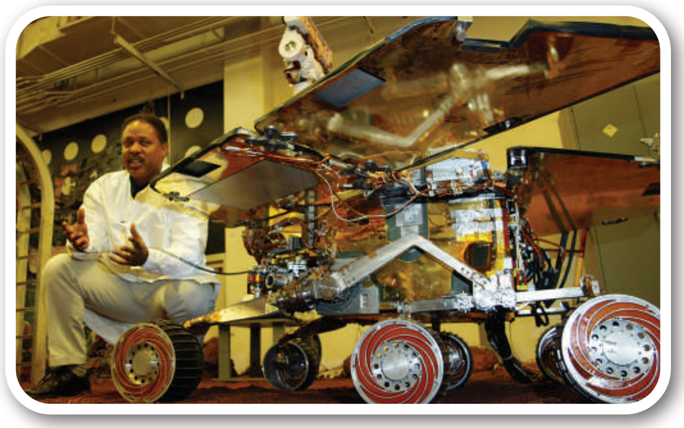
Core Knowledge® SCIENCE

Learning About Science

Science Literacy Teacher Guide

Predictions, claims, and evidence

The way things work



Using models

Learning About Science

Science Literacy Teacher Guide

Core Knowledge®

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Introduction

About Science Literacy

The goal of teaching students science from Kindergarten through high school graduation is not to turn every student into a scientist by profession, but rather it is to make scientifically literate citizens of them. At first glance, the term *science literacy* implies knowledge of the procedures and skills involved in scientific processes. A science-literate citizen does not necessarily commit to memory great volumes of content knowledge about the physical, life, or earth and space sciences. That person might know factual information, but science literacy is not limited to knowing facts. A science-literate person knows how to employ scientific thinking. Science literacy is a mindset that values the importance of observing, hypothesizing, and testing. Science literacy involves awareness of how scientists obtain and analyze data, what a conclusion is, how conclusions are shared, and what it means for an idea to be elevated to the status of a scientific theory or law. Furthermore, a person who is science-literate understands that science grows and that the science behind any subject may change as new facts become established. Certainly, science literacy must encompass all of these notions.

Expanding on this vision, a science-literate citizen understands the role of science in our society, acknowledging the importance of science knowledge in helping private and public groups make decisions based not on emotion, rumor, gossip, or hearsay but rather on the foundation of careful research and established scientific facts. One ethical commitment of a scientifically literate populace is a willingness to incorporate scientific thought into aspects of popular thought, emotion, and mood, and so scientific thinking helps balance discussions at all levels of government and all levels of private decision-making.

An even wider view of science literacy is that it can apply to all aspects of human learning, such as art, history, biography, mathematics, music, philosophy, and literature. To these areas of human endeavor, the scientifically literate person applies scientific thinking to make informed judgments about a novel or a painting to understand the artist's vision. A scientifically literate view of history, for example, focuses on how science and society interacted in the past, determines at what times science flourished, and examines when and why at other times it did not.

Core Knowledge Foundation is committed to a broad view of the term *science literacy* and to curricula that fosters science literacy in students incrementally over time. A person, no matter what age, can be conversant with grade-appropriate science processes. Young learners can consider science and its relationship to society. Relating a scientific mindset to other areas of human thought builds citizens capable of contributing, clarifying, and communicating worthy viewpoints to all aspects of societal life. Indeed, building a science-literate citizenry is an elevated goal.

Designed instructionally into the Core Knowledge curriculum, science literacy means students know the following:

- what science is,
- how to describe science and participate in it, and
- how to evaluate information as evidence and use data for decision-making.

With practice, students can grow into their own science literacy by knowing how to read about—and for emerging readers, listen to—scientific topics and discern validity. Science literacy is made more achievable for all learners with fortified background knowledge.

- In Grades K and 1, science literacy is focused on students learning science words.
- In Grades 2 and 3 science literacy expands to reading comprehension, to recognizing science concepts, and to students making connections from chapter contents
  - to processes in the day-to-day, and
  - to other content areas and disciplines.
- In Grades 4–5, science literacy expands to students understanding the uses of background knowledge and new information for decision-making and problem-solving.
- In Grades 6–8, science literacy increases in complexity with the evaluation of the quality of information and the legitimacy of claims and the evidence used to support them.

Vocabulary fluency is integral to background knowledge and literacy. By the end of the CK Science Literacy series for Kindergarten through Grade 5, students will have been repeatedly exposed to the meanings of dozens of science domain terms across multiple contexts.

Standards

Core Knowledge Science offers units that comprehensively address all of the Next Generation Science Standards (NGSS) in a three-dimensional approach that integrates Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Crosscutting Concepts (CCCs). The program clusters the NGSS Performance Expectations into physical science, life science, and earth and space science units. Stemming from the commitment that background knowledge is essential, the units build around Student Books, which largely center on all of the NGSS DCI concepts. However, the pure NGSS approach de-emphasizes reading, and the standards do not treat the Science and Engineering Practices or the Crosscutting Concepts as *content*, or discreet ideas to be taught and learned. This omission makes the SEPs and CCCs logical concepts for focus of direct student attention. Core Knowledge maintains that it is favorable and valuable for students to read or hear stories that are specifically about practices and overarching concepts.

The lessons in Kindergarten Core Knowledge Science Literacy are constructed to cultivate student exposure to and understanding of the ideas present in the following NGSS dimensions. Lessons also cite relevant support of Common Core State Standards for English and Language Arts.

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

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Nature of Science

NOS1. Scientific Investigations Use a Variety of Methods

- Science investigations begin with a question.
- Scientists use different ways to study the world.

NOS2. Scientific Knowledge Is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world.

NOS3: Scientific Knowledge Is Open to Revision in Light of New Evidence

- Science knowledge can change when new information is found.

NOS4. Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Scientists use drawings, sketches, and models as a way to communicate ideas.
- Scientists search for cause-and-effect relationships to explain natural events.

NOS5. Science Is a Way of Knowing

- Science knowledge helps us know about the world.

NOS6. Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes natural events happen today as they happened in the past.
- Many events are repeated.

NOS7. Science Is a Human Endeavor

- People have practiced science for a long time.
- Men and women of diverse backgrounds are scientists and engineers.

NOS8. Science Addresses Questions About the Natural and Material World

- Scientists study the natural and material world.

Science and Engineering Practices

SEP1. Asking Questions (for science) and Defining Problems (for engineering)

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world(s) works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify ideas. Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Ask and/or identify questions that can be answered by an investigation.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

SEP2. Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions, and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs. Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Distinguish between a model and the actual object, process, and/or events the model represents.
- Compare models to identify common features and differences. Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
- Develop a simple model based on evidence to represent a proposed object or tool.

SEP3. Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- With guidance, plan and conduct an investigation in collaboration with peers (for K).
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.
- Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
- Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
- Make predictions based on prior experiences.

SEP4. Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective. Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Record information (observations, thoughts, and ideas).
- Use and share pictures, drawings, and/or writings of observations.

- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
- Compare predictions (based on prior experiences) to what occurred (observable events).
- Analyze data from tests of an object or tool to determine if it works as intended.

SEP5. Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks, such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).

- Decide when to use qualitative vs. quantitative data.
- Use counting and numbers to identify and describe patterns in the natural and designed world(s).
- Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
- Use quantitative data to compare two alternative solutions to a problem.

SEP6. Constructing Explanations (for science) and Designing Solutions (for engineering)

The end products of science are explanations and the end products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints. Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
- Generate and/or compare multiple solutions to a problem.

SEP7. Engaging in Argument from Evidence

Argumentation is the process by which evidence-based conclusions and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims. Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

- Identify arguments that are supported by evidence.
- Distinguish between explanations that account for all gathered evidence and those that do not.
- Analyze why some evidence is relevant to a scientific question and some is not.
- Distinguish between opinions and evidence in one's own explanations.
- Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument.
- Construct an argument with evidence to support a claim.
- Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

SEP8. Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs. Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.
- Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.
- Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Crosscutting Concepts

CCC1. Patterns

In grades K–2, children recognize that patterns in the natural and human-designed world can be observed, used to describe phenomena, and used as evidence.

Patterns . . . are a pervasive aspect of all fields of science and engineering. When first exploring a new phenomenon, children will notice similarities and differences, leading to ideas for how they might be classified. The existence of patterns naturally suggests an underlying cause for the pattern. For example, observing snowflakes are all versions of six-side symmetrical shapes suggests something about how molecules pack together when water freezes; or, when repairing a device, a technician would look for a certain pattern of failures suggesting an underlying cause. Patterns are also helpful when interpreting data, which may supply valuable evidence in support of an explanation or a particular solution to a problem.

CCC2. Cause and Effect

In grades K–2, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.

Cause and effect lies at the heart of science. Often, the objective of a scientific investigation is to find the cause that underlies a phenomenon, first identified by noticing a pattern. Later, the development of theories allows for predictions of new patterns, which then provides evidence in support of the theory. For example, Galileo's observation that a ball rolling down an incline gathers speed at a constant rate eventually led to Newton's Second Law of Motion, which in turn provided predictions about regular patterns of planetary motion, and a means to guide space probes to their destinations.

