**SUN, EARTH, AND MOON: CONTENTS**

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Correlation to Science Standards
For information on alignment to state science standards and NGSS, visit https://sallyridescience.com/learning-products/product-standards

Correlation to Common Core
Sally Ride Science’s Key Concepts and Cool Careers book series provide students with authentic literacy experiences aligned to Common Core in the areas of Reading (informational text), Writing, Speaking and Listening, and Language as outlined in Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects. Sun, Earth, and Moon: Our Star, Our Planet, Our Satellite and the accompanying activities align to the following standards:

Reading Standards for Informational Text K-5 (RI), Grades 3-5

Key Ideas and Details
1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. Grade 3
   Refer to details and examples in a text when explain what the text says explicitly and when drawing inferences from the text. Grade 4
   Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. Grade 5
2. Determine the main idea of a text; recount the key details and explain how they support the main idea. Grade 3
   Determine the main idea of a text and explain how it is supported by key details; summarize the text. Grade 4
   Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text. Grade 5

Craft and Structure
4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade appropriate topic or subject area. Grades 3-5

Integration of Knowledge and Ideas
7. Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). Grade 3
   Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. Grade 4

Range of Reading and Level of Text Complexity
10. By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts. Grades 3-5

Writing Standards K-5 (W), Grades 3-5

Text Types and Purposes
2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly. Grade 3 a.-d., Grade 4 a.-e., Grade 5 a.-e.

Production and Distribution of Writing
4. With guidance and support from adults, produce writing in which the development and organization are appropriate to task and purpose. Grade 3
   Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. Grades 4 and 5
Research to Build and Present Knowledge

7. Conduct short research projects that build knowledge about a topic. Grade 3
   Conduct short research projects that build knowledge through investigation of different aspects of a topic. Grade 4
   Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. Grade 5

8. Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. Grade 3
   Recall relevant information from experiences or gather relevant information form print and digital sources; take notes and categorize information, and provide a list of sources. Grade 4
   Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. Grade 5

9. Draw evidence from literary or informational texts to support analysis reflection, and research. Grade 4 b., Grade 5 b.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. Grades 3-5

Speaking and Listening Standards K-5 (SL), Grades 3-5

Comprehension and Collaboration

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade appropriate topics and texts, building on others’ ideas and expressing their own clearly. Grades 3-5 a.-d.

2. Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. Grade 3
   Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. Grade 4
   Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. Grade 5

Language Standards K-5 (L), Grades 3-5

Knowledge of Language

3. Use knowledge of language and its conventions when writing, speaking, reading, or listening. Grade 3 a.-b., Grade 4 a.-c., Grade 5 a.-b.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade appropriate reading and content, choosing flexibly from a range of strategies. Grade 3 a.-d., Grade 4 a.-c., Grade 5 a.-c.

6. Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that:
   - signal spatial and temporal relationships. Grade 3
   - signal precise actions, emotions, or states of being (e.g., quizzed, whined, stammered) and that are basic to particular topic (e.g., wildlife, conservation, and endangered when discussing animal preservation.) Grade 4
   - signal contrast, addition, and other logical relationships (e.g., however, although, nevertheless, similarly, moreover, in addition). Grade 5

*Book pages pictured in the Teacher Guides are from eBook editions. Some pages in the print books have different images or layouts.*

**Cool Careers**
- Cool Careers in Biotechnology
- Cool Careers in Earth Sciences
- Cool Careers in Engineering (Upper Elementary)
- Cool Careers in Engineering (Middle School)
- Cool Careers in Environmental Sciences (Upper Elementary)
- Cool Careers in Environmental Sciences (Middle School)
- Cool Careers in Green Chemistry
- Cool Careers in Information Sciences
- Cool Careers in Math
- Cool Careers in Medical Sciences
- Cool Careers in Physics
- Cool Careers in Space Sciences

**Key Concepts in Science**
- Adaptations
- Biodiversity
- The Biosphere
- Cells
- Earth’s Air
- Earth’s Climate
- Earth’s Energy
- Earth’s Natural Resources
- Earth’s Water
- Elements and Compounds
- Energy Basics
- Energy Transformations
- Flowering Plants
- Food Webs
- Forces
- Genetics
- Geologic Time
- Gravity
- Heat
- Life Cycles
- Light
- Motion
- Organic Molecules
- Photosynthesis and Respiration
- Physical Properties of Matter
- Plant and Animal Systems
- Plate Tectonics
- The Rock Cycle
- Solids, Liquids, and Gases
- Sound
- Space Exploration
- Sun, Earth, and Moon
- Units of Measurement
- Vertebrates
- The Water Cycle
- Weathering and Erosion

Sally Ride Science provides professional development and classroom tools to build students’ passion for STEM fields and careers. Founded by Dr. Sally Ride, America’s first woman in space, the company brings science to life for upper-elementary and middle school students.

