will be able to tell you, visually, that the Big Dipper was "over here" one night and "over there" the next. They should explain that Polaris helps serve as a point of reference to see that the Big Dipper has moved. (See **Know the Standards 2**.)
- **Ask students in what direction it looks like the Big Dipper is moving.**
  - » It looks like the Big Dipper is moving in a counterclockwise direction.

Monitor Progress

Listen for student responses to your questions to determine understanding of the following concepts:

- The stars appear to change their position in the sky.
- The stars appear to be moving counterclockwise around Polaris.

See the Activity Page Answer Key for correct answers and sample student responses.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the stars and constellations after their observations.

Tie to the Anchoring Phenomenon

In observing how the stars move across the sky, students understand that this is part of a repeated path, which is a pattern in nature that can be predicted. Lin is familiar with this idea, as he learned about the moon and the sun.

Know the Standard

TEACHER DEVELOPMENT

2. CCC 1 Patterns: Students observe that the Big Dipper changed position in the sky over the course of three nights and at three different times of night. Students will use this information to identify patterns and make predictions about where and how the Big Dipper will move in the future.

LESSON 4.3

How Do the Stars Move?

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How do stars seem to move in the night sky?

Today's Question: How do stars seem to move in the night sky?

Tie to the Anchoring Phenomenon: Lin noticed the sun and the moon changing positions in the sky. But what about the stars? Students will learn that stars are other objects in the sky that appear to move.

At a Glance

Learning Objective

✓ Summarize the apparent motion of stars across the night sky.

Instructional Activities

- teacher demonstration
- teacher Read Aloud
- class discussion

NGSS References

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students analyze the patterns of the apparent movement of stars in the night sky.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

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constellation **pattern** **predictable** **star**

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bright **north** **visible**

Instructional Resources

Student Book

Ch. 5

Student Book, Chapter 5
"How Does the Starry Sky Change?"

Materials and Equipment

- beach ball
- red construction paper (several sheets)
- yellow construction paper (several sheets)
- green construction paper (several sheets)
- scissors
- tape
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Draw stars on the sheets of construction paper. Make the stars different shapes and sizes. Then cut them out, and have them ready for the in-class demonstration.

The Core Lesson 4.3

1. Focus student attention on Today's Question.

NGSS Elements

CCC 1
DCI ESS1.A

How do stars seem to move in the night sky?

- **Start out by asking students how they arrived to school this morning.**
  - » We took a bus to school. We walked to school. We drove to school in a car.
- Explain that those are all different ways of getting to school. Tell students that when they ride in a car or on a bus and they look out the window, it looks as

if the trees, buildings, and other things outside are moving. (See **Know the Science 1**.)

- **Ask,** Are these things actually moving? If students answer "no," have them explain why it looks like the trees, buildings, and other things outside are moving. Students should be able to tell that they are the ones moving in the bus or the car but that the other things are standing still.
- Explain that this is why it looks like the stars are moving in the sky. Earth is the one moving, but the stars are still.

2. Guide a demonstration.

- Prepare for the demonstration by setting up an area in the classroom where students can stand around the beach ball. Tape the star cutouts on various walls of the classroom. Place the green stars together on one wall, the yellow stars together on another wall, and the red stars together on another wall. Tell students that the walls represent outer space and that the stars are the constellations that we see. (See **Know the Standards 1**.)
- Place the beach ball in the center of the classroom. Explain that the beach ball represents the sun.
- Invite students to stand around the beach ball. Tell students that each of them represents Earth. Depending on the size of your class, you may just want to have a few students come up to try the demonstration at one time. Then, switch so the rest of the students can do the demonstration, too.
- Tell students to look at any of the stars on any of the walls. Now ask students to turn their heads to the right.
- **Ask if the stars on the wall changed position.**
  - » No, the stars did not change position.

Know the Science

TEACHER DEVELOPMENT

1. Star Movement: The stars do not actually change position in the sky. Earth revolves around the sun and rotates on its axis, which allows us to see different stars and constellations at different times of the year and at different times of the night, so that it appears as though the stars are moving. Really, we are just looking at a different part of the sky due to the movement of Earth.

Know the Standards

TEACHER DEVELOPMENT

1. DCI ESS1.A The Universe and Its Stars: Students participate in a demonstration where they act out how, when their perspective changes, it appears as though the things around them are moving. This supports and enhances their understanding of how our view of the night sky works.

- Explain that the stars that students first looked at are no longer right there in front of them. Now, the stars are to the side. It was not the stars that moved; it was the students that moved when they turned their heads. This gives students a new perspective.
- Make a connection to Earth and the stars in the sky. Explain that when Earth moves, it looks like the stars are moving, but really we just see a different part of the sky.
- Continue the demonstration. Tell students to all face the same wall. Now tell students to slowly spin in a circle, keeping their head in line with the rest of their body. Say "stop" when everyone is facing a new wall in the classroom. Ask students to look at the new wall in front of them.
- **Ask students which stars they are looking at now.**
  - » We are looking at the green (or red or yellow) stars.
- **Ask students if they can still see the other stars from where they are standing.**
  - » Yes, we can see them if we look to the side.
- Clarify that the stars did not move. They did not change position. And they did not disappear. The stars are all still there. But the students were the ones that moved, and this means that it looks like the stars moved, too.

Online Resources

- Show a video to further demonstrate that the stars are not moving.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

Differentiation

SUPPORT—Some students may have a difficult time understanding the concepts and comparisons being highlighted in this demonstration and would have a better experience if they have visuals to look at. Put together a series of visuals of the night sky, from the same perspective with the same horizon, for several nights in a row. And have these students tell how the sky changes.

CHALLENGE—Challenge students to make paper models that demonstrate this same concept. Give them black, blue, and yellow construction paper; glue; scissors; and white chalk. Explain that students will draw constellations on the black construction paper with the chalk. They will glue a yellow circle in the middle of the piece of paper, which represents the sun. Then they will glue a blue circle onto the paper, close to the sun, to represent Earth. Tell students to come up with a way—using this model—to demonstrate how our perspective of the sky changes.

EXTEND—Have students investigate a constellation other than the Big Dipper that can be seen during this time of year and track its position in the sky using visuals. Then prompt students to compare what they notice to the investigation with the Big Dipper. Did the constellations seem to move in the same direction? Did they seem to move at the same speed?

3. Read together: "How Does the Starry Sky Change?"

Student Book

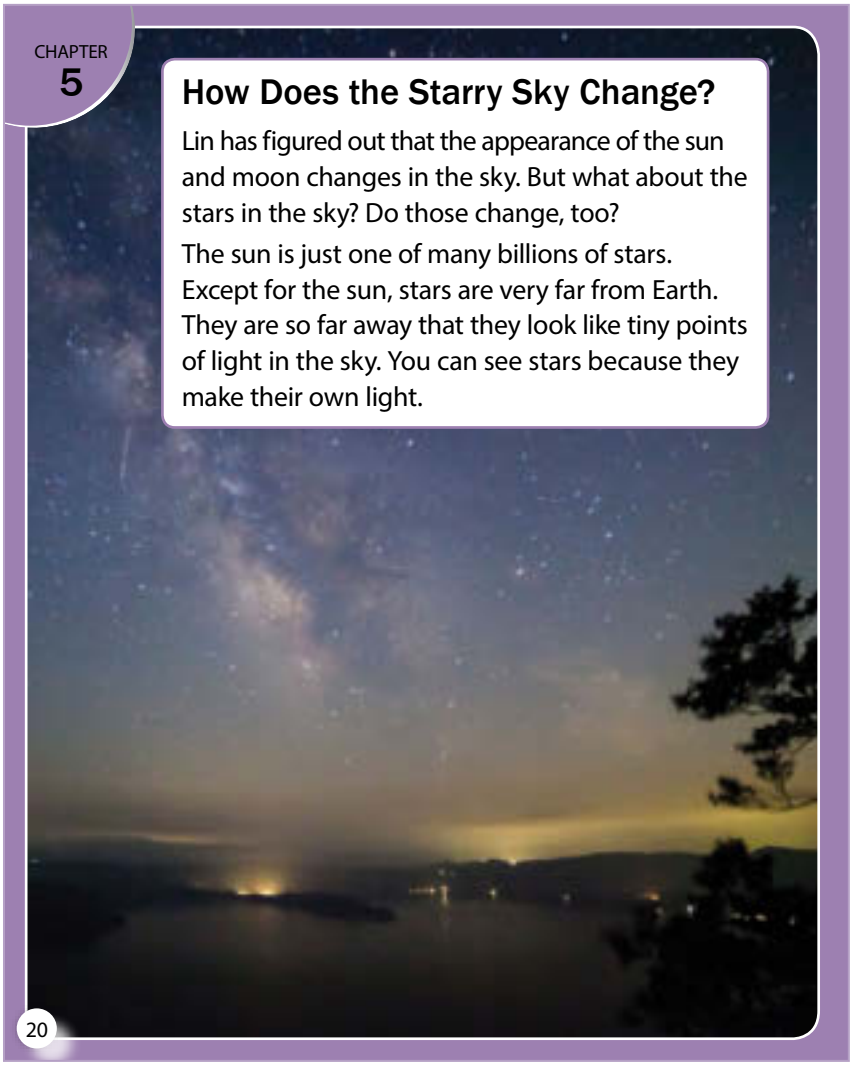
Ch. 5

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 20

Ask students to turn to page 20 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is "How Does the Starry Sky Change?" and tell them to pay special attention to the pictures of the stars and what kinds of pictures they make in the sky as you read.



CHAPTER 5

How Does the Starry Sky Change?

Lin has figured out that the appearance of the sun and moon changes in the sky. But what about the stars in the sky? Do those change, too?

The sun is just one of many billions of stars. Except for the sun, stars are very far from Earth. They are so far away that they look like tiny points of light in the sky. You can see stars because they make their own light.

20

Ask students to look at the picture on page 20. Explain that the picture is showing the sky at nighttime. The tiny dots of light in the sky are stars.

CORE VOCABULARY—Explain that **stars** are objects that are very far away and make their own light. We can only see the stars from that far away because of the light they give off.

LITERAL—How many stars are in the sky?

» There are many billions of stars in the sky.

LITERAL—Are stars close to Earth or far away from Earth?

» Stars are far away from Earth.

SUPPORT—Students may need assistance when it comes to understanding large quantities, such as billions. Find ways to teach large quantities to students so they understand just how many stars are out there. For instance, you can explain that there are about 31 million seconds in one year. Or talk about how long it would take to count to one million, if someone counts one number per second. Show students the math for this on the board. If there are 24 hours a day and 60 minutes per hour and 60 seconds per minute, it would take about 12 days to count to one million. After students understand the magnitude of a million, explain that a billion is even greater than that—1,000 times bigger, to be exact!

Page 21

Ask students to look at the picture on page 21. Explain that stars are always in the sky. They do not go away. But we can only see them at night because the daytime light is so bright from the sun. (See **Know the Standards 2**.)

Stars are in the sky all the time. But we can only see them at night. During the day, the sun's bright light blocks out light from other stars. When the sun sets, the stars show up against the dark sky once again.

Some stars appear to be larger and brighter than others. Still, it is hard to tell them apart.

21

LITERAL—When can you see a lot of stars?

» You can see the stars at nighttime.

LITERAL—Can you see a lot of stars in the daytime?

» No, you cannot see them in the daytime.

LITERAL—Do the stars disappear from the sky during the day?

» No, the stars are always in the sky, and they do not go away.