CCC3. Scale, Proportion, and Quantity

In grades K–2, students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.

Scale, proportion, and quantity are essential considerations when deciding how to model a phenomenon. For example, when testing a scale model of a new airplane wing in a wind tunnel, it is essential to get the proportions right and measure accurately or the results will not be valid. When using a computer simulation of an ecosystem, it is important to use informed estimates of population sizes to make reasonably accurate predictions. Mathematics is essential in both science and engineering.

CCC4. Systems and System Models

In grades K–2, students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world(s) have parts that work together.

Systems and system models are used by scientists and engineers to investigate natural and designed systems. The purpose of an investigation might be to explore how the system functions or what may be going wrong. Sometimes investigations are too dangerous or expensive to try out without first experimenting with a model.

CCC5. Energy and Matter (flow in systems)

In grades K–2, students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.

Energy and matter are basic to any systems model, whether of a natural or a designed system. Systems are described in terms of matter and energy. Often, the focus of an investigation is to determine how energy or matter flows through the system, or in the case of engineering to modify the system, so a given energy input results in a more useful energy output.

CCC6. Structure and Function

In grades K–2, students observe the shape and stability of structures of natural and designed objects are related to their function(s).

Structure and function can be thought of as a special case of cause and effect. Whether the structures in question are living tissue or molecules in the atmosphere, understanding their structure is essential to making causal inferences. Engineers make such inferences when examining structures in nature as inspirations for designs to meet people's needs.

CCC7. Stability and Change (factors to always consider)

In grades K–2, students observe some things stay the same while other things change, and things may change slowly or rapidly.

Stability and change are ways of describing how a system functions. Whether studying ecosystems or engineered systems, the question is often to determine how the system is changing over time, and which factors are causing the system to become unstable.

Engineering and Design

ED.A. Defining and Delimiting Engineering Problems

Defining and delimiting engineering problems involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.

- Define - Identify situations that people want to change as problems that can be solved through engineering

ED.B. Developing Possible Solutions

Designing solutions to engineering problems begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.

- Develop solutions - Convey possible solutions through visual or physical representations

ED.C. Optimizing Design Solutions

Optimizing the design solution involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important.

- Optimize - Compare solutions, test them, and evaluate each

Science, Technology, Society, and the Environment

STSE1. Interdependence of Science, Engineering, and Technology

- Science and engineering involve the use of tools to observe and measure things.

STSE2. The Influence of Engineering, Technology, and Science on Society and the Natural World

- Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Taking natural materials to make things impacts the environment.

Common Core State Standards for English and Language Arts

Reading Standards for Informational Text

Key Ideas and Details:

- **CCSS.ELA-LITERACY.RI.2.1:** Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text.
- **CCSS.ELA-LITERACY.RI.2.2:** Identify the main topic of a multiparagraph text as well as the focus of specific paragraphs within the text.
- **CCSS.ELA-LITERACY.RI.2.3:** Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

Craft and Structure:

- **CCSS.ELA-LITERACY.RI.2.4:** Determine the meaning of words and phrases in a text relevant to a *grade 2 topic or subject area.*
- **CCSS.ELA-LITERACY.RI.2.5:** Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.
- **CCSS.ELA-LITERACY.RI.2.6:** Identify the main purpose of a text, including what the author wants to answer, explain, or describe.

Integration of Knowledge and Ideas:

- **CCSS.ELA-LITERACY.RI.2.7:** Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.
- **CCSS.ELA-LITERACY.RI.2.8:** Describe how reasons support specific points the author makes in a text.
- **CCSS.ELA-LITERACY.RI.2.9:** Compare and contrast the most important points presented by two texts on the same topic.

Range of Reading and Level of Text Complexity:

- **CCSS.ELA-LITERACY.RI.2.10:** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2–3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

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.

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

Students come to elementary classrooms across the country with a wide range of prior experiences. Some have grown up in cities away from nature. Others have grown up in the country, intimately involved in nature.

Some have had teachers and/or family members who have been reading aloud and sharing the wonderful world of animals and plants with them for several years, while others have not. Some have traveled to other cities, states, and countries, while others may know only their own family and neighborhood.

Draw out students. Give them the opportunity to express what they know about the natural world, about rocks, the stars, motion, giraffes, or matter. You can assess the prior knowledge students have about science, and since science deals with everything around a child, the wealth of their background in science should not be underestimated.

Features

Using the Student Book

The *Learning About Science* Student Book includes twenty chapters, intended to be read aloud by the teacher as the students look at images on each page.

Online Resources

The Student Book is spiral bound to allow students to lay it flat when reading or following along. Core Knowledge offers a template for a bookmark. (See the Online Resources Guide for a link to the template **www.coreknowledge.org/cksci-online-resources**) When starting any unit of study, you may wish to download the template, print one per student, and have each student create a personal bookmark.

As you will note when you examine the Student Book, limited 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–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 CK Science Literacy lessons is to build students' understanding and knowledge of science concepts, as well as of associated practices and skills, 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 texts that they hear read aloud than they would ever be able to read or comprehend when they read to themselves. 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.

Online Resources

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

Activity Pages

Activity Pages

AP 1–20

Black line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 176–199. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced.

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

Lesson 1—Work in Space! (AP 1)

Lesson 2—Draw Your Own Comic About Nature (AP 2)

Lesson 3—What Do You Say? (AP 3)

Lesson 4—What's the Problem? (AP 4)

Lesson 5—Plan Your Own Model (AP 5)

Lesson 6—Make Your Own Squishy Putty (AP 6)

Lesson 7—Using Weather Data (AP 7)

Lesson 8—Ice Cream Sales (AP 8)

Lesson 9—Designing a Solution (AP 9)

Lesson 10—Claims, Evidence, and Reasoning (AP 10)

Lesson 11—Growing Gummies (AP 11)

Lesson 12—Patterns in Your School (AP 12)

Lesson 13—Theories (AP 13)

Lesson 14—Half, Quarter, Whole (AP 14)

Lesson 15—Learning from Models (AP 15)

Lesson 16—Flexible and Rigid (AP 16)

Lesson 17—Structures and Functions (AP 17)

Lesson 18—Are You Able to Label the Fable? (AP 18)

Lesson 19—Best Test (AP 19)

Lesson 20—Raw Materials (AP 20)

Online Resources and Digital Engagements

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. In addition to resources supporting specific chapter activities, Core Knowledge also offers a collection of Digital Engagements designed for teacher-facilitated classroom use.

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

www.coreknowledge.org/cksci-online-resources

Materials and Equipment

These lessons suggest a moderate variety of materials to support activities that enhance the Science Literacy chapter readings. Prepare in advance by collecting the materials and equipment needed for all the demonstrations and hands-on investigations.

Internet access and the means to project images/videos for whole-class viewing are also required in many lessons but not repeated below.

Lesson 2

- ball or marble
- ramp
- masking tape
- colored pencils, erasers

Lesson 6

- folded paper airplane
- cornstarch
- clear dish soap
- spoon
- bowl
- food dyes

Lesson 7

- colored beads or markers to display a pattern

Lesson 9

- reference books and other research materials
- materials for drawing, such as pencils, markers, crayons, and paper

Lesson 10

- reference books and other research materials

Lesson 11

- gummy bear candies
- small bowls
- plastic spoon
- paper towels
- water
- ruler (optional)

Lesson 13

- computers or tablets for research

PACING

The Core Knowledge Science Literacy Student Book consists of twenty chapters, each six pages long. This accompanying Teacher Guide contains one lesson of instructional support per chapter. Each lesson offers prompts for the teacher to use in facilitation of class discussion. Many lessons offer brief hands-on activities, teacher demonstrations, or online enhancements in addition to the reading support. All lessons include an Activity Page reproducible master.

The Science Literacy lessons, requiring 30–45 minutes each, can be implemented in sequence, as a stand-alone unit across twenty consecutive class sessions. The unit can also serve as the basis of an enrichment program. Or, teachers may elect to use one lesson per week across the school year, layered in tandem with other physical, life, and earth/space science content units. To assist with the latter approach, the following table provides a key suggesting the science domain most prominently emphasized in each Science Literacy chapter to help pair the chapters meaningfully with other units.

Science Literacy Chapter	Has content that ties to . . .	Science Literacy Chapter	Has content that ties to . . .
1. Scientists All Over	Physical, life, and earth science	**11.** Sparky Shares Evidence	Physical science, energy
2. Nature!	Physical, life, and earth science	**12.** Patterns and Designs	Earth science, land and water
3. Evidence	Physical science, matter	**13.** What's a Theory?	Earth science, land and water
4. Defining Problems	Physical science, matter	**14.** Parts of Whole Amounts	Earth science, land and water
5. Look at Models	Life science, habitats	**15.** Learning from Models	Life science, plants
6. Ahn's Evaluation	Physical science, matter	**16.** Single-Sheet Creativity	Life science, plants
7. Using Data	Life science, habitats	**17.** Working Parts	Life science, plants
8. Patterns in Numbers	Live science, habitats	**18.** Stable Mabel	Life science, habitats
9. Will It Work?	Life science, habitats	**19.** Test That Tech!	Life science, habitats
10. A Friendly Challenge	Physical science, energy	**20.** Nature's Building Supplies	Physical science, light and sound

Online Resources

Also, see the Online Resources Guide for recommendations about when to best enhance instruction through the use of the Core Knowledge Science Literacy Digital Engagements designed to support these chapters.

www.coreknowledge.org/cksci-online-resources

LESSON 1

Scientists All Over

At a Glance

Lesson Question

Who takes part in science?