Visit us at [SALLYRIDESCIENCE.COM](http://SALLYRIDESCIENCE.COM) for more information.
Sun, Earth, and Moon: Our Star, Our Planet, Our Satellite
guides students as they explore the Sun-Earth-Moon system. They discover the important ways in which both the Sun and the Moon affect Earth. Students learn that the Sun is the center of the solar system and that it provides Earth and the other planets with light and heat. They discover why Earth is different from the other planets in the solar system. They also learn how the Moon formed and why it has phases. At the end of each two-page spread, a brief statement called The Bottom Line reinforces students’ understanding by summing up the key ideas about the Sun, Earth, and Moon covered in those pages.

In Your World engages students’ interest and sparks their curiosity about the Sun, Earth, and the Moon by describing a typical day at the beach. Their attention is focused on the heat and light that the Sun produces. They learn that no other planet that circles the Sun has just the right temperature for liquid water to exist on its surface. Students also learn that the Moon is largely responsible for Earth’s tides. The brief scenario sets the stage for the chapters to follow by sparking students’ interest in how the Sun and Moon affect Earth.

Chapter 1 explores the Sun. Students learn that the Sun, like all stars, is a ball of very hot gas. Unlike other stars, though, the Sun has a huge effect on Earth. For example, energy from the Sun moves life-nourishing water around the globe. Plants and phytoplankton use sunlight to make the food that starts almost all of the food chains on Earth. Students learn that the Sun’s gravity holds the entire solar system together.

Chapter 2 focuses on Earth and its position in the solar system. Students learn how Earth differs from the Sun, not only in size but in the stuff it’s made of. Striking photos impress upon students that Earth is the only planet in the solar system with liquid water on its surface and the only one known to support life. Clear diagrams help students understand how Earth’s motions cause a day, a year, and seasons.

Chapter 3 introduces students to Earth’s Moon. The chapter explains that the Moon is Earth’s nearest neighbor in space and is held in orbit by Earth’s gravity. Students discover that light from the Moon is actually reflected sunlight. They get a sense of what it’s like to be on the Moon, from its stark landscape to its extreme temperatures. They explore the Moon’s phases and learn how the Moon’s gravity causes tides.

Thinking Like a Scientist shows students how scientists use scale to make models that reflect the actual sizes of objects and the distances between them. Students use the distances between Earth and the Moon, between Earth and satellites in space, and between Earth and the Sun to calculate how far apart these objects would be in a scale model.

How Do We Know? introduces students to Carle Pieters, a planetary geologist who studies the different colors of the Moon’s surface—colors that can be detected only with sensitive instruments aboard orbiting space probes such as Chandrayaan-1. Carle Pieters analyzes these colors to determine what minerals make up the Moon’s surface. In Math Connection, students make calculations about Chandrayaan-1’s orbits of the Moon.

Hey, I Know That! allows students to assess their own learning through a variety of assessment tasks relating to the key concepts covered in Sun, Earth, and Moon.
Preview the book

Ask students to browse through *Sun, Earth, and Moon: Our Star, Our Planet, Our Satellite.* Have them look at the table of contents and the chapter titles. Draw their attention to the special features. Encourage them to look at each of the photos and diagrams. Explain to students that paying attention to all of these features will provide clues about the text and help them understand it better as they read.

Read *In Your World* (pages 4 and 5) and discuss key concepts

Tell students to read *In Your World.* After students have finished reading the text, encourage them to think about what they have read by leading a class discussion. Ask,

*Why do people wear sunscreen at beaches?* [Sample answer: People wear sunscreen to protect themselves from harmful ultraviolet (UV) rays in sunlight.]

*How do tides affect a day at the beach?* [Sample answer: Tides cause the water level to get higher and lower, so the beach is wider or narrower at different times of day.]

Then ask,

*How do you think a day at the beach would change if there were no Sun or Moon affecting Earth?* [Sample answers: If there were no Sun, the temperature of the air would be very cold and any water would be frozen. In fact, there would be no life on Earth without the Sun. If there were no Moon, there would be no tides.]