Know the Standards

TEACHER DEVELOPMENT

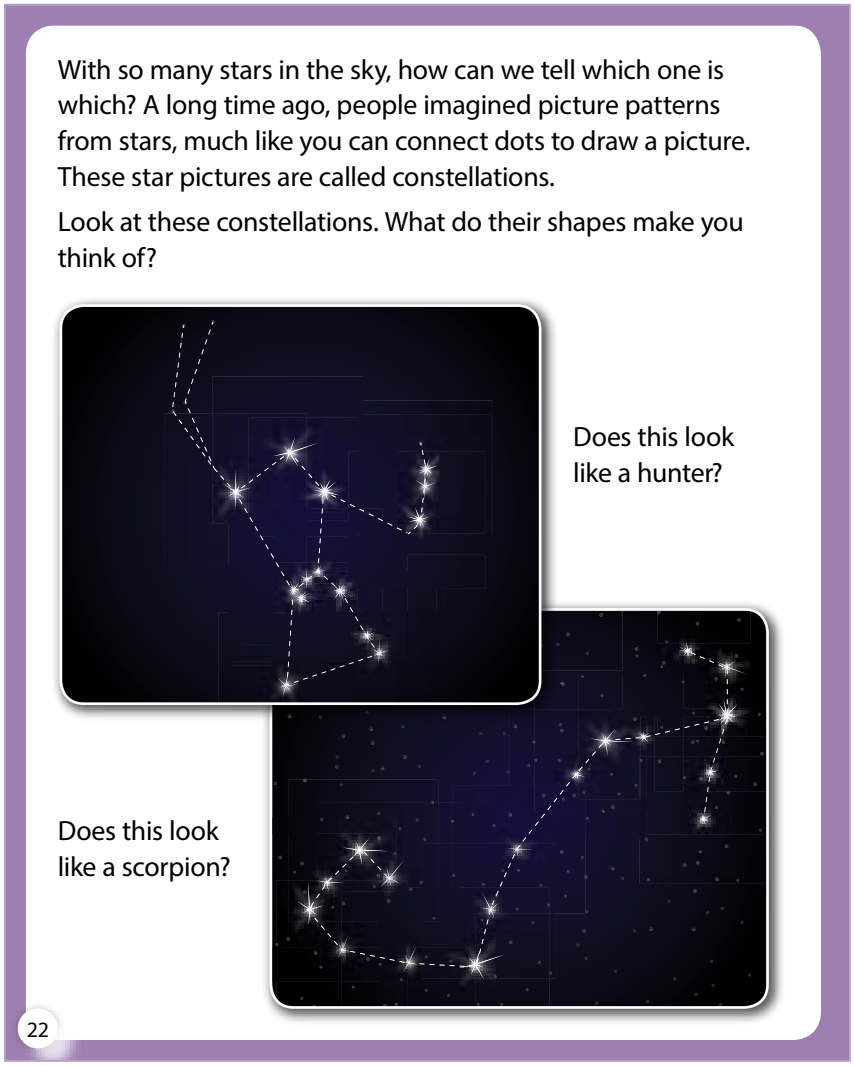
2. DCI ESS1.A The Universe and Its Stars: Students observe pictures of the stars in the sky during the nighttime to get a sense for how many there are and how small they look from Earth.

INFERENTIAL—Why do you think it is hard to tell the stars apart?

» It is hard to tell the stars apart because there are so many of them and they are so far away.

Page 22

Ask students to look at the two pictures on page 22. Explain that there are imaginary lines drawn between the stars to make pictures. These pictures are what people use to find the same stars in the sky. Remind students that they drew pictures or shapes with dots that they connected in a previous lesson segment. (See **Know the Standards 3** and **4**.)


With so many stars in the sky, how can we tell which one is which? A long time ago, people imagined picture patterns from stars, much like you can connect dots to draw a picture. These star pictures are called constellations.

Look at these constellations. What do their shapes make you think of?

Does this look like a hunter?

Does this look like a scorpion?

22

Know the Standards

TEACHER DEVELOPMENT

3. DCI ESS1.A The Universe and Its Stars: Students use media to observe pictures of the stars in the sky to see how constellations can be made up of many or just a few stars.

4. SEP 4 Analyzing and Interpreting Data: Students use what they learned from their visual observations to tell that the stars appear to change position in the sky. They also call on their observations to discuss the apparent movement of constellations across the sky.

CORE VOCABULARY—Explain that **constellations** are the groups of stars that make star pictures.

LITERAL—When did people start making star pictures?

» People started making star pictures a long time ago.

INFERENTIAL—Do you think all of the stars in the sky belong to a constellation? Why or why not?

» There are too many stars in the sky for them to all be part of a constellation.

INFERENTIAL—What do the star images on the page look like?

» Accept students' impressions. The people who identified these constellations thought the top image looked like a person holding a bow and arrow and the bottom image looked like a scorpion.

Page 23

Ask students to look at the picture on page 23. Explain that some constellations are small and are part of larger constellations. (See **Know the Science 2**.)

Constellations can contain just a few stars or many stars. The Big Dipper is one of the easier groups of stars to spot in the night sky. The Big Dipper contains seven stars. It is shaped like a ladle. A ladle is a type of deep spoon. The Big Dipper is visible in the northern night sky.

Remember what Lin noticed about objects in the sky. He noticed the way the positions of the sun and the moon change. Do you think that the positions of stars change, too? How could you find out?

23

LITERAL—How many stars are in the Big Dipper?

» There are seven stars in the Big Dipper.

LITERAL—What is the shape of the Big Dipper?

» The Big Dipper is shaped like a spoon.

Know the Science

TEACHER DEVELOPMENT

2. The Big Dipper: The Big Dipper is circumpolar. It is a constellation in a larger constellation called Ursa Major. This is an object in the sky that is visible throughout the entire year, when seen from specific northern latitudes. This is because the Big Dipper is close to one of Earth's celestial poles. Earth has a northern celestial pole and a southern celestial pole. Since Earth rotates around its axis every twenty-four hours, it looks like the stars and constellations—like the Big Dipper—that are close to the celestial poles circle around the pole each day.

4. Check for understanding.

Monitor Progress

Students should progress throughout this lesson to understand what stars are, how stars form constellations, and how those constellations appear to move in the sky because of the position of Earth in its rotation and revolution around the sun.

Review student responses to the demonstration and reading questions to determine their understanding of the following concepts:

- The stars do not actually move in the sky.
- The stars appear to move in the sky only because Earth moves.
- The stars appear to move in a counterclockwise direction.

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the stars after their observations.

Tie to the Anchoring Phenomenon

In observing how the stars appear to change their position in the sky because of the rotation and revolution of Earth, students understand that different constellations can be seen at different times of the year. This is a pattern in nature that can be predicted. Lin can know that when he sees the stars at night, he may be looking at a different constellation depending on the season.

LESSON 4.4

Lesson 4 Roundup: Patterns of the Stars

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Lesson Guiding Question: How do stars seem to move in the night sky?

Today's Question: How do stars seem to move in the night sky?

Tie to the Anchoring Phenomenon: Lin understands that the moon and sun appear to move through the sky and can be found in different positions. But what about the stars? Students have learned that the stars and constellations appear to move across the sky as well, due to how Earth rotates and revolves around the sun. Now, students describe the patterns they notice and make predictions.

At a Glance

Learning Objectives

✓ Conclude the direction of a constellation's apparent motion in the sky throughout a night.

✓ Use data to predict the position of a constellation at a future time.

Instructional Activities

- making predictions
- class discussion
- drawing

NGSS References

Performance Expectation: 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Disciplinary Core Idea: ESS1.A The Universe and Its Stars

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 1 Patterns

Students interpret data as they explore the patterns of apparent movement of the stars in the night sky.

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constellation **data** **pattern** **predict**
star

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graph **identify** **investigate** **notice**
observe

Instructional Resources

Activity Page

AP 4.4.1

Activity Page
What Will the Sky Look Like?
(AP 4.4.1)

Materials and Equipment

- question board
- internet access and the means to project images/video for whole-class viewing

The Core Lesson 4.4

1. Focus student attention on Today's Question.

How do stars seem to move in the night sky?

- Remind students that they did an investigation where they compared the stars in the sky for three nights.
- Tell students that today they are going to look for patterns in data and make predictions about how the stars will move in the sky.

2. Facilitate the activity.

Activity Page

AP 4.4.1

- Distribute What Will the Sky Look Like? (AP 4.4.1), and review it together as a class. Explain that the first three panels show the stars in the sky—the Big Dipper—at three different times on the same night: 7 p.m., 9 p.m., and 11 p.m. The fourth panel is blank, and this is where the students will draw what they think the sky will look like two hours later. (See **Know the Science** on the following page.)

NGSS Elements

CCC 1
SEP 4
DCI ESS1.A

- Have students form small groups of three or four. Explain that students can work together to figure out how to draw the fourth panel on Activity Page 4.4.1. You will use questions to guide students along the way and then give them time to make their drawings.
- **Ask students what they notice about the Big Dipper on the second and third pictures compared to the first picture.** Is the Big Dipper in the same spot? Students should be able to tell that the Big Dipper appears to have moved and that it looks like it is moving all the way around Polaris in a counterclockwise motion.
- Prompt students to identify Polaris in all three pictures.
- Cue students to use Polaris as a guide or point of reference for the direction that the Big Dipper is moving to tell where the Big Dipper will be in two hours.
- Circulate around the room, and review student drawings in the fourth panel on Activity Page 4.4.1. Check to ensure that students are drawing the Big Dippers in a pattern that moves in a counterclockwise direction from where the first three pictures show the Big Dipper. Provide support to individuals and groups as needed. (See **Know the Standards 1**.)
- Prompt students to pay attention to how much the Big Dipper is moving in two hours, based on its positions in panels 1, 2, and 3. **Ask students if it is moving a lot or just a little.** Tell students to be as precise as they can be with their drawings.

Know the Science

TEACHER DEVELOPMENT

The Big Dipper and Polaris: The Big Dipper circles around Polaris in a counterclockwise pattern. Polaris acts like the center of a giant twenty-four-hour celestial clock, and the two pointer stars of the Big Dipper (Merak and Dubhe) act like the hour hand of the clock. On a regular clockface, each hour takes up thirty degrees of a full circle. However, the hour hand on this celestial clock in the sky moves fifteen degrees each hour. This means that for every two hours—which is the amount of time that the students are studying in this activity—the Big Dipper will move thirty degrees counterclockwise.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 4 Analyzing and Interpreting Data: Students use three pictures to study the movement of the Big Dipper over the course of a night to predict where it will be in the sky in two hours from where it left off. Students should understand that the Big Dipper is moving counterclockwise, but they do not need to measure the number of degrees that the Big Dipper is moving at the two-hour intervals.

3. Summarize and discuss.

NGSS Elements

SEP 4

- Bring the class back together, and summarize the position of the Big Dipper they drew in the fourth panel.
- **Ask students how they were able to tell what the sky would look like in the future.**
  - » We could tell that the Big Dipper was moving in a counterclockwise direction, so we knew where it would be in two hours.
- Encourage students to talk about and describe how they used the data to make the predictions.
- Summarize the activity by emphasizing that students used patterns to make a prediction. (See **Know the Standards 2**.)

4. Check for understanding.

Activity Page

AP 4.4.1

- Listen for student responses and comments during the prediction activity to ensure that they are on track to understanding that patterns repeat themselves and that they can use existing data to tell information about the future.
- Review students' drawings on Activity Page 4.4.1 and their responses in the discussion to ensure understanding of the following concept:
  - Patterns can be used to make predictions about what the stars in the sky will look like.