Learning Objective

✓ Relate science investigations to the work people do in many fields, including:

- materials and the building of physical objects;
- understanding living things and how they survive;
- understanding Earth and the processes that take place on the planet; and
- understanding outer space and the objects within it.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration

Main Science Idea

Science is done by people seeking answers to questions. Scientists can work in many different fields of knowledge and use tools as part of their investigations.

NGSS and CCSS References

NOS1. Scientific Investigations Use a Variety of Methods: Science investigations begin with a question. Scientists use different ways to study the world. (Also NOS7)

For detailed information about the NGSS and CCSS 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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Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

engineer **science** **scientist**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

glacier **material**

Instructional Resources

Student Book
Ch. 1

Student Book, Chapter 1
"Scientists All Over"

Activity Page
AP 1

Activity Page
Work in Space! (AP 1)

Materials and Equipment

Collect or prepare the following items:

- none

The Core Lesson

1. Focus attention on the Lesson Question.

Discuss what it takes to become an astronaut. Students may say that the candidate has to be physically fit and like new adventures. Point out that many people who go to space have studied to become scientists or engineers.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: Who takes part in science?

2. Read together: "Scientists All Over."

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 1 on page 2. Tell students that the title of this chapter is "Scientists All Over," and tell them to pay special attention to how NASA astronauts use science as you read.

Read Aloud Support

Page 2

Ask students to look at the images as you read aloud. Make sure they understand that NASA is the U.S. space agency.

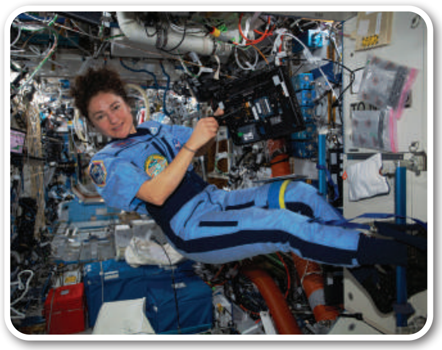
CHAPTER 1

Scientists All Over

Welcome to NASA! Many scientists and engineers have worked here. Let's meet some of them and see what science they have done.

Kathryn Beckwith is an engineer. She solves problems related to exploring the planet Mars with rovers and helicopters. One problem is how to make the helicopters as light as possible. She thinks about different kinds of materials and tests how well they solve the problem.

Jessica Meir is a scientist and an astronaut. While in space, she investigated how the human heart works in space. She also solved all kinds of computer problems.



2

LITERAL—What is Kathryn Beckwith's job title?

» She is an engineer.

Call attention to the word **engineer**. Build on students' prior knowledge of engineers, and explain that an engineer solves problems by using **science** and math. As an example, point out that Mars has very little gas surrounding the solid planet, compared to the air around Earth, so a helicopter that flies on Earth could not fly on Mars.

LITERAL—What are Jessica Meir's job titles?

» She is a scientist and an astronaut.

Call attention to the word **scientist**. Elicit from students that a scientist investigates to answer questions, such as how well a material works in space.

Page 3 **Ask students to look at the images of Victor Glover in space as you read aloud.**

Victor Glover is also an engineer and an astronaut. On the International Space Station, he carried out science investigations in space. Here, he is working on an investigation to learn how small plants grow in space without soil.

He also completed four space walks to set up and fix science equipment attached to the space station.

3

INFERENTIAL—How did Victor Glover work as a scientist and an engineer in space?

» As a scientist, he carried out investigations about growing plants; as an engineer, he fixed equipment.

EVALUATIVE—Which is more interesting, working as a scientist or as an engineer in space?

» Sample answer: an engineer, because they get to go outside the space station to do space walks

Call attention to the investigation about growing small plants. Ask students the following: What science question is this investigation trying to answer? (How well do small plants grow in space without soil?) Point out that if plants grow well in space, they can be used as food for astronauts on long space journeys.

Page 4

Have students listen for the words of Jane Rigby as you read aloud. Point out the quotation marks, and explain that they show where the exact words of a speaker or writer begin and end.

NASA scientists work on the ground, too. These scientists are checking a newly made mirror. It will be part of a telescope that circles Earth. The telescope will be used to answer questions about planets beyond our solar system.

Jane Rigby hopes to use the space telescope to find out how stars form and change. "Give me a telescope, and I can come up with something good to do with it," she said.

Jane Rigby's words come from an article titled "Meet the Woman Who Makes the James Webb Space Telescope Work" in a magazine called *Scientific American*. The article was written by an author named Lee Billings and published on July 11, 2022. When a book uses somebody else's words, it is important to tell the reader where the words came from.

4

Explain that the six-sided mirror shown is one of eighteen identical mirrors that fit together like a jigsaw puzzle when the telescope was assembled.

The problem engineers of the James Webb Space Telescope were trying to solve was how to design and launch a telescope large enough to see planets forming around distant stars.

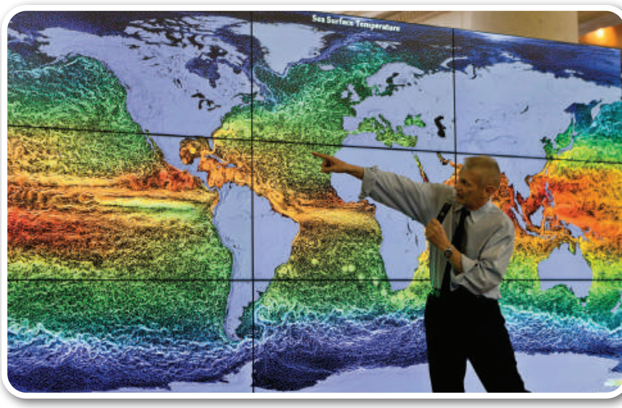
Online Resources

EXTEND—Allow interested students to go online to explore the James Webb Space Telescope in greater detail. The NASA website for K–5 students is called "Space Place" and includes animations, photos, and videos about the telescope. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 5 **Have students look at the images as you read aloud.** Ask what they notice about the tools the scientists use.

Konrad Steffen was a NASA scientist who investigated the cold ice of glaciers on Earth. One thing he studied was how much ice is melting or freezing.

Piers Sellers was a NASA scientist and an astronaut. He investigated Earth's weather using satellites that orbit Earth. Here, he points to the Atlantic Ocean on a map. The map shows ocean water temperatures. over time.



5

INFERENTIAL—What kinds of tools did these scientists use?

» laptop computers and giant video screens

INFERENTIAL—What parts of Earth did they investigate?

» places where it is very cold and the ocean

Online Resources

SUPPORT—If students are unfamiliar with glaciers, show them online images, animations, and text explaining where these large bodies of ice are located and how they move. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Point out that NASA often investigates Earth and its processes using tools that are launched into space, such as satellites carrying sensors that can measure changes on Earth.

Page 6 **Have students look at the image as you read aloud.** Discuss what they notice about the plant.

Nick Hague is a scientist and an engineer. One of his science-in-space investigations was to find out if food can be grown in space to feed astronauts.

Think about questions that a scientist like Nick Hague must try to answer. Start by thinking about the differences between where plants grow on Earth and the conditions in space. In orbit, both people and plants experience a microgravity environment. There is no wind or rain inside a space station. There is no ground composed of soil. Some of those conditions can be duplicated to test plant growth on Earth. Which condition cannot?

6

Point out that the plant in the photo is mizuna mustard greens.

INFERENTIAL—Does the plant in the photo remind you of foods you or your family eat?

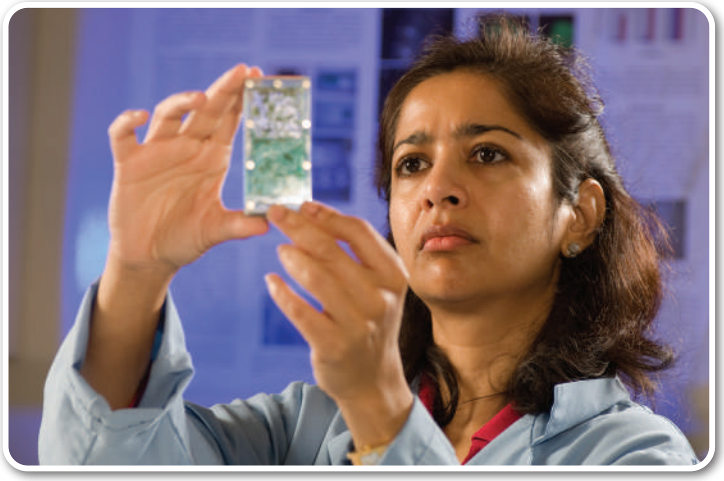
» Yes, it looks like the greens my parents cook in a pan with garlic and oil.