Allow time for several students to share their ideas with the class.
Read Chapter 1: Our Sun

Before reading: Model asking questions as you read

Tell students that asking questions while they read is a good way to improve their understanding of what they read. Have students turn to page 6 in Sun, Earth, and Moon. Read aloud the title and subtitle of Chapter 1: Our Sun: Star Light, Star Bright. Say,

Hmm, the chapter is titled Our Sun, and the subtitle is Star Light, Star Bright. The Sun and a star must be related somehow. I’ll write this down as a question I want to answer.

Write on the board, How are the Sun and a star related? Have students look at the picture on page 6. Read aloud the picture’s caption and the first two paragraphs of the text as students read silently along with you. Then say,

Ah, I see the answer to my question. The Sun is a star, which is a huge hot ball of gas. But that makes me curious. How does the Sun compare to other stars? That’s another question.

Explain to students that asking themselves questions as they read will help focus their attention on important points of the reading. The questions and the answers might come from images, captions, or text.

Read Chapter 1: Our Sun (pages 6-9)

Ask students to finish reading Chapter 1: Our Sun. Provide them with the Chapter 1 handout. Tell students they can use it for recording the questions they have while reading and also any answers that they find.

After reading: Explore key concepts

Let students experience how the distance of an object from a viewer affects the apparent size of the object. Place a large ball, such as a soccer ball or basketball, on a table in the front of the room. Make sure that everyone has a clear view of the ball. Have students close one eye and look directly at the ball with their other eye. Say,

Hold your thumb in front of your open eye so that you can see the ball behind it. Now move your thumb closer to your eye until your thumb just barely blocks your view of the ball. Which is the larger object—the ball or your thumb? [The ball is the larger object.]

How is it possible that a small object like your thumb could block your view of the large ball? [The ball is farther away from me than my thumb is. Objects look smaller when they are far away.]

Why did you have to move your thumb closer to your eye to just barely block your view of the ball? [My thumb looked bigger and smaller as I moved it closer and farther away. I had to move it so it looked just the right size to block my view of the ball.]

If there is a round wall clock in the classroom, you can use that instead of a ball. Call on several students to relate what they observed in the classroom exercise to how the Sun looks to us on Earth.
Read Chapter 2: *Earth, Our Very Own Planet*

Before reading: Model how to summarize with a Venn diagram

Give students the Chapter 2: *Earth, Our Very Own Planet* handout. Point out that it has a place for them to make a Venn diagram summing up some of the concepts in Chapter 2. Help students get started by drawing two partially overlapping circles on the board. Write *Sun* above the left circle, *Earth* above the right circle, and *Both* above the overlapping section.

Remind students that they should write characteristics of the Sun and Earth that are the same in the overlapping section. Then ask,

**What are some of the characteristics of the Sun and Earth that you can compare?** [We can compare the size, shape, temperature, makeup, and motions of the Sun and Earth.]

**What is one characteristic we could write in the overlapping part of the diagram?**

Listen to students’ suggestions and then write one characteristic, such as *spherical shape*, in the *Both* area of the diagram. Tell students they can add to the diagram as they read the chapter.

Read Chapter 2: *Earth, Our Very Own Planet* (pages 10-17)

Ask students to read Chapter 2: *Earth, Our Very Own Planet*. Tell them to use their handouts to take notes on the chapter and to complete their Venn diagrams as they read.

After reading: Discuss key concepts

Direct students’ attention to the diagram on page 17, shown here. Ask,

**What is different about Earth in each drawing?** [Sample answer: The things that are different about Earth in each drawing are which hemisphere is tilted toward or away from the Sun and which continents this affects. The four smaller drawings of Earth represent Earth in each of the four seasons. The two larger drawings show a close-up of Earth in summer in the Northern Hemisphere and summer in the Southern Hemisphere. Each drawing shows Earth’s location in orbit around the Sun, the tilt of the axis, and its rotation.]

Have students locate the axis in each Earth in the diagram. Ask,

**What do you notice about Earth’s axis as it orbits the Sun?** [It always points in the same direction.]

The caption asks, When does the North Pole tilt toward the Sun? What does that mean for the northern half of our planet? How would you answer those questions? [The North Pole points toward the Sun in June. That’s when it is summer in the northern half of Earth.]
**Why does the direction that the axis points cause summer and winter?**

[Sample answer: The half of Earth that has its axis tilted toward the Sun gets more direct sunlight and has summer, while the half that is tilted away from the Sun gets less direct sunlight and has winter.]