Monitor Progress

Call attention to the question board. Review any questions that have been answered. Add new questions that students have about the stars after their observations.

Tie to the Anchoring Phenomenon

Lin knows that the moon and the sun can be seen from different places in the sky. Students now understand how the stars also seem to change position in the sky at night.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 1 Patterns: Students talk about how patterns in data helped them make predictions.

UNIT CAPSTONE

Sun, Moon, and Stars

Big Question: How do the sun, the moon, and stars appear to change position in the sky?

Tie to the Anchoring Phenomenon: Students use what they learned throughout the unit about the sun, the moon, and stars to complete an activity that reinforces understanding of how objects in the sky appear to move in repeated patterns.

At a Glance

Learning Objective

✓ Write about the sun, the moon, and stars.

Instructional Activities (2 days)

- teacher Read Aloud
- class discussion

NGSS References

Performance Expectations: 1-ESS1-1; 1-ESS1-2

Disciplinary Core Ideas: ESS1.A The Universe and Its Stars; ESS1.B Earth and the Solar System

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Students summarize the investigations and data in their exploration of the patterns in the apparent movement of the sun, moon, and stars.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

moon **star** **sun**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

pattern **phase** **position**

Instructional Resources

Student Book

Ch. 1
Ch. 2
Ch. 3
Ch. 4
Ch. 5

Student Book, Chapter 1
"The Mysterious Movement of the Moon"

Student Book, Chapter 2
"What Causes Night and Day?"

Student Book, Chapter 3
"Longer and Shorter Times of Daylight"

Student Book, Chapter 4
"Why Does the Moon Seem to Move?"

Student Book, Chapter 5
"How Does the Starry Sky Change?"

Materials and Equipment

- flip chart poster paper
- markers
- question board

Advance Preparation

- Prepare the poster paper as a flip chart, with sentence frames on each page. Use the following sentence frames as a guide.

  Page 1:

  The sun appears to move in a _____ across the sky every day.

  The sun rises in the _____ every morning.

  The sun sets in the _____ every evening.

  This pattern repeats every _____.

  Page 2:

  The amount of daylight changes with the _____ .

  Daylight _____ in the fall.

Daylight is shortest in the _____.

Daylight _____ in the spring.

Daylight is longest in the _____.

This pattern repeats every _____.

Page 3:

The moon appears to move in a pattern across the sky every

_____.

The moon rises in the _____ and sets in the _____.

Page 4:

The apparent shape of the moon changes in _____.

It takes about one _____ for the moon phases to go through a whole cycle.

The pattern repeats about every _____.

Page 5:

Stars are grouped into _____ to make them easier to recognize and identify.

Groups of stars—like the Big Dipper—appear to move across the sky during the

period of one _____.

The apparent motion of stars occurs from _____ to

_____, in a pattern like that of the sun and the moon.

Day 1: 1. Focus student attention on the Big Question.

NGSS Elements

CCC 1

DCI ESS1.A

How do the sun, the moon, and stars appear to change position in the sky?

- During this unit, students took a break to work on their long investigations of the sunrise and sunset times. Students will need to be reminded of all the things they learned in the first part of the school year, including about the sun, the moon, and stars.
- Remind students that they read about Lin and how he wondered about daylight and nighttime and when he could see the sun, the moon, and stars.

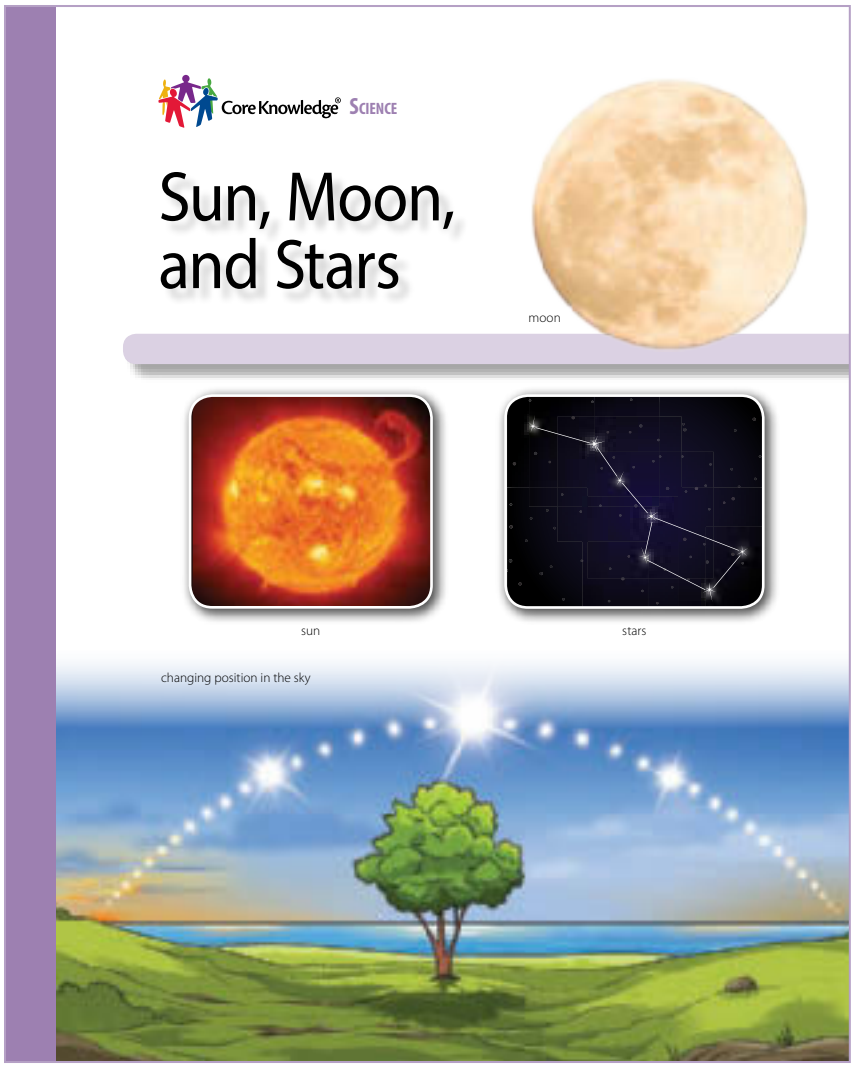
- Let students know that today they will be working together as a class to complete sentence frames based on what they learned. But first they will reread the Student Book for this unit.

2. Read together: Sun, Moon, and Stars

Student Book

Ch. 1
Ch. 2
Ch. 3
Ch. 4
Ch. 5

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.



NGSS Elements

SEP 4
CCC 1
DCI ESS1.A

- Reread the Student Book together for Chapters 1–5. As you read, remind students of the investigations they did throughout the unit that reinforce what they are learning about in the chapters. Students should feel familiar with the content, having read it already and participated in the short- and long-term investigations.
- Allow a few minutes for students to ask questions about the content in the chapters or to talk about observations they made throughout the school year related to the sun, moon, and stars.

Day 2: 1. Preview the activity.

- Show students the poster pages on the flip chart that you prepared before class. Explain how the poster pages will work. Each page has a different group of sentence frames.
- The sentence frames are grouped together according to the sun, the moon, and stars. Page 1 is about the sun. Page 2 is about daylight. Pages 3 and 4 are about the moon. And page 5 is about stars.
- Students will work as a class to use what they learned throughout the unit to complete the sentences by filling in the missing words. (See **Know the Standards 1**.)

2. Facilitate the activity.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.A
Differentiation

- Start with page 1. Read the first sentence out loud, saying the word *blank* where the blank is in each sentence. (See **Know the Standards 2**.)
- Guide students to fill in the missing word. **Ask students what word makes sense to put in the blank.** Give students clues that will help point them in the direction of what the sentence is trying to say.
- As students suggest words to put in the sentence, say the sentence out loud with the suggested word, and ask the class if it makes sense to use. If everyone agrees, add the word to the sentence in the blank space. If the suggested words do not make sense, suggest the correct word to the class, and allow students to weigh in.
- Continue this process for all of the sentences on all five pages.

  SUPPORT—Alternatively, provide a word box, or give two or three word choices for each sentence frame.

  CHALLENGE—Alter the activity so that students complete the sentences independently or in small groups. You can write the sentence frames onto worksheets that you pass out to individual students, or you can assign groups to work on the sentence frames for different pages. Then, students can present their sentence frame pages to the rest of the class.

Know the Standards

TEACHER DEVELOPMENT

1. Language Arts Connection: This activity serves as a summary of what students learned throughout the school year. This unit has been broken up over the course of several months, and it is important to remind students of everything they learned to tie the concepts all together. Using sentence frames gives students an opportunity to showcase what they learned about the sun, the moon, and stars; their patterns; how they appear to move across the sky; and where they rise and set.

2. CCC 1 Patterns: Students use what they learned about how the sun, the moon, and stars appear to move across the sky to identify that these are patterns in nature that can be predicted and expected, over and over again, on daily, monthly, or yearly bases.

EXTEND—Have students make a visual display that shows how the sun, the moon, and stars appear to move in the sky. This can be a poster, a diorama, a collage, or a demonstration using volunteers.

3. Check for understanding.

NGSS Elements

SEP 4
CCC 1
DCI ESS1.A
Monitor Progress

Gauge students' understanding of concepts covered throughout the unit based on their ability to comprehend the sentence frames and complete the missing words on the poster pages. Students should be able to demonstrate knowledge of what they learned by applying the primary concepts to a story.

Listen for student responses for the sentence frames to ensure students understand the following concepts:

- The sun, the moon, and stars appear to move across the sky in repeated patterns.
- The sun, the moon, and stars appear to rise in the east and set in the west.
- The shape of the moon appears to change because of its phases.

Review the answered and unanswered questions on the question board. Discuss how the class can find answers to the remaining unanswered questions.

Tie to the Anchoring Phenomenon

The sentence frames that summarize what students learned throughout the year coincide with the anchoring phenomenon. Lin's observations of the sky are investigated and studied in this unit through a series of activities, demonstrations, investigations, and reading opportunities.

UNIT SUPPLEMENT

Science in Action: Meeting an Astronomer

Tie to the Anchoring Phenomenon: Students join Lin as he learns about astronomers and the types of things they do and study.

At a Glance

Learning Objectives

- ✓ Listen to reading about what an astronomer does.
- ✓ Draw a constellation to make a star map.

Instructional Activities (2 Days)

- teacher Read Aloud
- student activity

NGSS References

Understandings About the Nature of Science: Scientific Investigations Use a Variety of Methods; Scientific Knowledge Assumes an Order and Consistency in Natural Systems; Science Is a Human Endeavor; Scientific Knowledge Is Based on Empirical Evidence

Crosscutting Concept: 1 Patterns

Connection to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology

Students listen to reading about the work astronomers do and examples of early astronomers. Students then make star maps of their own constellations.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Language of Instruction

The Language of Instruction consists of terms that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves.

astronomer **constellation** **design** **map**

pattern **planetarium** **prediction** **star**

telescope

Instructional Resources

Student Book

Ch. 6

Student Book, Chapter 6
"Science in Action: Meeting an Astronomer"

Materials and Equipment

- glow-in-the-dark markers or fabric paint (2 per group)
- black construction paper (1 sheet per group)
- tape

Advance Preparation

Clear an area on the classroom wall where students can hang their sheets of construction paper with tape to make one large projection of the sky.