Guide students to answer the text question by asking their own questions about foods they would like to eat in space. Students will likely hold a lively discussion about their favorite foods. Focus on foods from plants that can be grown in relatively contained spaces.

SUPPORT—Provide a sentence frame for students to complete, such as "How can astronauts grow ________ in space?

Page 7 **Ask students to listen as you read aloud for the kind of animal this scientist investigates.**

Sharmila Bhattacharya is also a NASA scientist. She works on Earth's surface, but her investigations send fruit flies into space. Her team investigates how animals survive in space.



Well, that ends your visit with some people at NASA who do science. What if you become a NASA scientist or engineer? Would you want to work on the ground or become an astronaut and perform your investigations in space?

Main Science Idea

All kinds of people are scientists. They work in many different types of places.

7

LITERAL—What kind of animal does Sharmila Bhattacharya send into space?

» fruit flies

SUPPORT—For students not familiar with common fruit flies, explain that these are very small (3 mm long) insects. They take up very little room on a space vehicle, are easy to feed, and lay eggs and complete their life cycles in ten days.

3. Check for understanding.

Activity Page

AP 1

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 1 to students, and explain that their task is to complete the poster by writing four science or engineering activities astronauts do.

See the Answer Key for sample or correct answers.

LESSON 2

Nature!

At a Glance

Lesson Question

What is certain about nature?

Learning Objectives

- ✓ Recognize that some events can be predicted with certainty.
- ✓ Distinguish age-accessible examples of events that are certain from outcomes that can vary with conditions.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- cartoon drawing

Main Science Idea

Science assumes certain patterns in nature repeat and have always repeated. This allows scientists to make predictions about what will happen next.

NGSS and CCSS References

NOS6. Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes natural events happen today as they happened in the past. Many events are repeated.

L.2.4. Vocabulary Acquisition and Use: Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 2 reading and content, choosing flexibly from an array of strategies.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

nature **predict** **repeats**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

certain **vary**

Instructional Resources

Student Book

Ch. 2

Student Book, Chapter 2
"Nature!"

Activity Page

AP 2

Activity Page
Draw Your Own Comic About Nature (AP 2)

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project images/video for whole-class viewing
- ball or marble
- ramp
- masking tape
- colored pencils, erasers

The Core Lesson

1. Focus attention on the Lesson Question.

If it is a sunny day, take students outdoors, and have them stand in the shade. Then have them predict how they will feel if they step into the sun. Discuss how they always feel warmer when sunlight reaches them.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What is certain about nature?

2. Read together: "Nature!"

Student Book

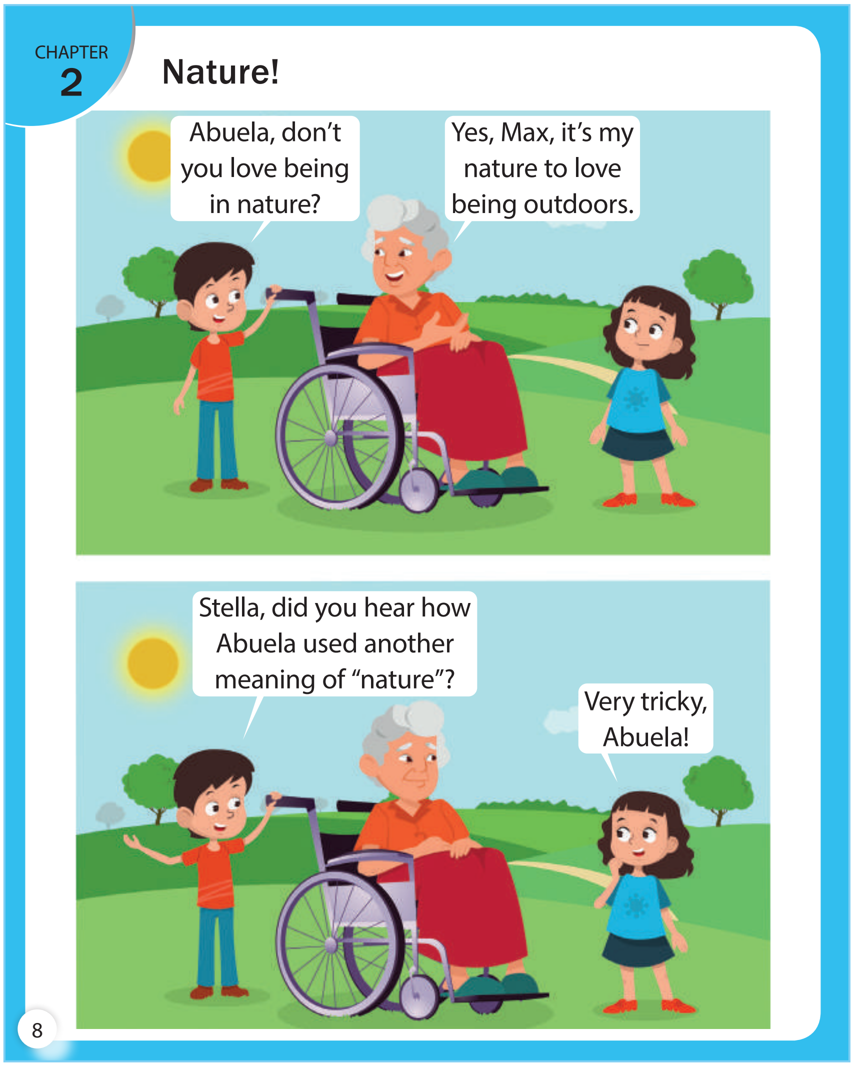
Ch. 2

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 2 on page 8. Tell students that the title of this chapter is "Nature!" and tell them to pay special attention to how nature repeats itself as you read.

Page 8

Ask students to look at the pictures and speech bubbles as you read aloud. Talk about how each bubble has a tail that points to the character who is speaking.



LITERAL—Who are the characters in this comic-book story?

» Max, Abuela, and Stella

If students do not know it, point out that *abuela* means "grandmother" in Spanish.

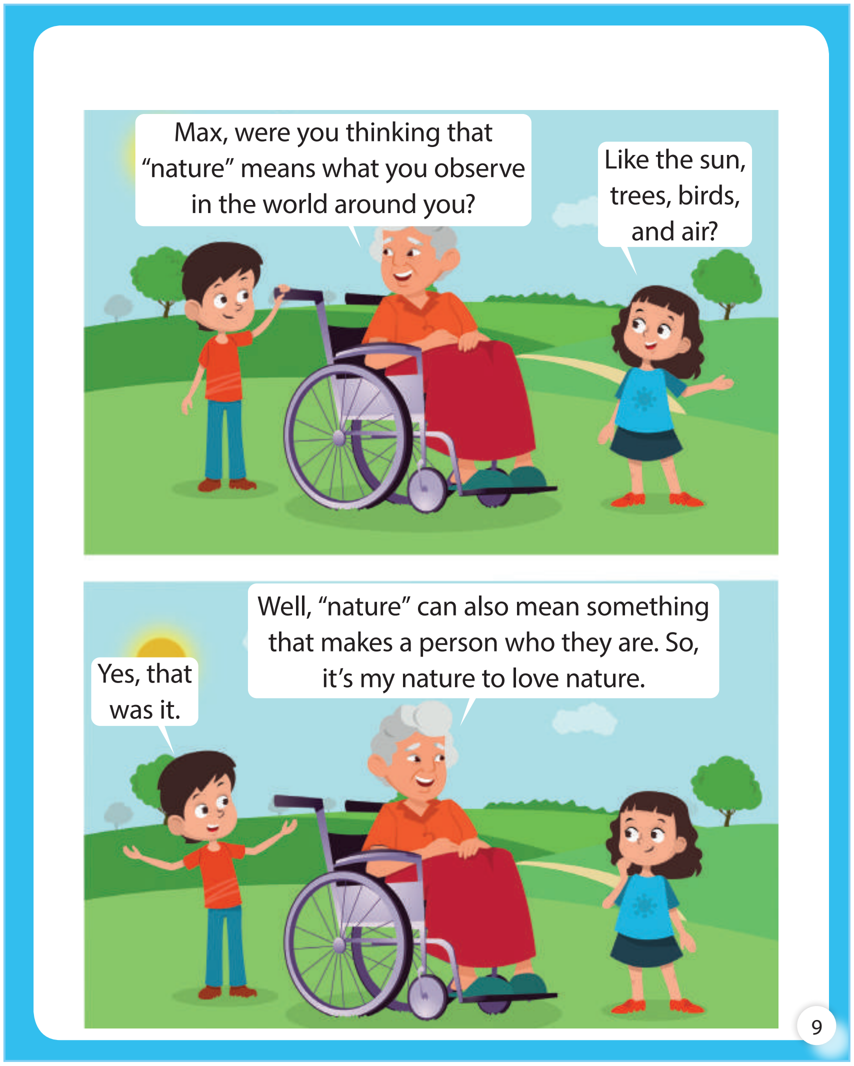
INFERENTIAL—Which word on this page seems to have more than one meaning?

» *nature*

INFERENTIAL—Why is Abuela tricky in her answer?

» because she wants to teach her grandchildren a new word meaning

Page 9 **Have students look at the speech bubbles as you read aloud.** Challenge them to listen for the two meanings of **nature**.