**On which half of Earth do we live? What season is it now? Is our half of Earth tilted toward the Sun or away from the Sun?**

[Sample answer: I live in the Northern Hemisphere. It is winter here now. That means our half of the Earth is tilted away from the Sun.]

**SCIENCE BACKGROUND**

The Sun and Earth share a few characteristics: They both are part of the solar system; they both have a spherical shape; and they both rotate on their axes. Otherwise, they are very different. The Sun is large enough to contain about 1 million Earths. Its high temperatures do not allow life to exist. The Sun is a star; Earth is a planet. As a star, the Sun is composed of gases, mostly hydrogen and helium. Earth, however, is made up of solid and liquid layers of rock. The outermost layer of Earth is solid. Beneath this is a semi-liquid layer. The interior of Earth is made of a liquid outer core and a solid inner core. Our solid/liquid home in space is enveloped in a layer of gases—our atmosphere. In terms of motion, the Sun and Earth differ in two ways. First, although both the Sun and Earth rotate on their axes, the Sun rotates faster at its equator than at its poles. (It rotates once every 27 Earth days at its equator and once every 31 Earth days at its poles.) Second, Earth travels around the Sun, but the Sun does not travel around another body in the solar system. It is the center of our solar system in a tiny part of the Universe.
Read Chapter 3: *Our Moon*

Before reading: Model summarizing with a concept map

Give students the Chapter 3: *Our Moon* handout. Point out that it has a place to draw a concept map summarizing the key concepts in the chapter.

To get students started, draw a circle in the middle of the board and write *Our Moon* in the circle. Draw a second level of circles ringing the middle circle. Draw connecting lines from the middle circle to the new circles. Tell students that each level provides more detail for the previous level. Tell students to copy the concept map on their handouts.

Call on a student to read aloud the text on page 18. Then ask,

**What are some of the main ideas about the Moon on this page?**

In the second level of circles, write students’ responses, such as *The Moon formed from a chunk knocked off Earth* and *The Moon is smaller than Earth*. Tell students that they can draw another level of circles to give more details about the ideas in the second level.

Tell students that as they read Chapter 3, they can add to the concept map of the chapter’s main ideas.

Read Chapter 3: *Our Moon* (pages 18-23)

Have students read Chapter 3: *Our Moon*. As they read, they should take notes and add to the concept map on their handouts.

After reading: Explore key concepts

Call students’ attention to the photos of the Moon’s phases on page 21, shown here. Tell students that the photos are of the Moon as it is seen from Earth. Begin a discussion about the Moon’s phases with these questions:

**What is the source of light from the Moon?** *[The Sun is the source of light from the Moon. Moonlight is really reflected sunlight.]*

**How much of the Moon can we see from Earth during a new Moon?** *[We can’t see any amount of the Moon from Earth during a new Moon.]*

**If we were in space on the other side of a new Moon, how would the Moon look?** *[It would look like a full Moon.]*

**What causes the phases of the Moon?** *[The variation in the amount of the sunlit side of the Moon that we can see from Earth causes the phases of the Moon.]*
Then call students’ attention to the photos on page 23, shown here. Ask,

*What causes the tides shown in the photos? [The Moon’s gravity pulling on Earth and its oceans causes the tides.]*

*Do you think the Sun affects tides in any way? Why do you think it does or doesn’t? [Accept any answer students can explain. Sample answer: I think the Sun must have some effect on tides because the Sun’s gravity is very strong and keeps Earth in orbit.]*

Then say,

*Because the Moon is close to Earth, it has the largest effect on tides. However, the Sun’s gravity also pulls on Earth’s water and affects tides.*

Use the information in the Science Background at right to engage students in a discussion of how the Sun increases the difference between high and low tide during a new Moon and full Moon, and how the Sun decreases the difference between high and low tide during the Moon’s first-quarter and third-quarter phases.

Draw the positions of the Sun, Earth, and Moon on the board to show the situation for spring tides and for high tides. Or call on students to model the situations using balls of different sizes.