1. Day 1: Introduce the topic.

Remind students that they read about Lin, who noticed the sun, moon, and stars at different times of the day and night. Explain that today students will read more about what Lin learns about objects in the sky.

2. Read together: "Science in Action: Meeting an Astronomer"

Student Book

Ch. 6

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 24

Ask students to turn to page 24 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is "Science in Action: Meeting an Astronomer," and tell them to pay special attention to the different things you can see in the sky as you read.

CHAPTER 6

Science in Action

Meeting an Astronomer

Lin has learned a lot about the objects in the sky since he started noticing them through his kitchen window. He knows where the sun rises and sets. Sometimes, Lin sees a full moon. Sometimes, he sees a skinny crescent moon. At other times, he cannot see the moon at all. Lin has made enough observations that he knows the pattern. He can predict how the moon's shape will appear from one week to the next.

24

NGSS Elements

CCC 1

Ask students to look at the picture on page 24. Explain that the picture shows Lin walking his dog under the moon. Emphasize that people can see the sun, the moon, stars, and other objects in the sky from anywhere in the world.

LITERAL—What kinds of objects can you see in the sky?

» the sun, the moon, and stars

Remind students that a pattern is something that repeats itself the same way each time. (See **Know the Standards 1**.)

Explain that a prediction is like telling what will happen in the future. It is more than just guessing, because it involves knowing information, like facts and data.

Page 25

NGSS Elements

Scientific Investigations Use a Variety of Methods

Ask students to look at the picture on page 25. Explain that this is a picture of a planetarium.

Now Lin is excited to be on a class field trip. The students are visiting a planetarium. The planetarium is a dark theater. Stars are projected on the curved ceiling. It makes the dome look like the night sky.

The planetarium operator is named Danielle. "The planetarium can show what the night sky will look like here tonight," Danielle says. "It can also show what the night sky would look like on any other night and from any other place on Earth!"

25

Know the Standards

TEACHER DEVELOPMENT

1. CCC 1 Patterns: Students studied a lot about patterns in this unit. Take a moment to remind them of some of the patterns they observed and studied, including where the sun rises and sets, how the moon moves across the sky, what the moon looks like at different times of the month, and how the stars/constellations move across the sky.

Explain that a planetarium is like a dark theater. It has a ceiling shaped like a dome, and stars are projected on it. The ceiling turns into an image of the sky. (See **Know the Standards 2**.)

INFERENTIAL—What do you think you can learn from being at a planetarium?

» You can learn where things are in the sky. You can learn about what the sky looks like.

Page 26

Ask students to look at the picture on page 26. Explain that the picture shows stars being projected in a planetarium. Emphasize the fact that planetariums show stars in the sky exactly as they really are and that this is not a movie or anything that people make up.

Danielle explains that scientists who study stars and other objects in space are called astronomers. "Astronomers have been observing the night sky for thousands of years," she tells the class.

"Long ago, people looked at the stars. They noticed that they saw different groups of stars during different seasons. They recorded what they saw and discovered patterns. Now scientists know they can use those patterns to predict which stars they will see on any night. In a planetarium, we can display what that looks like."

26

Know the Standards

TEACHER DEVELOPMENT

2. Scientific Investigations Use a Variety of Methods: Space and the objects in the sky can be studied and observed in different ways. Some people, like astronauts, go into space to study it directly. Other people study space by using tools, like telescopes, that help them see things from far away. A planetarium is another place where people can study space.

NGSS Elements

Science Is a Human Endeavor

Explain that an astronomer is a person who studies stars and other objects in the sky.

LITERAL—When did people start studying the stars? (See **Know the Standards 3**.)

» thousands of years ago

LITERAL—What did people notice about stars when they looked at them a long time ago?

» They noticed groups of stars during different seasons. They noticed patterns.

LITERAL—What are the different groups of stars called?

» constellations

Know the Standards

TEACHER DEVELOPMENT

3. Science Is a Human Endeavor: People began noticing and studying the stars and other objects in the sky thousands of years ago. Back then, many societies used groups of stars as part of their stories. People eventually realized that they could use the stars to navigate their way around the world. Today, we are still learning new things about stars and other objects in the sky.

Page 27

Ask students to look at the picture on page 27. Explain that the picture shows a star chart, or planisphere.

Astronomers a long time ago recorded what the stars looked like in the sky. They made maps of the stars. A planetarium combines information of many star maps, from many places. Danielle tells the students about some of the first makers of star maps. She also tells the students that some of the lights in the night sky are not stars at all. They are other planets!

27

NGSS Elements

Interdependence of Science, Engineering, and Technology

Explain that a map is like a picture that represents where things are. People use maps all the time. **Ask students if they have ever used a map to find out where they were going.** A star map is a certain kind of map. It represents where stars are positioned in the sky. (See **Know the Standards 4**.)

LITERAL—What can the projection from a planetarium show?

» It can show what the sky looked like in the past or will look like in the future. It can show the sky from any place on Earth, at any time.

Know the Standards

TEACHER DEVELOPMENT

4. Interdependence of Science, Engineering, and Technology: A map is a type of tool that scientists can use to study things on land, in the sea, and in the sky. Star maps focus only on the stars in the sky and can be drawn to record how the sky looks from different places on Earth.

LITERAL—What are the lights that twinkle in the sky?

» Some are stars, and others are planets.

INFERENTIAL—Why do you think people made maps of the stars?

» to find their way around on Earth; to help them with directions

Page 28

Ask students to look at the picture on page 28. Explain that the picture shows a Chinese star map from a long, long time ago.

Shi Shen, Gan De, and Wu Xian

Danielle tells the class about Shi Shen, Gan De, and Wu Xian. They were Chinese astronomers. They lived more than two thousand years ago. They mapped the positions of stars. Their star chart used lines to connect groups of stars together into constellations. Those constellations are different from the ones Lin is used to. They imagined different pictures made from stars in the night sky.

28

LITERAL—When did the Chinese astronomers Shi Shen, Gan De, and Wu Xian live?

» more than 2,000 years ago

LITERAL—What did these astronomers do?

» They mapped the positions of stars.

SUPPORT—Have students take a few minutes to study the picture of the star chart on the page. Before reading on, **ask students to share how they think the star chart worked.** Invite them to tell what they think the shapes and lines represent in the sky.

LITERAL—How did this star chart work?

» It used lines to connect groups of stars together into constellations.

INFERENTIAL—Since this star chart was made over two thousand years ago, do you think it still applies to the sky today?

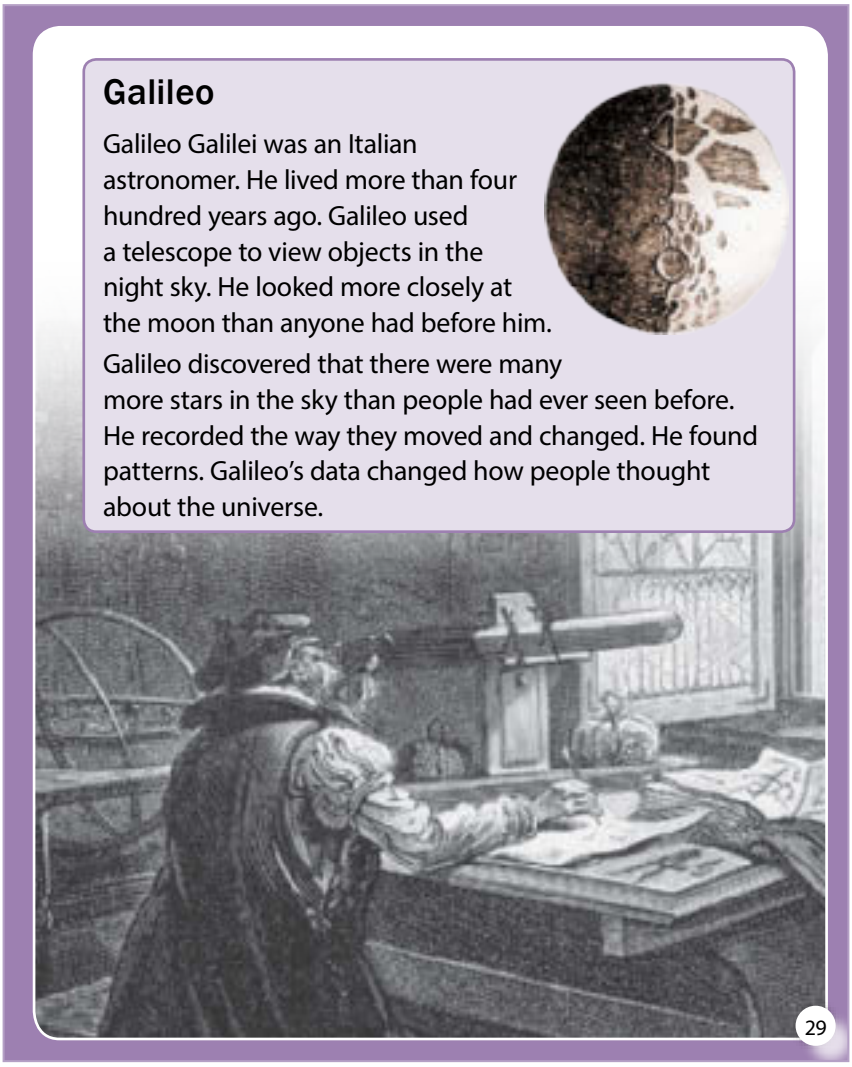
» Accept all answers, and encourage students to think about why or why not.

Page 29

NGSS Elements

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Ask students to look at the two pictures on page 29. Explain that the large picture shows Galileo and his telescope. The small picture shows Galileo's moon drawing.



Galileo

Galileo Galilei was an Italian astronomer. He lived more than four hundred years ago. Galileo used a telescope to view objects in the night sky. He looked more closely at the moon than anyone had before him.

Galileo discovered that there were many more stars in the sky than people had ever seen before. He recorded the way they moved and changed. He found patterns. Galileo's data changed how people thought about the universe.

29

LITERAL—Who was Galileo Galilei? When did he live?

» He was an Italian astronomer who lived more than 400 years ago.

LITERAL—What did Galileo use to study the sky?

» He used a telescope.

Explain that a telescope is a tool that people use to see objects far away. A telescope makes faraway objects look closer so that people can see them better and study them. (See **Know the Standards 5**.)

INFERENTIAL—How do you think Galileo's discoveries influenced what we know about stars today?

» He discovered that there are more stars in the sky. This helped us know more about space and what is out there.

SUPPORT—Draw student attention to the picture on the page, of the moon drawing. Explain that this is a moon drawing that Galileo drew based on what he discovered about the moon. **Ask students to look at the drawing. Then have them tell you what they notice about the moon.**

» Half of the moon is lit, and half of it is not. There are shadings on the moon that look like they could be craters or mountains.

Know the Standards

TEACHER DEVELOPMENT

5. Scientific Knowledge Assumes an Order and Consistency in Natural Systems: The sky today looks similar to the sky that people observed hundreds or thousands of years ago. Certain phenomena such as the rising and setting of the sun, the movement of the moon, and the presence of the constellations are repeated and can be predicted.