LITERAL—What parts of nature did Stella identify?

» the sun, trees, birds, and air

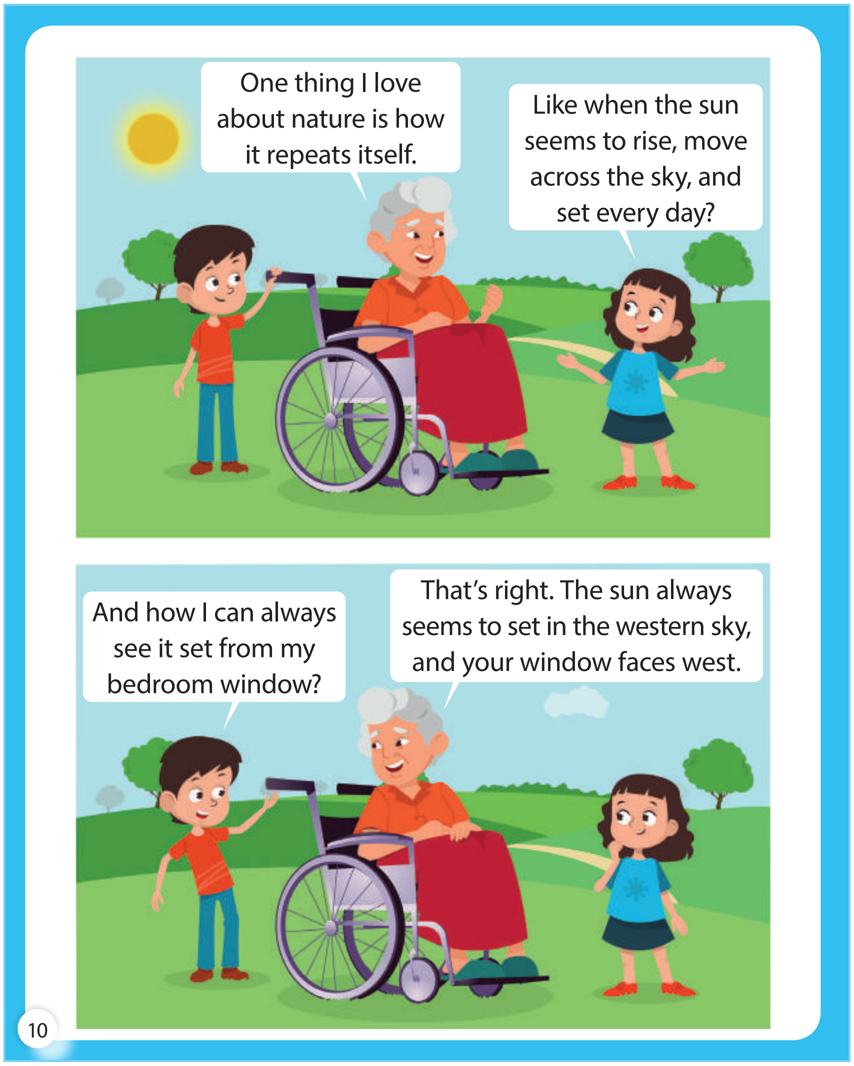
INFERENTIAL—What other parts of nature can you observe outside?

» Possible responses: the wind, the clouds, stars, rocks and fossils, how animals move, parts of plants

To help students clarify the meaning of *nature* as something that makes a person who they are, give an example of your own nature. For example, you might say, "It is my nature to want to help people." Then provide a sentence frame for students to complete, stating one thing about their own natures:

"It's my nature to be __________ in the morning."

Page 10 **Ask students to follow along reading the dialogue as you read aloud.**



LITERAL—What examples of nature repeating itself are on this page?

» the sun rising, moving across the sky, and setting each day; the sun setting in the western part of the sky

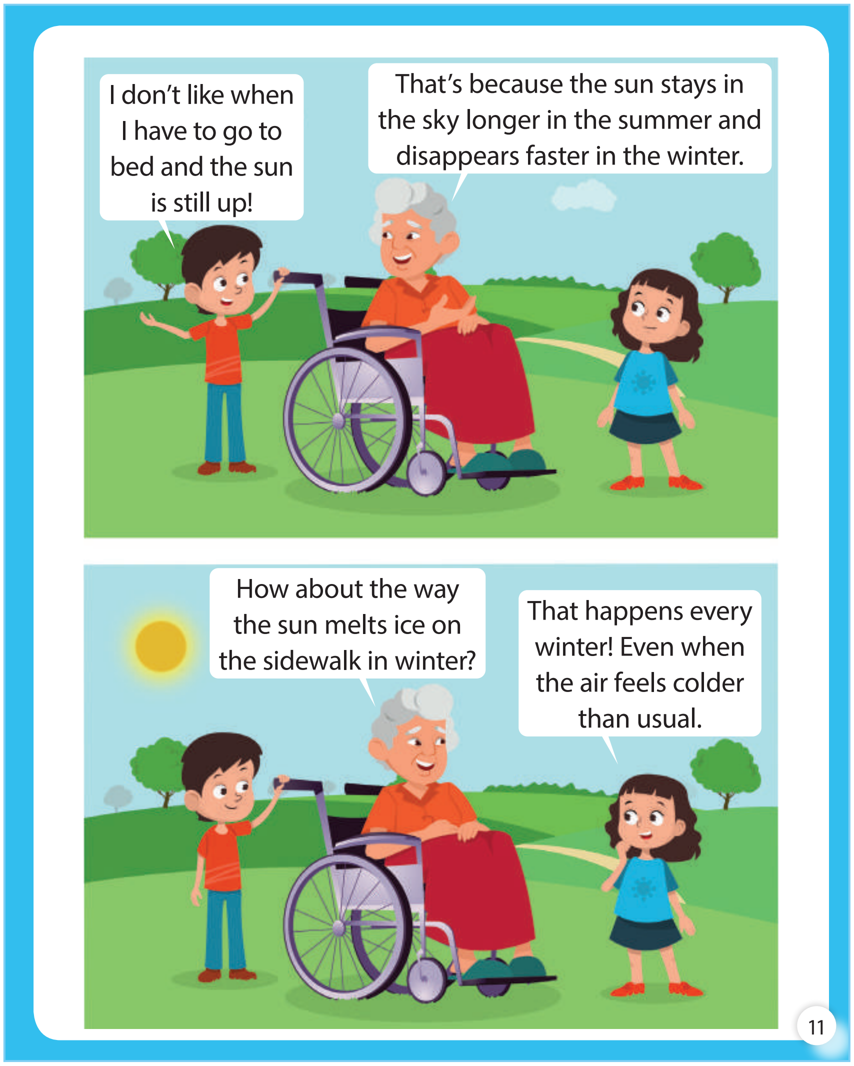
INFERENTIAL—What if it is a rainy day? Does the sun rise, move across the sky, and set on cloudy days?

» Yes, it does.

Online Resources

Show online time-lapse videos and composite images of the sun's apparent motion across the sky. Point out how the sun always rises on one side of the frame and sets on the other side. Emphasize that the motion **repeats** each day. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 11 **Ask students to look at the speech bubbles as you read aloud.**



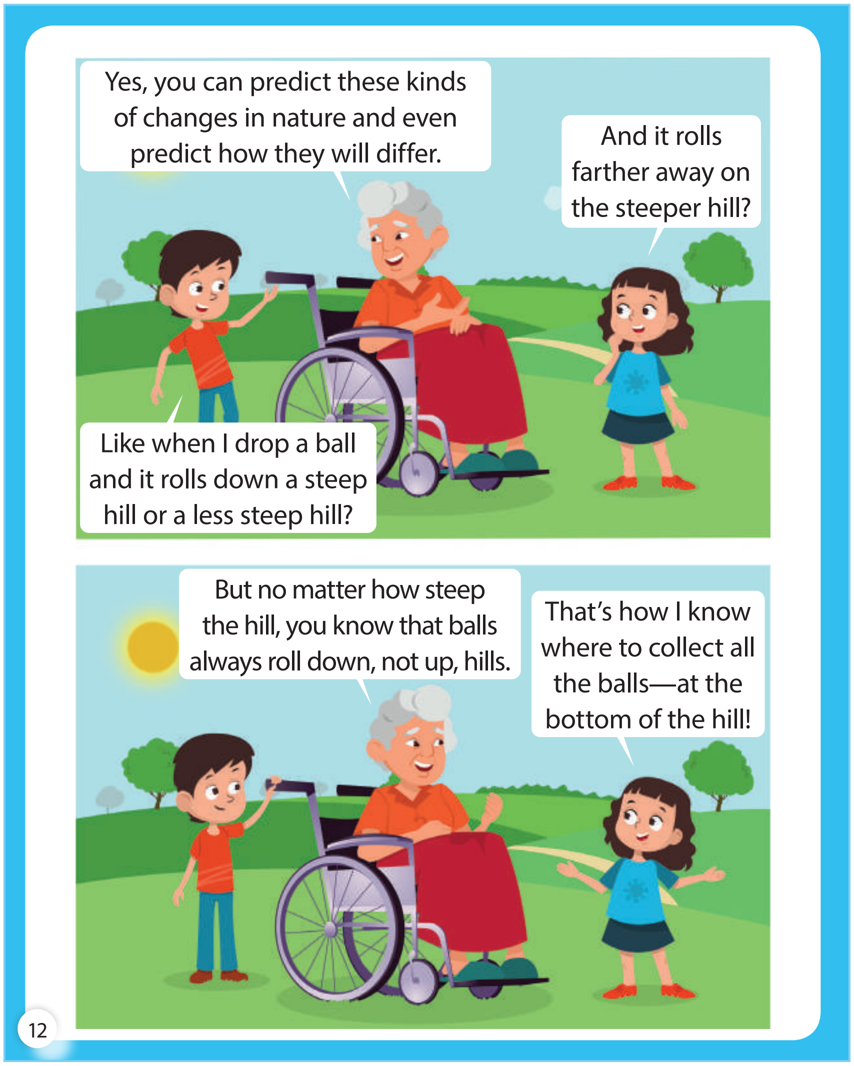
Invite students to share their experiences with these two phenomena: the length of daytime varying with the seasons and how the sun melts ice.