**SCIENCE BACKGROUND**

The Moon provides the greatest influence on ocean tides because it is closer to Earth than the Sun is. That means the Moon’s gravity exerts a more powerful pull on the oceans than the Sun’s gravity does. However, even though the Sun is more distant, it still influences the tides because of its massive size. When the Sun and Moon are aligned, the force of their gravity pulls in the same direction. The forces combine, like a strong person and a weak person both pulling a heavy box in the same direction. The combined gravitational forces of the Moon and Sun produce the highest high tides and the lowest low tides. These are called spring tides. They occur twice a month, during the new Moon and the full Moon. During the Moon’s first quarter and third quarter, the line between Earth and the Sun is at right angles to the line between Earth and the Moon. So the Sun’s pull is at a right angle to the Moon’s pull. It’s like the strong person pulling the heavy box in one direction while the weaker person pulls it in a direction at a right angle to the strong person’s pull. The box will still move in the direction of the strong person’s pull, but not as well. This arrangement of the Moon, Earth, and Sun produces a neap tide, which shows little difference between high tide and low tide.
Read *Thinking Like a Scientist* (pages 24-25) and answer the questions

Ask students to read *Thinking Like a Scientist*. Give them the *Thinking Like a Scientist* handout and tell them to use the information in the pages and the table to answer the questions on page 25. The questions are about what the distances would be in a scale model of the Earth, Sun, and Moon. Students should use the scale 1 centimeter = 530 kilometers (1 inch = equals 838 miles). They should show their calculations for each answer.

Encourage students to work in pairs as they answer the questions and come to agreement on the answers. Then discuss the questions and answers together as a class.

**ANSWER KEY**

1. How far away from Earth would the Moon be in centimeters and inches? [The distance from Earth to the Moon would be 724.5 centimeters, or 285 inches. (384,000 km x 1 cm/530 km = 724.5 cm. 239,000 miles x 1 inch/838 miles = 285 inches)]

2. How far away from Earth would a communication satellite be in centimeters and inches? [The distance between a communication satellite and Earth would be 66 centimeters, or 26 inches. (35,000 km x 1 cm/530 km = 66 cm. 21,748 miles x 1 inch/838 miles = 26 inches)]

3. How far away from Earth would the Sun be in centimeters and inches? [The distance between Earth and the Sun would be 283,018.9 centimeters, or 111,224 inches. (150,000,000 km x 1 cm/530 km = 283,018.9 cm. 93,205,748 miles x 1 inch/838 miles = 111,224 inches)]

4. About how many times farther away from Earth is the Sun than the Moon is? [The Sun is 390.6 times farther away from Earth than the Moon is. (150,000,000 km/384,000 km = 390.6)]
Map your classroom

Have groups of students work together to make a scaled map of their classroom. Measure the basic dimensions of the classroom with a tape measure before students begin. Arrange students in groups of four or five. Provide each group with the Create a Scaled Map handout, a metric ruler, a meter stick, and the dimensions of the classroom.

Tell groups that their task is to make a map of their classroom and the objects in it to scale. Have them include large objects in the room, such as desks, tables, and standing bookcases. Suggest that they assign different tasks to different group members, such as measuring, tracking measurements, doing calculations, and drawing locations on the map.

Determine a scale

Before groups begin, make sure that they determine the scale they will use for their map. Tell them that they should use most of the area on their handouts for the map. Help them determine an appropriate scale with these questions:

_I have written the basic dimensions of the classroom on the board. How will you use these measurements? [We will use them to calculate how much to shrink every distance by the same amount so the outline of the classroom will fit on the handout.]

_What will you need to know about the grid on your handout in order to know how much to shrink the distances? [We need to know the number of whole squares in the length and the width of the grid on our handouts.]

_What calculation can you make with the length of the room and the number of squares in the length of the grid on your handout to determine your scale? [We could divide the length of the classroom by the number of squares in the length of the grid. That will tell us how many centimeters one square can represent or how many meters a certain number of squares can represent.]

_What will you do for the width of the room? [We will do the same calculation using the width of the room and the number of whole squares in the width of the grid.]

A reasonable scale might be 2 squares on the graph paper for every meter of classroom length or width, depending on the size of your classroom. Once students have determined their scale, have them work on creating their maps by identifying the objects they will include in the map and by measuring these objects. Then they can convert the measurements to the scale they have determined and plot the objects on the graph paper. Have students display their maps around the classroom.