1. Day 2: Facilitate the activity.

NGSS Elements

Scientific Knowledge Is Based on Empirical Evidence

- Remind students that they previously heard about how scientists called astronomers study the stars in the sky. Tell students that today they will work on an activity where they get to act like a scientist! (See **Know the Standards 6**.)
- Have students form small groups. Explain that each group will pretend to be a team of astronomers who have described a new constellation of stars in the sky!
- Distribute the materials to each group. Tell students that they will use the markers to draw a star map that shows what the new constellation looks like on the black construction paper. Then, all of the groups will post their star maps on the wall to make one giant new view of the night sky.
- Explain that groups will need to decide how many stars are part of their new constellation and what the shape of the constellation is. Prompt students to also come up with a name for their constellation.
- Circulate around the room as students work on their drawings and star maps. Remind students to draw lines between the stars, connecting them together to make the outline of the shape/design.
- When the drawings are complete, invite groups to tape their star maps on the wall, in any order.

NGSS Elements

Differentiation

- When all the star maps are posted, turn the lights off in the classroom—surprise! The markers are glow in the dark, and now students can pretend they are in a planetarium. Go around the room, and have the groups talk about their constellations.

  SUPPORT—Some students may find it difficult to come up with their own constellations and star maps. Instead, offer these students worksheets where they connect the dots to make predrawn constellations.

  CHALLENGE—Challenge students to come up with a pattern for how their new constellation moves through the sky.

  EXTEND—Have students put together a time line of when the various constellations in the sky were named.

2. Check for understanding.

Review the constellations that students drew. Ensure students understand the concept of how a star map works and what it shows, but do not score students on their artistic ability.

Know the Standards

TEACHER DEVELOPMENT

6. Scientific Knowledge Is Based on Empirical Evidence: Astronomers look for patterns and order when making observations of the sky. This information can be used to help them predict natural events or understand the way things work in nature.

UNIT 1

Teacher Resources

Activity Pages

Name _____ Date _____

Activity Page UO.1 Use with Unit Opener

Day or Night?

Write the word *day* or *night* under the picture. Color the sky to show how night and day are different.

_____

Name _____ Date _____

Activity Page 1.1.1 Use with Lesson 1.1

The Sun

Write the words *day* or *night* to complete the sentences.

We see the sun's light during the _____.

We do not see the sun's light during the _____.

Draw and color a picture of the sun during the daytime.

Name _____ Date _____

Activity Page 1.2.1 Use with Lesson 1.2

Where Is the Sun?

Draw the location of the sun in the boxes.

Day 1

Day 2

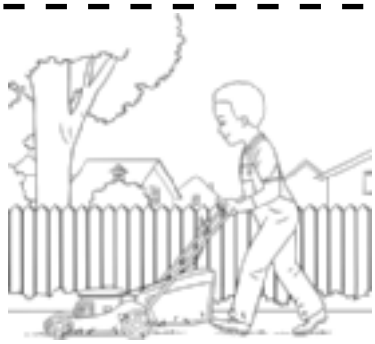
Day 3

Name _____ Date _____

Activity Page 1.3.1 Use with Lesson 1.3

Day and Night Activities

Cut out the pictures along the dotted lines. Sort them into two piles.



Name _____ Date _____

Activity Page 1.4.1 Use with Lesson 1.4

What Is the Pattern?

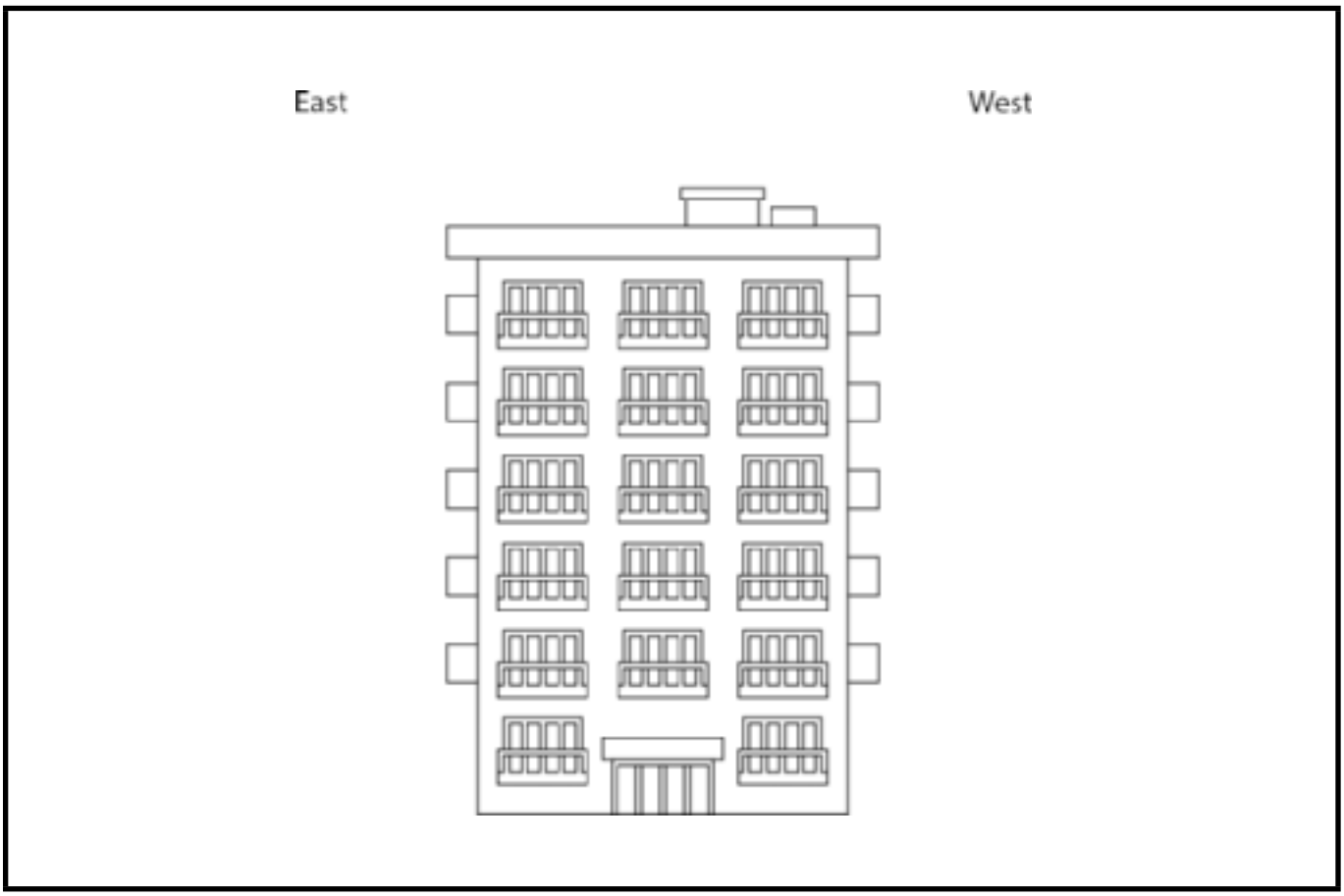
Circle the correct word to complete the sentence.

The sun will be on the **[east west]** side of the sky in the morning.

The sun will be on the **[east west]** side of the sky in the afternoon.

Draw a prediction.

Draw where the sun will be tomorrow morning when you wake up.



Name _____ Date _____

Activity Page 2.1.1 Use with Lesson 2.1

Sunrise, Sunset Sheet

Write the times for the sunrise and sunset.

Day of the Week	Date (Example: September 6, 2020)	Sunrise Time (morning)	Sunset Time (evening)
Sunday			

Name _____ Date _____

Activity Page 2.1.2 Use with Lesson 2.1

Take-Home Letter

Dear Family Members,

Your child has been learning about the sun and how it rises and sets at different times of the day.

For this take-home assignment, your child—and our whole class—will study the sunrise and sunset times for the entire school year. In doing so, the class will be performing an investigation to answer the question: how does the amount of daylight hours change among the seasons?

Your child will be assigned to record the sunrise and sunset times for one week (or maybe two) of the year. Your child is being sent home with an Activity Page that has a table where they can write down the sunrise and sunset times on their designated days. Then your child will report their findings to the class on the following Monday.

You can help your child participate in this investigation by taking the following steps:

1. Glance ahead at the sunrise and sunset times for the week that your child is assigned to observe them so you can prepare your child and make sure they are ready right before those times. You can find them printed in the newspaper or online in resources such as www.timeanddate.com. Sunrise occurs when the sun's disk first touches the horizon, and sunset occurs when the last bit of sun vanishes from the horizon. On cloudy days, this can be hard to determine, so published times for your area can be used instead.
2. Make sure your child has a watch or clock nearby to look at to record the time that the sun rises and sets.
3. Contact me immediately if your child has any conflicts with the week that has been assigned to record the sunrise and sunset times.
4. Make sure your child completes the table on Activity Page 2.1.1. Help emphasize the importance of being accurate and precise. Discourage your child from rounding the times up or down. Only the hour and minutes are to be recorded. Recording the seconds is not necessary.
5. Remind your child that they will need to present the times to the class on the Monday after the assigned weekend. Review the times with your child, and practice talking about the times so your child feels comfortable with the information.

The goal of the *Sun, Moon, and Stars* unit is for students to make their own observations, record data, and discern patterns. If you cannot make the observations directly, you can help your child check online for the sunrise or sunset times on the assigned dates.

TEACHER NOTE: If assigning students to make observations at home and return with data will not work for your class, you can complete the lesson using a hypothetical data set such as this.

The following substitute sunrise and sunset data is for Cincinnati, Ohio, from Sunday, August 2, 2020, through Sunday, July 25, 2021.

CINCINNATI, OHIO	Sunrise	Sunset
Sunday, August 2, 2020	6:40:44 AM	8:47:42 PM
Sunday, August 9, 2020	6:47:05 AM	8:39:38 PM
Sunday, August 16, 2020	6:53:29 AM	8:30:35 PM
Sunday, August 23, 2020	6:59:53 AM	8:20:44 PM
Sunday, August 30, 2020	7:06:13 AM	8:10:16 PM
Sunday, September 6, 2020	7:12:31 AM	7:59:20 PM
Sunday, September 13, 2020	7:18:48 AM	7:48:08 PM
Sunday, September 20, 2020	7:25:09 AM	7:36:48 PM
Sunday, September 27, 2020	7:31:35 AM	7:25:32 PM
Sunday, October 4, 2020	7:38:12 AM	7:14:29 PM
Sunday, October 11, 2020	7:45:02 AM	7:03:50 PM
Sunday, October 18, 2020	7:52:07 AM	6:53:46 PM
Sunday, October 25, 2020	7:59:29 AM	6:44:27 PM
Sunday, November 1, 2020	8:07:08 AM	6:36:04 PM
Sunday, November 8, 2020	8:14:55 AM	6:28:53 PM
Sunday, November 15, 2020	8:22:42 AM	6:23:04 PM
Sunday, November 22, 2020	8:30:20 AM	6:18:46 PM
Sunday, November 29, 2020	8:37:32 AM	6:16:09 PM
Sunday, December 6, 2020	8:44:02 AM	6:15:18 PM
Sunday, December 13, 2020	8:49:32 AM	6:16:14 PM
Sunday, December 20, 2020	8:53:44 AM	6:18:54 PM
Sunday, December 27, 2020	8:56:24 AM	6:23:09 PM
Sunday, January 3, 2021	8:57:24 AM	6:28:45 PM
Sunday, January 10, 2021	8:56:39 AM	6:35:25 PM
Sunday, January 17, 2021	8:54:09 AM	6:42:52 PM
Sunday, January 24, 2021	8:49:59 AM	6:50:47 PM
Sunday, January 31, 2021	8:44:19 AM	6:58:56 PM
Sunday, February 7, 2021	8:37:19 AM	7:07:05 PM
Sunday, February 14, 2021	8:29:09 AM	7:15:07 PM