Note that sidewalk ice melts on a sunny day because concrete absorbs more energy from the sun than the air does. As heat is conducted from the sidewalk to the ice, the ice starts to melt.

Know the Standards

NOS6. Scientific Knowledge Assumes an Order and Consistency in Natural Systems *Consistency* refers to events governed by natural or scientific laws—phenomena such as gravity, conservation of momentum, or thermal equilibrium, to name a few. Some are intuitive to students as a result of experience, for example, warm and cool objects eventually reaching the same temperature as their environment.

Page 12 **Ask students to listen for predictions as you read aloud.**



LITERAL—How does Stella know where to collect all the balls when she is playing outside?

» Balls always roll downhill.

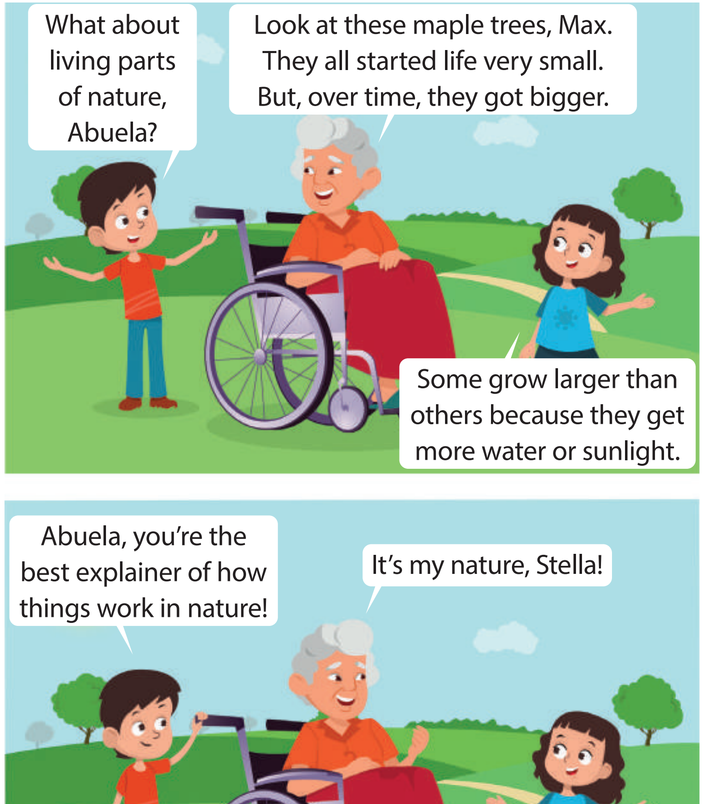
Point out that a prediction like Stella's—how round objects roll downhill in nature—is certain, or known for sure. Remind students that the sun rising in the east and setting in the west is also certain.

Give students a pair of identical balls or marbles and a flat object that they can use to make a ramp. Have students **predict** how far the balls will roll down the ramp and mark the distance with a piece of masking tape. Then have them raise or lower the ramp, predict again, and test their predictions.

INFERENTIAL—How did your results differ using a low ramp and a high ramp?

» The balls always roll farther when using the higher ramp.

Page 13 **As you read aloud, have students listen for things in nature that are certain and things that can vary.**



Main Science Idea

Some things naturally happen with certainty. In fact, that's what nature is—the set of processes that occur no matter what.

13

LITERAL—What are the living things Abuela talks about?

» maple trees

INFERENTIAL—How does Abuela return to what she taught the children on the first two pages of this chapter?

» She reminds them that the word *nature* has more than one meaning.

3. Check for understanding.

Activity Page

AP 2

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 2 and colored pencils to students, and review the directions. Look for evidence that students understand the meaning of *nature* and have identified a natural phenomenon that repeats.

See the Answer Key for sample or correct answers.

LESSON 3

Evidence

At a Glance

Lesson Question

What is scientific evidence?

Learning Objectives

- ✓ Define *evidence* as factual information (often distilled from data).
- ✓ Acknowledge that evidence is neutral and without an agenda (can just as easily support or refute a claim).

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration

Main Science Idea

Scientists look for and generate scientific evidence that can be used to support a scientific claim.

NGSS and CCSS References

NOS2. Scientific Knowledge Is Based on Empirical Evidence: Scientists look for patterns and order when making observations about the world. (Also **NOS3**)

RI.2.8. Integration of Knowledge and Ideas: Describe how reasons support specific points the author makes in a text.

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

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claim **measure** **measurement** **scientific evidence**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

matter

Instructional Resources

Student Book

Ch. 3

Student Book, Chapter 3
"Evidence"

Activity Page

AP 3

Activity Page
What Do You Say? (AP 3)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Make a claim about today's weather that is not likely correct, such as "I think it is 100 degrees Fahrenheit today." Ask students how they could check if your claim is correct or incorrect. Possible responses might include taking a thermometer outside and measuring the temperature or checking a weather app.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What is scientific evidence?

2. Read together: "Evidence."

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 3 on page 14. Tell students that the title of this chapter is "Evidence," and tell them to pay special attention to how claims are or are not supported by evidence as you read.

Read Aloud Support

Page 14 **Ask students to look at the image as you read aloud.** Discuss what they notice is happening.

CHAPTER 3

Evidence

Did anyone ever tell you a story that seemed too strange to be true? Did you ask them to "prove it"? If you did, you were asking for the facts—the scientific evidence.

Scientific evidence is information that comes from science investigations. Measurements and other observations are data that are shared with other scientists. When other scientists can repeat an investigation and get similar data, the evidence supporting a claim gets stronger. Even when new evidence does not support a claim, all the investigators learn something!

Let's look at some claims that might seem unusual.

14

LITERAL—Where do people get **scientific evidence** to support a **claim**?

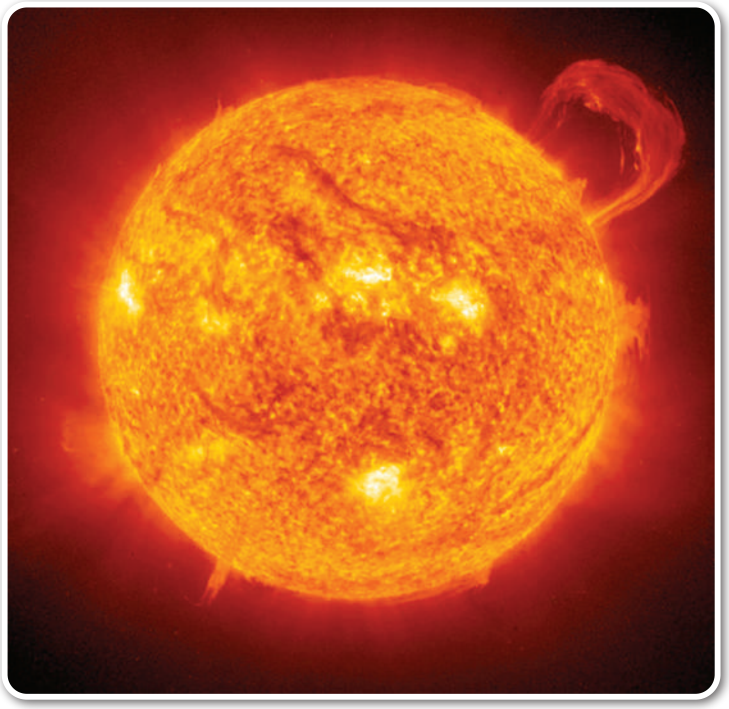
» from science investigations

INFERENTIAL—What do you think the scientists in this scene are doing?

» They are doing a science investigation to learn about the erupting volcano.

Point out that science investigations are planned to answer science questions. Brainstorm some likely questions the scientists may want to investigate in this scene, including those that require **measurement**, such as "How hot is the lava?"

Page 15 **Ask students to look at the image as you read aloud.**



Claim: The sun isn't solid, liquid, or gas.
Most people can name only those three states of matter. But scientists have observed several more states. The evidence comes from investigations that put matter in situations that are very unusual. The state of matter called plasma forms when a gas is heated to temperatures like those in the sun.