SCIENCE BACKGROUND

A scale model is a copy of an object that is larger or smaller than the actual size of the object and that maintains the relative proportions of the real object. Many toys and objects for hobbyists are scale models—from dolls and toy boats to model trains and self-propelled model airplanes. Scale models also are an important part of technology. Aeronautical engineers build scale models of a new plane to test the design in wind tunnels before building a full-size prototype. Architects build scale models of structures to evaluate the design and show a client what the structure will look like when it is completed. Filmmakers build scale models of objects and sets that would be too costly to build in full size, and then incorporate the models in a movie. Scientists build scale models and draw scaled diagrams and maps to better understand very large and very small systems and objects. For example, the solar system scale model on the National Mall in Washington, D.C., allows people to experience and understand the vast expanse of the solar system.
SUN, EARTH, AND MOON: HOW DO WE KNOW?
Meet planetary geologist Carle Pieters

Read How Do We Know? (pages 26-29)

Give students the How Do We Know? handout. Have them look at the first two questions. Then they should read The Issue (page 26), and answer the questions about that section. Have them complete the rest of the sections (The Expert, page 27; In the Field, page 28; Technology, page 29) in the same way. Tell students to share their answers in pairs. Then go over each question as a class. Call on two or three students to share their answers to each question.

ANSWER KEY

1. How does the science writer capture your interest at the beginning of the feature? [Sample answer: The writer reminds me that people have gone to the Moon and says that someday we’ll go back. That’s an exciting idea to me.]

2. How does the picture on page 26 (shown here) help you understand the topic? [Sample answer: The picture lets me see that the Moon is very barren. I can also see the places where astronauts landed in the past and where robotic spacecraft landed to study the Moon.]

3. How does Carle Pieters study the Moon? [As an expert in spectroscopy, Carle Pieters studies the colors that electronic sensors detect on the surface of the Moon. The colors show the different minerals that make up the Moon’s surface. Knowing the composition of the Moon’s surface helps scientists understand the Moon’s history, such as when volcanoes last erupted there.]

4. What does Carle Pieters do with the information collected by Chandrayaan-1? [Carle uses the information to better understand how asteroids and comets crashing into the Moon mix up the materials in its surface.]

5. How did the imaging spectrometer aboard Chandrayaan-1 work? [The spectrometer collected sunlight that bounced off the minerals in the rocks and soil on the Moon’s surface. Each type of mineral soaks up certain colors of sunlight, so the light reflected back to the spectrometer has a unique “fingerprint.”]
Answer the Math Connection questions (page 29)

Give students the Math Connection handout and have them use it to answer the Math Connection questions on page 29 of Sun, Earth, and Moon. Tell students to show their calculations.

Math Connection: Run Around

India’s Chandrayaan-1 spacecraft orbited the Moon once every 117 minutes 36 seconds (117.6 minutes).

ANSWER KEY

1. How many times did the robotic spacecraft circle the Moon in one day? [The spacecraft circled the Moon a little more than 12 times per day. (24 hours/day x 60 minutes/hour = 1,440 minutes/day. 1,440 minutes/day ÷ 117.6 minutes/orbit = 12.245 times per day)]

2. How many orbits did the spacecraft complete in the 312 days it spent circling the Moon? [The spacecraft completed a little more than 3,820 orbits. (12.245 orbits/day x 312 days = 3,820.44 orbits)]

SCIENCE BACKGROUND

Chandrayaan-1 was the Indian Space Research Organization’s first mission to the Moon. It was launched on Oct. 22, 2008. The Moon Mineralogy Mapper (M3) was one of six instruments aboard the spacecraft. The M3 mapped most of the Moon’s surface from an altitude of 100 kilometers to 200 kilometers (62 miles to 124 miles). The instrument had the ability to map in two modes. The Global Mode provided lower resolution images, and the Target Mode produced higher resolution images. Global mapping was the priority, and because the mission ended earlier than planned, most of the data were obtained with Global Mode. Data from M3 has improved our knowledge about the Moon’s origin, the geologic changes it has gone through, and the early development of the terrestrial planets. The data also allowed scientists to map lunar resources that may be of practical use to future Moon explorers.
What would you ask a scientist?

Give students the Interview Questions handout. Tell them to imagine that they are journalists for a kids’ science magazine. They are assigned to write an article about planetary geologist Carle Pieters and her work. Students’ job: prepare a list of 10 questions to ask Carle during an interview.

Have students work in pairs. Tell them to reread the How Do We Know? feature on pages 26-29 of Sun, Earth, and Moon, and to look back through the rest of the book to get ideas for questions.

Tell students that their questions should cover a variety of topics, including Carle’s experiences as a planetary geologist, her personal characteristics, and her work unraveling the Moon’s geology. Tell them that good journalists use the 5W’s and H—what, who, why, where, when, and how—to gather information.

After 10 minutes, have pairs gather in groups of four to six students. Each group should choose the five best questions from among the pairs in the group. Then have each group read their questions aloud as you (or one or two student helpers) record all original questions on the board. Then as a class, choose the five best questions.
Complete the Hey, I Know That! study guide (page 30)

Give students the Hey, I Know That! handout and ask them to use it to answer the questions on page 30 of Sun, Earth, and Moon. Have pairs of students discuss their answers. Call on several students to read their answers aloud, and encourage others in the class to comment and expand on the answers.