CINCINNATI, OHIO	Sunrise	Sunset
Sunday, February 21, 2021	8:20:02 AM	7:22:56 PM
Sunday, February 28, 2021	8:10:09 AM	7:30:30 PM
Sunday, March 7, 2021	7:59:42 AM	7:37:49 PM
Sunday, March 14, 2021	7:48:56 AM	7:44:53 PM
Sunday, March 21, 2021	7:37:54 AM	7:51:50 PM
Sunday, March 28, 2021	7:26:50 AM	7:58:41 PM
Sunday, April 4, 2021	7:15:55 AM	8:05:29 PM
Sunday, April 11, 2021	7:05:18 AM	8:12:17 PM
Sunday, April 18, 2021	6:55:10 AM	8:19:07 PM
Sunday, April 25, 2021	6:45:42 AM	8:25:57 PM
Sunday, May 2, 2021	6:37:04 AM	8:32:46 PM
Sunday, May 9, 2021	6:29:26 AM	8:39:27 PM
Sunday, May 16, 2021	6:23:00 AM	8:45:54 PM
Sunday, May 23, 2021	6:17:52 AM	8:51:56 PM
Sunday, May 30, 2021	6:14:12 AM	8:57:20 PM
Sunday, June 6, 2021	6:12:02 AM	9:01:52 PM
Sunday, June 13, 2021	6:11:24 AM	9:05:20 PM
Sunday, June 20, 2021	6:12:16 AM	9:07:30 PM
Sunday, June 27, 2021	6:14:31 AM	9:08:13 PM
Sunday, July 4, 2021	6:17:58 AM	9:07:24 PM
Sunday, July 11, 2021	6:22:26 AM	9:05:01 PM
Sunday, July 18, 2021	6:27:40 AM	9:01:06 PM
Sunday, July 25, 2021	6:33:28 AM	8:55:43 PM

The unshaded rows reflect daylight saving time, which is the practice of setting clocks forward one hour from standard time during the summer months and back again in the autumn to make better use of natural daylight. The shaded area reflects standard time, but these times have been adjusted as if daylight saving time were year-round. This is for the sake of simplicity to calculate the amount of daylight. The actual times would be one hour earlier.

Name _____ Date _____

Activity Page 2.4.1 Use with Lesson 2.4

What Did We Learn?

Circle the correct answer.

1. Earlier sunrises and later sunsets make [**longer days** **shorter days**].

2. Later sunrises and earlier sunsets make [**longer days** **shorter days**].

3. There are longer days in the [**summer** **winter**].

4. There are shorter days in the [**summer** **winter**].

Draw and color a picture of something you like to do outside when the sunsets are late.

Name _____ Date _____

Activity Page 2.5.1 Use with Lesson 2.5

Draw the Future

Draw a picture of the morning sky. Then draw a picture of the evening sky.

Write the future date: _____

Name _____ Date _____

Activity Page 3.2.1 Use with Lesson 3.2

Moon on the Move

Draw the location of the moon in the drawing boxes.

Day 1

Day 2

Day 3

Name _____ Date _____

Activity Page 3.3.1 Use with Lesson 3.3

Moon Models

Shape your models to look like the moon.

New Moon	Crescent Moon
Quarter Moon	**Full Moon**

Name _____ Date _____

Activity Page 3.4.1 Use with Lesson 3.4

Moon Phase Sheet

Draw the moon shape that you see each night.

Date: _____ Day: _____	Date: _____ Day: _____	Date: _____ Day: _____	Date: _____ Day: _____	Date: _____ Day: _____	Date: _____ Day: _____	Date: _____ Day: _____

Name _____ Date _____

Activity Page 3.4.2 Use with Lesson 3.4

Take-Home Letter

Dear Family Members,

Your child has been learning about the moon and how its shape seems to change during a month.

For this take-home assignment, your child—and our whole class—will study the moon's changing phases for the next two months. In doing so, your child will answer the question: *What does the moon look like at different times in a month?*

Your child will be assigned to record the way the moon looks for one week straight (seven days). Your child is being sent home with an Activity Page that has a table where they can draw a picture of the moon each night. Then your child will report their findings to the class after collecting the times for a full week.

You can help your child participate in this investigation by taking the following steps:

1. Remind your child to look at the moon for the nights that they are assigned.

2. Contact me immediately if your child has any conflicts with the week that they are assigned to record the moon's phases.

3. If your child is unable to record the moon phases in real time, use the website https://www.timeanddate.com/moon/phases/ to find the moon phase for that time of the month.

4. Make sure your child is filling out the chart on Activity Page 3.4.1 to record how the moon looks (and to avoid forgetting what it looked like for the week).

5. Remind your child that they will need to present the times to the class. Review the moon phases with your child, and give them practice talking about the moon phases so they feel comfortable with the information.

TEACHER NOTE: The goal of the *Sun, Moon, and Stars* unit is for students to make their own observations, record data, and discern patterns. If you cannot accommodate live observations and data collection over time, you can complete the unit presenting this supplied data for students.

The following substitute moon phase data is for Cincinnati, Ohio, from September 2020 through May 2021. The information below shows the moon phases for full moon, new moon, and quarter moons. Crescent moons are found between the new moon and the quarter moons.

Moon Phase Calendar

Sep	**2: ○**	**10: ◑**	**17: ●**	**23 ◐**	
Oct	**1: ○**	**9: ◑**	**16: ●**	**23: ◐**	**31: ○**
Nov	**8: ◑**	**15: ●**	**21: ◐**	**30: ○**	
Dec	**7: ◑**	**14: ●**	**21: ◐**	**29: ○**	
Jan	**6: ◑**	**13: ●**	**20: ◐**	**28: ○**	
Feb	**4: ◑**	**11: ●**	**19: ◐**	**27: ○**	
Mar	**5: ◑**	**13: ●**	**21: ◐**	**28: ○**	
Apr	**4: ◑**	**11: ●**	**20: ◐**	**26: ○**	
May	**3: ◑**	**11: ●**	**19: ◐**	**26: ○**	

Key

Full moon = ○ Quarter moon = ◑ New moon = ●

Name _____ Date _____

Activity Page 3.5.1 Use with Lesson 3.5

Moon Comic

Draw the moon phase. Write about it.

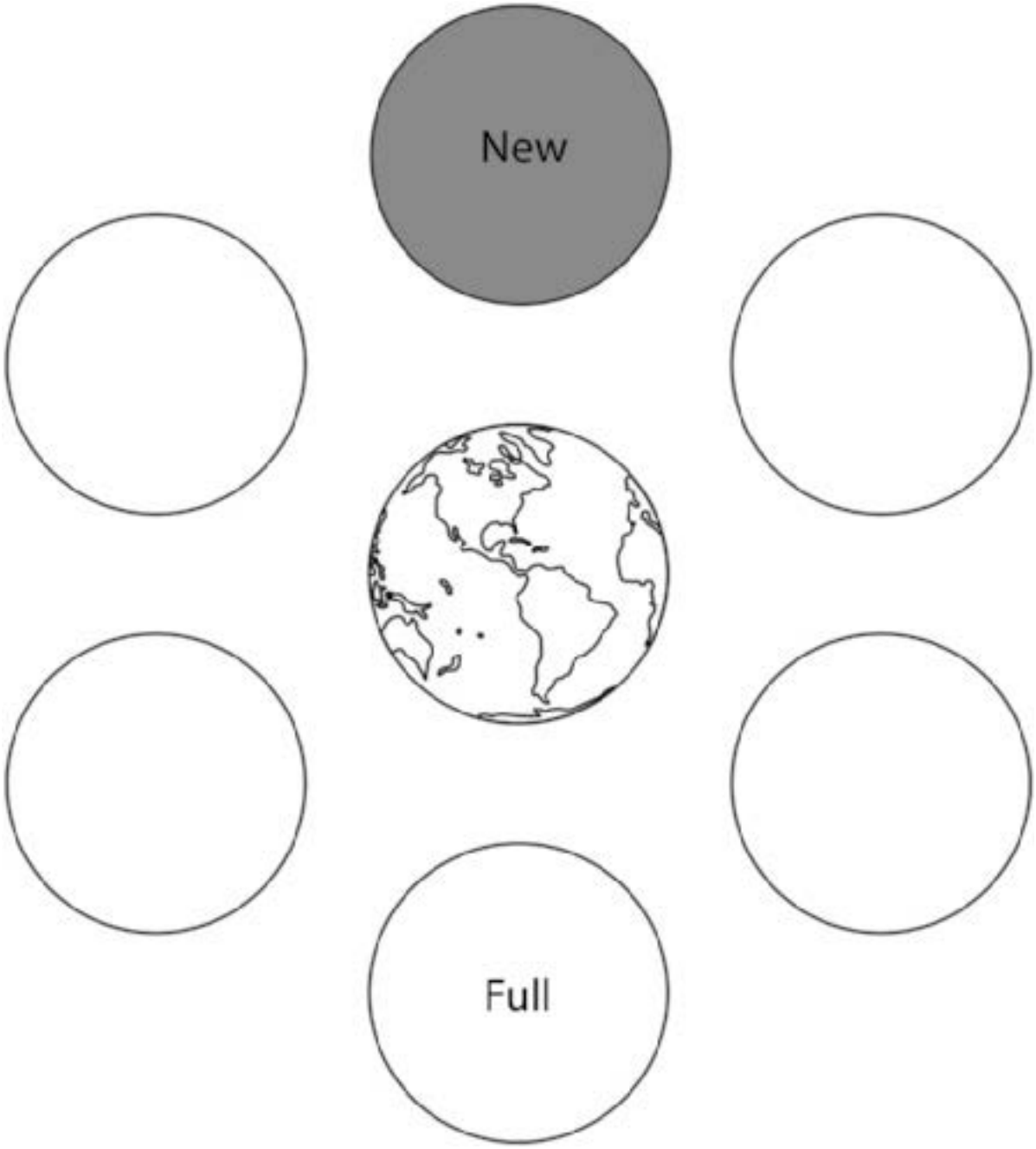
New Moon	Crescent Moon
	
Quarter Moon	Full Moon
	
Quarter Moon	Crescent Moon
	

Name _____ Date _____

Activity Page 3.6.1 Use with Lesson 3.6

What Will the Moon Look Like?

Draw pictures of the moon phases in its cycle.