15

Explain to students that scientists use CER thinking (claim-evidence-reasoning) when developing their work.

LITERAL—What claim is made on this page?

» that the sun is some other state of matter—not a solid, liquid, or gas

INFERENTIAL—How do scientists know the sun is a plasma?

» They did an investigation that heated matter as hot as the sun, and it changed into a plasma.

Know the Standards

NOS3. Scientific Knowledge Is Open to Revision in Light of New Evidence This connection to the Nature of Science standard is closely related to Science and Engineering Practice 7: Engaging in Argument from Evidence, especially the K–2 statement "Construct an argument with evidence to support a claim."

Page 16 **Have students look at the images as you read aloud.** Talk about what they notice the animals are doing.

Claim: Animals that don't get enough salt in their food go looking for it.

Scientists have observed that many types of grazing animals gather in places where they can find salt. Salt can occur naturally in some rock formations. Animals will lick the rocks to get the salt they need to add to their plant diet. Farmers who raise grazing animals as livestock provide blocks of salt for the animals to lick. These places are called salt licks.

16

INFERENTIAL—How can scientists gather evidence about the amount of salt in different places on Earth?

» Possible answer: They can test the soil and rocks for salt.

INFERENTIAL—Based on what we read, what are the animals in the photos doing?

» They are licking and eating the salt.

INFERENTIAL—What do you predict scientists would find if they tested the soil in a grassland for salt?

» That there isn't much salt there.

Ask students to decide, based on the images and text, if the claim on this page is correct. Point out that the objects in the green buckets are salt licks.

Page 17 **Ask students to look for the spider in the image as you read aloud.** Have them point out the threads of silk.

Claim: Spider silk is incredibly strong!

Spider silk is a very light but strong form of matter. Scientists discovered that a Darwin's bark spider's silk is twice as strong as that made by other kinds of spiders. They measure the strength of spider silk with a machine. The measurement is a number that shows how much force is needed to break the thread.

The claim is true, but if another kind of spider that has a stronger silk is discovered, the claim would have to change. But that change would be OK because it would be based on evidence!

17

Explain that spiders produce silk in certain body parts and that the silk can be spun into long threads that have different functions, such as to construct webs to catch food or to move through the air.

LITERAL—What claim have scientists made about Darwin's bark spiders?

» that they make stronger silk than any other kinds of spiders do

Online Resources

EXTEND—Many students will be interested to see Darwin's bark spiders in action. Show online videos that show how these spiders use their strong silk. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 18 **Before you read, ask students to look at the image and describe what they see.**

Claim: Ice skates glide so easily on ice because the place where they touch the ice becomes liquid instead of solid.
Scientists investigated what happens when a solid material presses against the surface of ice. They found evidence that the weight of a person pressing a skinny ice-skate blade against the ice changes that sliver of the surface of the solid ice to liquid water. The liquid water makes the ice more slippery when you skate on it.

18

LITERAL—If the ice that people walk or skate on is not really solid, what is it?

» A thin layer of liquid forms on top of the ice.

INFERENTIAL—Based on what we read, how do you think scientists gathered evidence to support their claim?

» They might have put a heavy piece of metal on ice and then lifted it to find the bottom was wet.

Have students consider what would happen if the scientists had not found liquid water on top of the ice. Point out that the claim would have to be discarded and that further investigating would be needed to come up with a new claim to explain why ice is slippery.

Page 19 **Ask students to look at the image as you read aloud.**

Claim: This huge rock came from outer space.

The scientific evidence to support this claim comes from comparing properties of space rocks to those of Earth rocks. Space rocks usually feel much heavier than Earth rocks of the same size. If you cut into them, there is a way to tell that a thin crust around the rocks melted and then changed back into a solid.

If this rock was light-colored or had bubbles, that would be evidence that the rock did not come from space. The claim would be untrue—and that would be OK, too. It's just important to always follow the evidence.

Main Science Idea

Evidence is factual information. Evidence does not intentionally support claims or prove them wrong. The correctness of a claim is determined by evidence.

19

Point out that facts are facts—even if they do not support a claim.

LITERAL—What scientific evidence would support the idea that the rock in the photo is from outer space?

» if it is heavier than other rocks its size; if it attracts a magnet; if you cut it and see that the outside had melted

Online Resources

Show a video about the Hoba meteorite, the largest meteorite ever discovered. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

3. Check for understanding.

Activity Page

AP 3

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 3, and read the directions and scenario with students.

See the Answer Key for sample or correct answers.

LESSON 4

Defining Problems

At a Glance

Lesson Question

How do people define problems?

Learning Objectives

- ✓ Characterize wants and needs as problems in the engineering sense of the word.
- ✓ Recognize defining a problem as the first step in an engineering design process for inventing a limitless variety of solutions.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration

Main Science Idea

After identifying a problem, scientists define the problem so they can design solutions to correct the problem.

NGSS and CCSS References

SEP1. Asking Questions (for science) and Defining Problems (for engineering): Define a simple problem that can be solved through the development of a new or improved object or tool.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text.

For detailed information about the NGSS and CCSS 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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Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

designed **problem** **solution**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

engineer **suspension**

Instructional Resources

Student Book

Ch. 4

Student Book, Chapter 4
"Defining Problems"

Activity Page

AP 4

Activity Page
What's the Problem? (AP 4)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Show students an item in your classroom that needs a repair (e.g., a squeaky door, a loose knob, a chair with a missing foot, a flickering overhead light). Model how to state the problem with enough detail that a listener would understand the need and how people would be affected if it were solved.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How do people define problems?

2. Read together: "Defining Problems."

Student Book

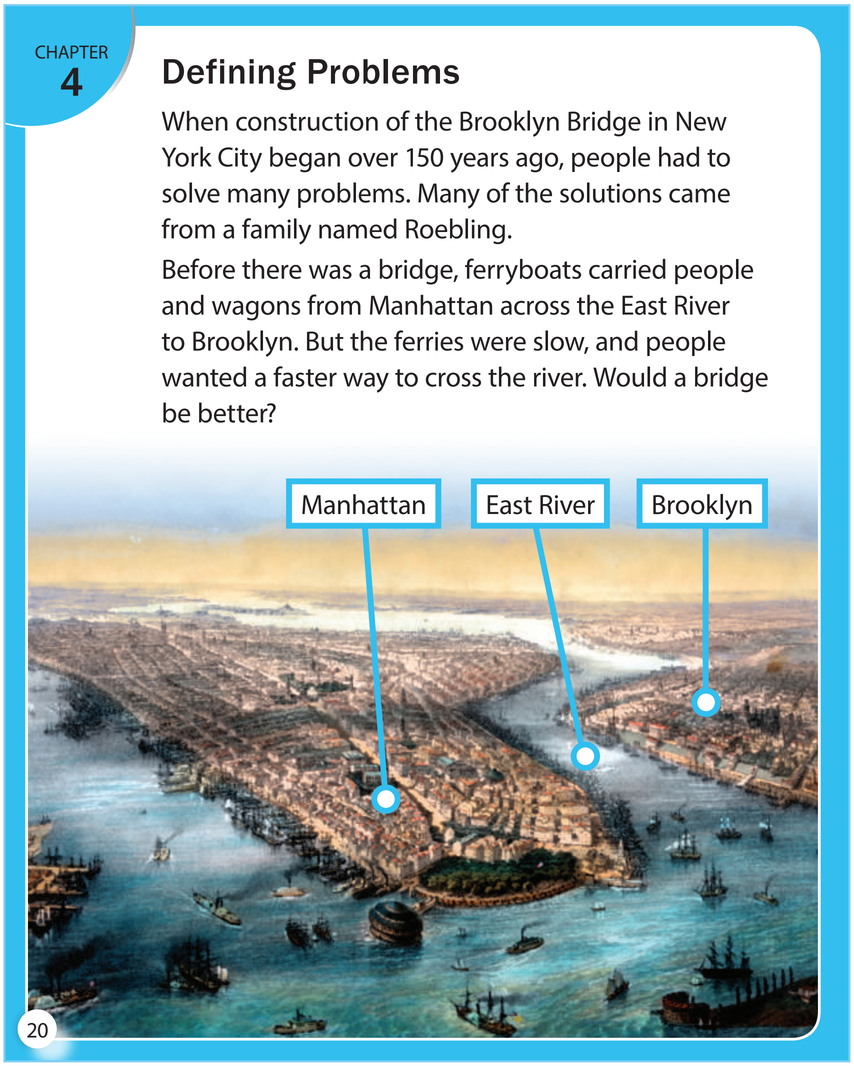
Ch. 4

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 4 on page 20. Tell students that the title of this chapter is "Defining Problems," and tell them to pay special attention to the problems that each member of the Roebling family worked to solve as you read.

Read Aloud Support

Page 20 **Ask students to look at the image before you read aloud.** Explain that this is a bird's-eye view of the island of Manhattan in the center with Brooklyn on the right.


CHAPTER 4

Defining Problems

When construction of the Brooklyn Bridge in New York City began over 150 years ago, people had to solve many problems. Many of the solutions came from a family named Roebling.