ANSWER KEY

1. A spacecraft took this picture of Earth and the Moon. In which direction would you look to find the Sun? Why? (page 17) [Photo B. You would look to the right to find the Sun because its light is shining on the right sides of Earth and the Moon.]

2. The dark smudge on Earth’s surface is the enormous shadow of what? (page 20) [Photo D. The dark smudge on Earth’s surface is the shadow of the Moon. The photo was taken by the Mir space station during a solar eclipse in 1999.]

3. What bright objects created the streaks in this time-lapse photograph? What is spinning to create the streaking effect? (page 16) [Photo E. The streaks are time-lapse images of stars. Because Earth is rotating on its axis, the stars appear to move across the sky.]

4. Hey, where did all the water go? Why are these boats stranded high and dry? Explain what is happening in this photo. (page 23). [Photo A. These boats in Brittany, France, are stranded because the tide is low. The tide ebbs and flows because the Moon’s gravity pulls on different parts of the Earth’s oceans as the Earth rotates.]

5. Look at this photo from space of North America and South America. What season is it in the north? How about the south? Is the North Pole or South Pole pointing toward the Sun? (pages 16 and 17). [Photo C. In this image, it is winter in the Northern Hemisphere and summer in the Southern Hemisphere. The South Pole is tilted toward the Sun, and the North Pole is tilted away from the Sun.]
Our Sun: Notes for Chapter 1

As you read Chapter 1, write down any questions that occur to you. Also write down any answers that you find.

STAR LIGHT, STAR BRIGHT

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

SUN ALL AROUND

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

THAT’S SOME SUN

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

THE SUN’S PULL ON US

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
PICTURE THIS

Review your notes for Chapter 1. Summarize your notes by making drawings or diagrams to illustrate the two *Bottom Line* statements in the chapter: *The Sun is a star, and it is the source of light and heat on Earth* and *The Sun is at the center of our solar system and is by far the largest thing in it.*

PUT IT ALL TOGETHER

Use your notes and drawings to help you identify and list the most important ideas—the key concepts—in Chapter 1.

__________________________________________________________________________________________

__________________________________________________________________________________________

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__________________________________________________________________________________________
Earth, Our Very Own Planet: Notes for Chapter 2

As you read, write down the most important information you come across. Resist the urge to write down everything that you read. Instead, focus on the big ideas, or gist, of what you are reading.

NUMBER THREE OF EIGHT

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

GET AROUND EARTH

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

THE SOLID EARTH

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

OUR COZY HOME

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

A TURN IN TIME

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

A YEAR AROUND

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
THE REASON FOR SEASONS

TIME AND PLACE

PICTURE THIS

Review your notes for Chapter 2. Summarize your notes by developing a Venn diagram. Draw two overlapping circles. Write Sun above one circle and Earth above the other. Write Both above the overlapping area. Write characteristics that only the Sun has in the Sun circle and characteristics that only the Earth has in the Earth circle. Write characteristics that Earth and the Sun share in the overlapping area.

PUT IT ALL TOGETHER

Use your notes and Venn diagram to help you identify and list the most important ideas—the key concepts—in Chapter 2.
Our Moon: Notes for Chapter 3

As you read Chapter 3, write down the most important information you come across. Resist the urge to write down everything that you read. Instead, focus on the big ideas, or gist, of what you are reading.

A CHIP OFF THE OLD BLOCK

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

OUR NEIGHBOR NEXT DOOR

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__________________________________________________________________________________________
__________________________________________________________________________________________

LUNAR LOOK

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

PHASE IN . . . AND OUT

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________

RISE AND FALL WITH THE MOON

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__________________________________________________________________________________________
__________________________________________________________________________________________

AS REGULAR AS THE TIDES

__________________________________________________________________________________________
__________________________________________________________________________________________
__________________________________________________________________________________________
PICTURE THIS

Review your notes for Chapter 3. Summarize your notes by developing a concept map that makes sense to you. You might start with a central circle labeled Our Moon. Extending from this circle might be other circles about formation, size, light, surface, phases, and tides.

PUT IT ALL TOGETHER

Use your notes and concept map to help you identify and list the most important ideas—the key concepts—in Chapter 3.