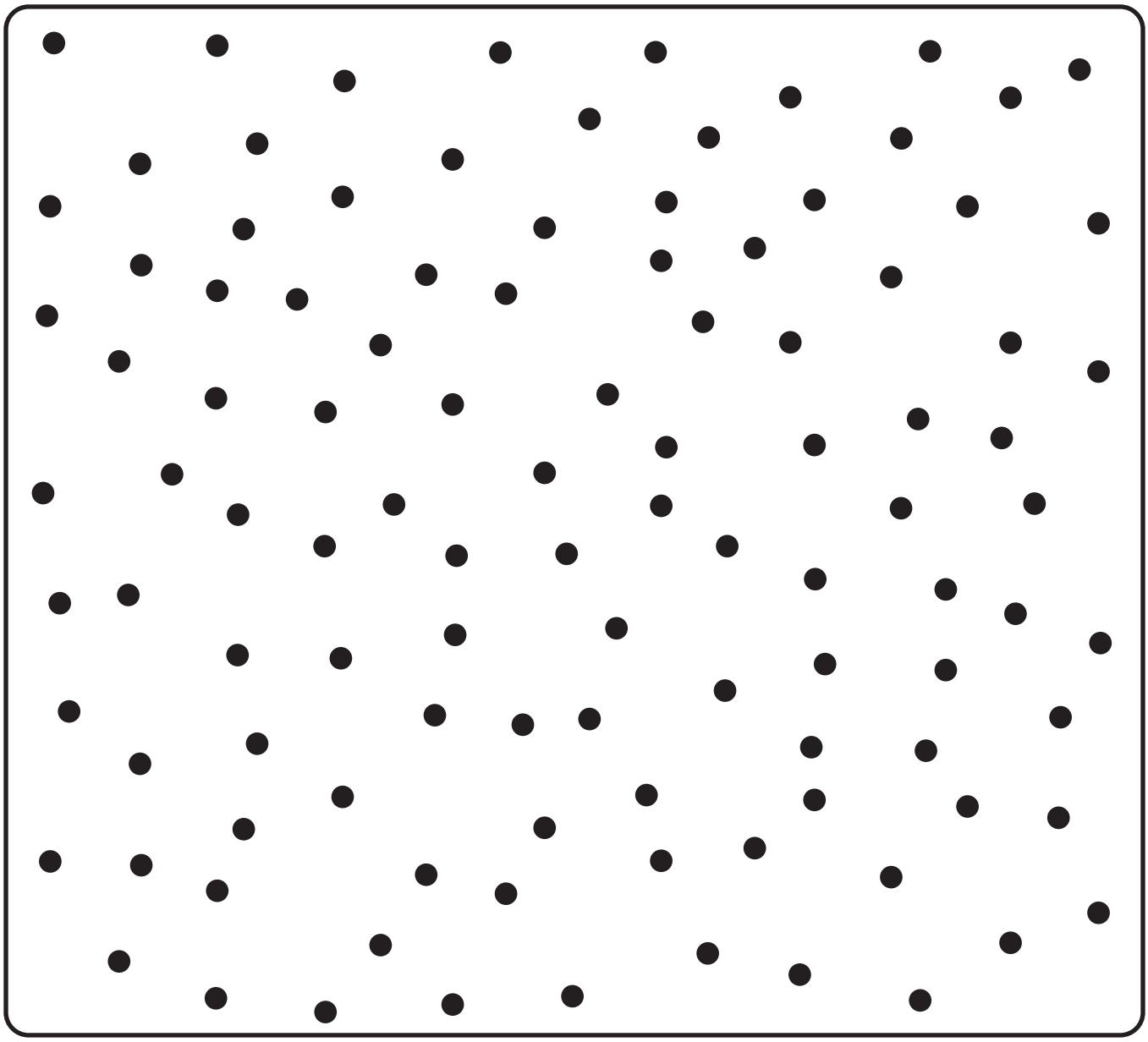


Name _____ Date _____

Activity Page 4.1.1 Use with Lesson 4.1

Connect the Dots

Connect some of the dots to draw a picture.

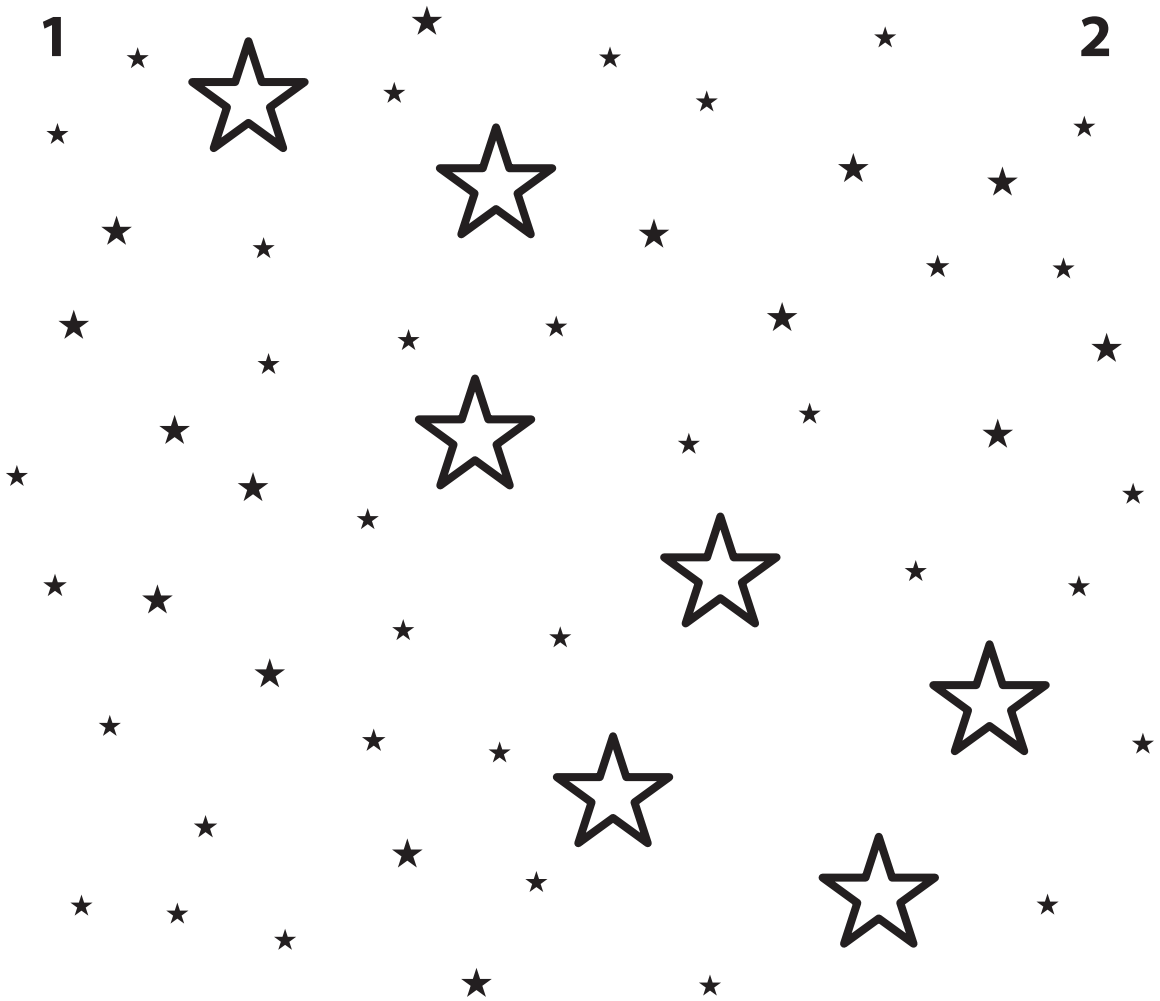


Name _____ Date _____

Activity Page 4.2.1 Use with Lesson 4.2

The Big Dipper

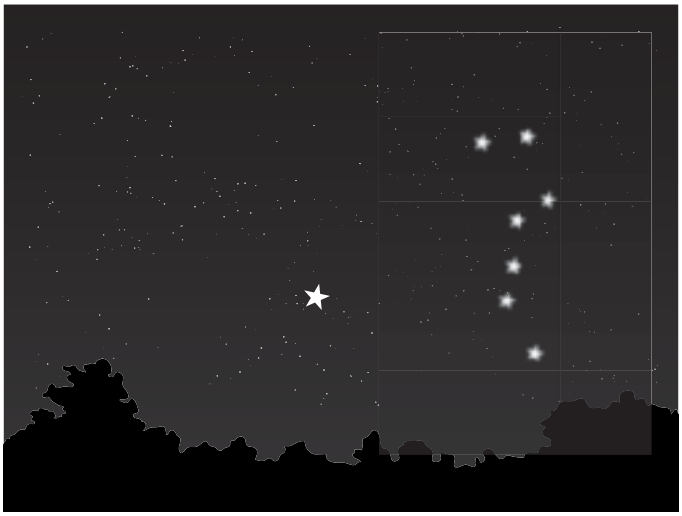
Draw the Big Dipper.

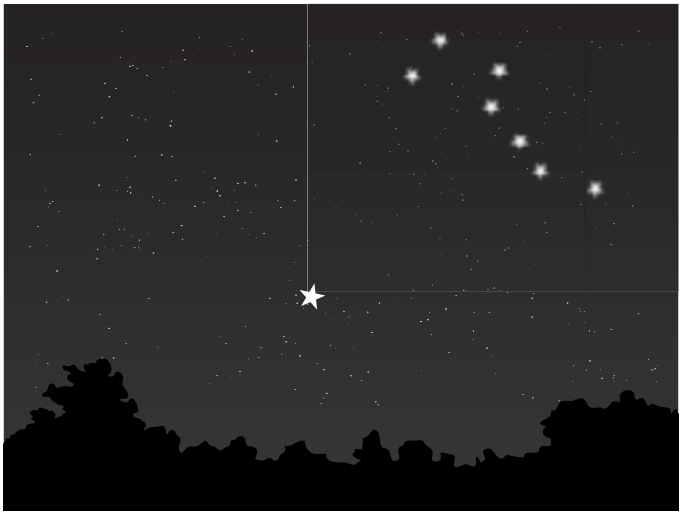


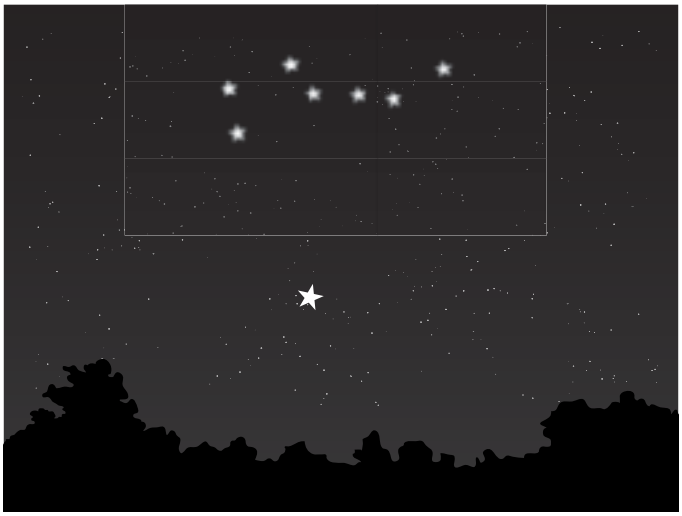
Name _____ Date _____

Activity Page 4.2.2 Use with Lesson 4.2

Big Dipper Investigation





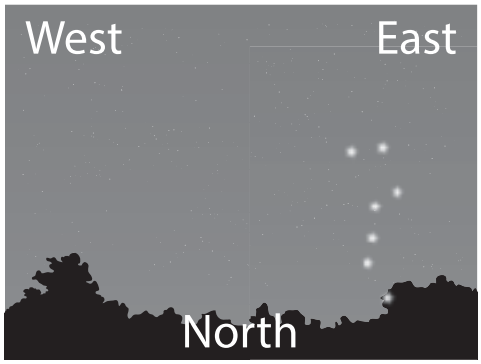


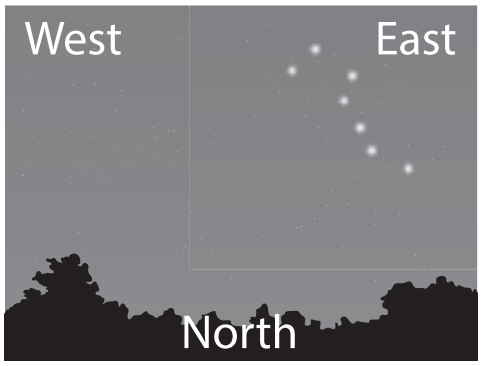
Name _____ Date _____

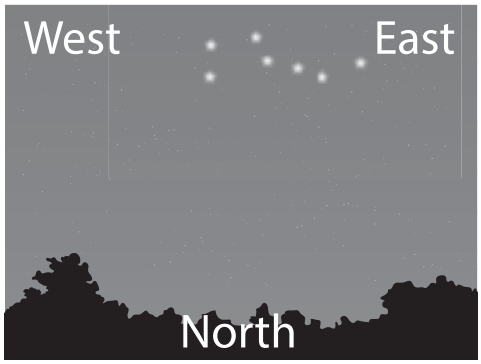
Activity Page 4.4.1 Use with Lesson 4.4

What Will the Sky Look Like?

Draw where the Big Dipper will be in the sky in two hours after the last image.







Activity Pages Answer Key: *Sun, Moon, and Stars*

This answer key offers guidance to help you assess your students' learning progress. Here you will find descriptions of the expectations and correct answers for each Activity Page of this unit.

Day or Night? (AP UO.1) (page 187)

Students should correctly label the picture with the word "Night."

The Sun (AP 1.1.1) (page 188)

Student drawings should reflect a sunlit scene with visible elements such as trees and buildings.

Where Is the Sun? (AP 1.2.1) (page 189)

For each day, students should draw the sun early in the day and later in the day with a reference point to show movement from east to west.

Day and Night Activities (AP 1.3.1) (page 190)

Daytime: mowing the lawn, fishing, gardening, playing soccer

Nighttime: sleeping, walking with flashlight, camping, looking at stars

What Is the Pattern? (AP 1.4.1) (page 191)

The sun will be on the **east** side of the sky in the morning.

The sun will be on the **west** side of the sky in the afternoon.

Sunrise, Sunset Sheet (AP 2.1.1) (page 192)

This is a data collection sheet for students to take home and capture the sunrise and sunset times for their assigned week. It should include the date and the exact times, which will be collected with those of other students throughout the school year.

Take-Home Letter (AP 2.1.2) (pages 193–195)

This explains the sunrise and sunset data collection to families.

What Did We Learn? (AP 2.4.1) (page 196)

1. longer

2. shorter

3. summer

4. winter

Students should draw a daytime summer activity, such as playing soccer. Accept all reasonable responses.

Draw the Future (AP 2.5.1) (page 197)

Students should draw a scene of dark or light morning and evening depending on date given.

Moon on the Move (AP 3.2.1) (page 198)

For each day, students should draw the moon early in the day and later in the day with a reference point to show movement from east to west.

Moon Models (AP 3.3.1) (page 199)

Students should create models of four different moon phases: new moon (barely visible), crescent moon, quarter moon, and full moon.

Moon Phase Sheet (AP 3.4.1) (page 200)

This is a data collection sheet for students to take home and record their observations of the moon's appearance during their assigned observation period.

Take-Home Letter (AP 3.4.2) (pages 201–202)

This explains the moon phase data collection to families.

Moon Comic (AP 3.5.1) (page 203)

Student drawings and text should reflect the different phases of the waxing and waning moon with clear distinctions between new and full moon and between crescent and quarter moon.

What Will the Moon Look Like? (AP 3.6.1) (page 204)

Student drawings should reflect the different phases of the waxing and waning moon clockwise starting with new moon at the top, crescent moon, quarter moon, full moon, quarter moon, crescent moon.

Connect the Dots (AP 4.1.1) (page 205)

Students should draw a recognizable shape by connecting a portion of the dots. Accept all reasonable responses.

The Big Dipper (AP 4.2.1) (page 206)

Students should draw lines between the stars of the Big Dipper.

Big Dipper Investigation (AP 4.2.2) (page 207)

Students should identify the Big Dipper and Polaris in each picture.

What Will the Sky Look Like? (AP 4.4.1) (page 208)

Students should predict and draw the position of the Big Dipper as it appears to rotate around Polaris.

Appendix A

Glossary

Purple words and phrases are Core Vocabulary for the unit. **Bold-faced words and phrases** are Language of Instruction, additional vocabulary terms related to the unit that you should model for students during instruction. Vocabulary words are not intended for use in isolated drill or memorization.

B

Big Dipper, n. one of the most recognizable groups of stars visible in the night sky; seven stars in the constellation Ursa Major (the Great Bear) that provide a reference point from which to find the North Star, Polaris

bright, adj. giving off or reflecting a lot of light

C

change, v. to become different; to make something different (also n. a difference from something's former condition)

circle, n. a round shape; all points on a circle's curved line are the same distance from its center

constellation, n. a group of stars that make a recognizable pattern

crescent, n. a curved bowl shape that is thicker in the center and thinner and pointed at the ends

crescent moon, n. a phase of the visible moon that is not a complete circle but a curved shape with pointed ends

D

dark, adj. with little or no light, not light

data, n. information that is observed or measured and recorded

daylight, n. natural light from the sun during the day

daytime, n. the period of time between the sunrise and sunset

direction, n. the path along which something moves or the point toward which something is aimed

E

east, n. the direction toward the horizon where the sun rises

F

full moon, n. the phase of the moon in which a full circular shape is visible

G

graph, n. a drawing or chart that shows mathematical information with lines, shapes, and colors (also v. to make a chart to show mathematical information)

I

identify, v. to indicate what something is

investigate, v. to observe and study something to collect information

L

light, n. the type of energy that makes vision possible (also v. to brighten)

M

moon, n. the large bright object in the sky that travels around Earth

move, v. to change position (movement, n. the process of changing position)

N

new moon, n. the phase of the moon when its dark side faces toward Earth so it is barely visible

nighttime, n. the time between the sunset and sunrise

north, n. the direction to the left of someone facing east and opposite of south, in line with Earth's North Pole

notice, v. to see and pay attention to something

O

observe, v. to watch something and notice details about it (observation, n. the process of noticing details or a specific detail that is noticed)

P

pattern, n. a reliable system of traits or a set of repeating details

phase, n. a step in a series of events or actions

point of reference, n. something that is used to understand something else through a comparison

Polaris (North Star), n. the brightest star in the constellation Ursa Minor, visible straight above Earth's North Pole

position, n. the spot where a thing is located

predict, v. to say that something is expected to happen

predictable, adj. expected because of a pattern or evidence

Q

quarter moon, n. a view in which half of the moon reflects sunlight and half is in darkness

R

rise, v. to move upward, opposite of *set*

S

set, v. to move down, opposite of *rise*

shape, n. the form or outline of an object

sky, n. the space over Earth where the sun, moon, stars, and clouds appear

south, n. the direction to the right of someone facing east and opposite of north, in line with Earth's South Pole

star, n. an object in space that gives off its own light

sun, n. the star that Earth moves around and that provides Earth with light and heat

sunrise, n. the time at which the sun appears above the horizon in the morning

sunset, n. the time when the sun falls below the horizon in the evening

U

universe, n. all of space and everything in it, including stars

V

visible, adj. able to be seen

W

west, n. the direction toward the horizon where the sun sets

Appendix B

Classroom Safety for Activities and Demonstrations

In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- Be aware of students who have food allergies, and adjust related activities or make materials substitutions as necessary. Check the ingredients of all food to make sure known allergies are not listed. Students with food allergies can still be affected even if they do not ingest the food item. Some common food allergies are peanuts, tree nuts (e.g., almonds, walnuts, hazelnuts, etc.), and cow's milk (rice milk is a good nut-free alternative).
- Report and treat any injuries immediately.
- Check equipment prior to usage, and make sure everything is clean and ready for use.
- Clean up spills or broken equipment immediately using the appropriate tools.
- Monitor student behavior to ensure they are following proper classroom and activity procedures.
- Do not touch your eyes, ears, face, or mouth while engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page. Have a read-along, and have students agree to the expectations for students when engaged in science activities prior to the start of the first unit.

Online Resources

For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

When doing science activities, I will do the following:

- Report spills, breakages, or injuries to the teacher right away.
- Listen to the teacher for special instructions and safety directions. If I have questions, I will ask the teacher.
- Avoid eating or drinking anything during the activity unless told to by my teacher.
- Review the steps of the activity before I begin. If I have questions, I will ask the teacher.
- Wear safety goggles when working with liquids or things that can fly into my eyes.
- Be careful around electric appliances and unplug them, just by pulling on the plug, when a teacher is supervising.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ _____/_____/_____/

Student signature and date

_____

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your student and sign this contract. If you have any questions, please feel free to contact me.

_____ _____/_____/_____/

Parent/guardian signature and date

Appendix C

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned, and will last for more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources

The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

Consider some of the following as methods for acquiring the science materials:

- School Supply Drive—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- Open Houses—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- Parent-Teacher Organizations—Reach out to the local PTO for assistance with acquiring materials.
- Science Fair Drive—Consider adding a table to your science fair as part of a science materials drive for future units.
- College or University Service Project—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- Local Businesses—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or for examples of how their sponsorship will benefit students.

Remember: If your school is public, it will be tax exempt, so make sure to have a Tax Identification Number (TIN) when purchasing materials. If your school is private, you may need proof of 501(c)(3) status to gain tax exemption. Check with your school for any required documentation.

Appendix D

Advance Preparation for Activities and Demonstrations

Being properly prepared for classroom activities and demonstrations is the first step to having a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class, do the following:

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues, such as food allergies, that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher's Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

While engaged in the activity or demonstration, do the following:

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration, do the following:

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices, such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

Appendix E

What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and X-rays are just some of the discoveries made when people were practicing science and something did not go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity doesn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence, or they missed a step when performing the activity. Review and provide feedback on students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson segment's guiding question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly; a measurement was made in error, such as a wrong unit of measure or quantity; or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but guiding them through the problem to figure out why something happened will help them to develop a better sense of how to do science.

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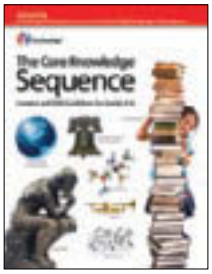
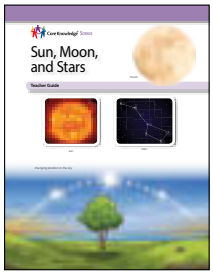
Sun, Moon, and Stars

Core Knowledge Science 1



What is the Core Knowledge Sequence?

The *Core Knowledge Sequence* is a detailed guide to specific content and skills to be taught in Grades K–8 in language arts, history, geography, mathematics, science, and the fine arts. In the domains of science, including Earth and space, physical, and life sciences, the *Core Knowledge Sequence* outlines topics that build systematically grade by grade to support student learning progressions coherently and comprehensively over time.



For which grade levels is this book intended?

In general, the content and presentation are appropriate for students in the early elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 1 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the **Core Knowledge SCIENCE** series, visit **www.coreknowledge.org**.

CKSci™

Core Knowledge Science™

A comprehensive program in science, integrating topics from Earth and Space, Life, and Physical Sciences with concepts specified in the ***Core Knowledge Sequence*** (content and skill guidelines for Grades K–8).

Core Knowledge Science™
units at this level include:

Sun, Moon, and Stars
Plant and Animal Survival
Exploring Light and Sound
Simple Machines
Human Body Systems

www.coreknowledge.org

Core Knowledge Curriculum Series™
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