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Thinking Like a Scientist: Calculating Scale

Read Thinking Like a Scientist on pages 24 and 25 of Sun, Earth, and Moon.

Imagine you are building a scale model of the Earth, Moon, and Sun. What would the distances be in your model? Use a scale of 1 centimeter = 530 kilometers (1 inch = equals 838 miles) and the information in the table to answer these questions. Be sure to show your calculations for each question.

Scale: 1 centimeter = 530 kilometers (1 inch = equals 838 miles)

1. How far away from Earth would the Moon be in centimeters and inches?

2. How far away from Earth would a communication satellite be in centimeters and inches?

3. How far away from Earth would the Sun be in centimeters and inches?

4. About how many times farther away from Earth is the Sun than the Moon is?

<table>
<thead>
<tr>
<th>Distance (Kilometers)</th>
<th>Distance (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth-communications satellite</td>
<td>35,000</td>
</tr>
<tr>
<td>Earth-Moon</td>
<td>384,000</td>
</tr>
<tr>
<td>Earth-Sun</td>
<td>150,000,000</td>
</tr>
</tbody>
</table>
Create a Scaled Map of Your Classroom

Use this sheet to create a scaled map of your classroom with objects in it drawn to scale. Your teacher will tell you the dimensions of your classroom.

First determine the scale you will use. Figure out how many squares on your graph paper will represent a certain unit of measurement. For instance, two squares on the graph paper might represent 1 meter.

Your map should include large objects such as desks, tables, and standing bookcases.

Classroom dimensions: ________________________________

Scale: ____________________________________________

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How Do We Know? Mine the Moon

Review the questions below for each section of *How Do We Know?* Then read each section in the book and answer the questions.

**THE ISSUE**
As you read, analyze the writing by thinking about these questions:

1. How does the science writer capture your interest at the beginning of the feature?

_______________________________________________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________

2. How does the picture on page 26 help you understand the topic?

_______________________________________________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________

**THE EXPERT**

3. How does Carle Pieters study the Moon?

_______________________________________________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________

**IN THE FIELD**

4. What does Carle Pieters do with the information collected by *Chandrayaan-1*?

_______________________________________________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________

**TECHNOLOGY**

5. How did the imaging spectrometer aboard *Chandrayaan-1* work?

_______________________________________________________________________________________
_______________________________________________________________________________________
_______________________________________________________________________________________
Math Connection: Run Around

India’s *Chandrayaan-1* spacecraft orbited the Moon once every 117 minutes 36 seconds (117.6 minutes).

Show your calculations as you answer the questions.

1. How many times did the robotic spacecraft circle the Moon in one day?

2. How many orbits did the spacecraft complete in the 312 days it spent circling the Moon?
Imagine you are a journalist for a kids’ science magazine. You are assigned to write an article about planetary geologist Carle Pieters and her work.

Your job: Prepare 10 questions to ask Carle in an interview.

Your questions should cover a variety of topics, such as:
> Carle’s experiences as a planetary geologist.
> Carle’s childhood and personal characteristics.
> Carle’s research on the Moon’s geology.

Remember, good journalists use the 5W’s and H—what, who, why, where, when, and how—to gather information.

Interview questions

1. ______________________________________________________________________________________
2. ______________________________________________________________________________________
3. ______________________________________________________________________________________
4. ______________________________________________________________________________________
5. ______________________________________________________________________________________
6. ______________________________________________________________________________________
7. ______________________________________________________________________________________
8. ______________________________________________________________________________________
9. ______________________________________________________________________________________
10. ____________________________________________________________________________________
Use this sheet to answer the *Hey, I Know That!* questions on page 30 of *Sun, Earth, and Moon*.

**Match each question to a photograph and then answer the questions.**

1. A spacecraft took this picture of Earth and the Moon. In which direction would you look to find the Sun? Why? (page 17)

   **Photo:** _______
   **Answer:**
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

2. The dark smudge on Earth’s surface is the enormous shadow of what? (page 20)

   **Photo:** _______
   **Answer:**
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

3. What bright objects created the streaks in this time-lapse photograph? What is spinning to create the streaking effect? (page 16)

   **Photo:** _______
   **Answer:**
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

4. Hey, where did all the water go? Why are these boats stranded high and dry? Explain what is happening in this photo. (page 23).

   **Photo:** _______
   **Answer:**
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

5. Look at this photo from space of North America and South America. What season is it in the north? How about the south? Is the North Pole or South Pole pointing toward the Sun? (pages 16 and 17).

   **Photo:** _______
   **Answer:**
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________