Before there was a bridge, ferryboats carried people and wagons from Manhattan across the East River to Brooklyn. But the ferries were slow, and people wanted a faster way to cross the river. Would a bridge be better?

20

LITERAL—In what city does this story take place?

» New York City

Note that in the 1880s, Brooklyn and Manhattan were separate cities. In 1898, they, along with the Bronx, Staten Island, and Queens, merged.

INFERENTIAL—How would building a bridge over the river meet people's needs?

» It could allow people to cross the river faster.

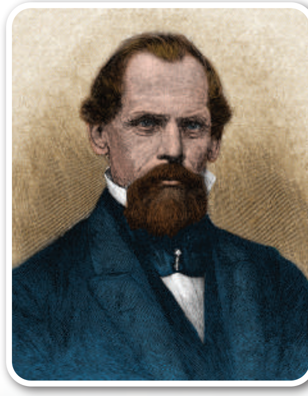
Call attention to the text question, "Would a bridge be better?" Discuss the advantages of moving people and products over a bridge, pointing out that many people who lived in Brooklyn had to travel to work in Manhattan.

Page 21 **Ask students to look at the images as you read aloud.** Have them listen for the **problem** that John Roebling solved.

The new bridge needed to be tall enough that it would not block sailing ships on the river. Could this problem be solved?

John Roebling had a solution. He planned a suspension bridge, in which the roadway hangs from above. But the iron chains used at the time to hold up the roadways were too heavy.

Roebling solved the problem by designing steel ropes that were much lighter.



21

Have students reword the problem as a question, such as "How could a bridge be designed to allow tall ships to sail under it?

Point out that sailing ships of the 1880s had very tall wooden masts to hold up their huge sails. Search online for images of "sailing ships 1880s" to show students these ships, some of which also had steam engines.

INFERENTIAL—If the roadway could not be held up from above, what was needed to hold it up above the water?

» many bases or towers placed across the river

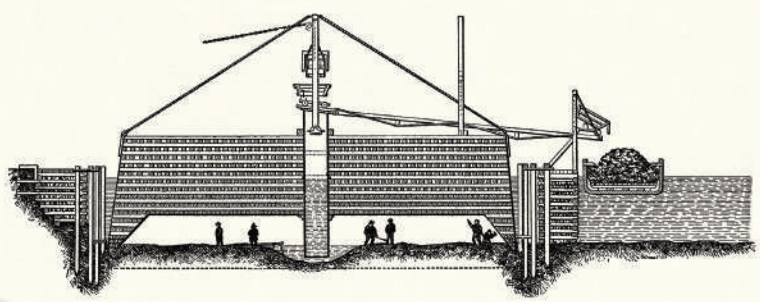
INFERENTIAL—Where in the photo are the steel ropes that were the solution?

» They connect the tops of the towers and hang down to the roadway.

Page 22 **Ask students to look at the images as you read aloud.**

John Roebling got hurt while working on the new bridge and died. His son took over the project. More problems came up that Washington Roebling had to solve.

How could workers build towers at the bottom of the river? His solution was to put boxlike structures in the river. Air was pumped into the structures, and the water and mud were forced out. Then the workers could work inside the structures. The problem was solved.



22

INFERENTIAL—Who was Washington Roebling?

» John Roebling's son

INFERENTIAL—What need did the boxlike structures fulfill?

» The workers needed a dry place filled with air to breathe so that they could build the bridge towers at the bottom of the river.

Call attention to the workers in the air-filled wooden boxes at the bottom of the river. Explain that the boxes, called *caissons*, kept the river water pushed back.

Online Resources

SUPPORT—Show an online video for children that reinforces and adds vocabulary to explain how the bridge was built. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 23 **Have students picture themselves participating in the parade at the opening of the bridge as you read aloud.**

How could the bridge also serve a busy city filled with people who walked? The solution to this problem was to put a walkway above the roadway. The walkway would be a safe place for walkers to cross the river. There even was a lively parade over the walkway when the bridge was opened.

23

LITERAL—What want or need did the walkway above the roadway meet?

» It gave walkers a safe place to cross the river.

EVALUATIVE—Do you think it would be fun to walk across the river on the Brooklyn Bridge? Explain.

» yes, because I could see all the boats below

Point out that solving problems related to the Brooklyn Bridge has never stopped. For example, in 2021, responding to the need for a safer way for bicyclists to cross, engineers **designed** a new bike lane on the bridge. Their solution was to change one of the car lanes on the bridge to a protected bike lane.

Page 24 **Ask students to look at the images as you read aloud.** Discuss how the workers reached the steel cables high above the river to work on them. Students should notice that the workers stand on a platform that hangs from the largest cable.

But working inside the boxes at the bottom of the river was dangerous. Many workers got hurt or sick. Washington Roebling became too sick to leave his bed. Seeing the need to complete the bridge, his wife took over. Emily Warren Roebling made sure problems were identified and solved. She made sure the steel ropes would work. She made sure the workers followed the plans.

24

INFERENTIAL—What do you think the workers are doing to the steel ropes?

» Possible answer: putting a covering over them and clamping them in place

INFERENTIAL—How did the platform make it easier and safer for the workers?

» Possible answer: They had a flat place to stand and a place to lay down their tools.

Page 25 **Ask students to look at the image as you read aloud.** Point out that the photo was taken on the Brooklyn side of the river, facing Manhattan Island.

When the bridge was finally completed, Emily Roebling rode in the first carriage to cross the bridge. The Brooklyn Bridge is busier than ever today. Many people who visit New York City for the first time go see it.

The Brooklyn Bridge is a fine example of engineers defining problems and developing solutions. The Roeblings were a family of engineers. Each one clearly understood the problems they needed to solve to build a bridge that will last much longer than 150 years!

Main Science Idea

Something that people want or need can be viewed as a problem to solve. Describing such a problem is the first step to solving it.

25

EVALUATIVE—What was the most difficult problem to solve when the Roeblings designed the bridge? Why?

» how to build the towers at the bottom of a deep river

Point out that when the Brooklyn Bridge opened in 1883, it was the longest suspension bridge in the world. A year after it was built, the owner of a circus showed how strong the bridge was by leading twelve elephants over the bridge.

3. Check for understanding.

Activity Page

AP 4

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 4, and read the directions with students. Scaffold the writing exercise to meet the needs of your students.

See the Answer Key for sample or correct answers.

LESSON 5

Look at Models

At a Glance

Lesson Question

What are similarities and differences among models?

Learning Objectives

- ✓ Describe the purposes of models that represent amounts, relationships, and patterns/cycles.
- ✓ Identify similarities and differences between 2D diagrams and 3D physical models of similar concepts.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration

Main Science Idea

Science uses two- and three-dimensional models to represent nature and problems. Different types of models can show different aspects of nature or the problem.

NGSS and CCSS References

SEP2. Developing and Using Models: Distinguish between a model and the actual object, process, and/or events the model represents. (Also **SEP2**)

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text.

For detailed information about the NGSS and CCSS 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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Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

diagram **model** **three-dimensional** **two-dimensional**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

engineer

Instructional Resources

Student Book

Ch. 5

Student Book, Chapter 5
"Look at Models"

Activity Page

AP 5

Activity Page
Plan Your Own Model (AP 5)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Show students some interlocking toy bricks. Then ask the following question: What can you make by putting these together in different ways. Encourage students to share their personal experiences with building models of all sorts.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What are similarities and differences among models?

2. Read together: "Look at Models."

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 5 on page 26. Tell students that the title of this chapter is "Look at Models," and tell them to pay special attention to how models are alike and different as you read.

Page 26

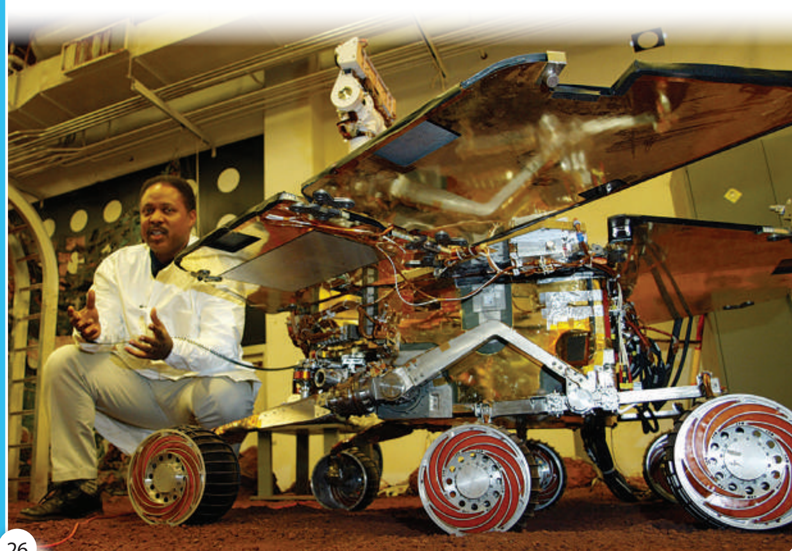
Ask students to look at the image as you read aloud. Point out that the person sitting next to the **model** and speaking is a NASA engineer. This is a test model that is very similar to the real rover.

CHAPTER 5

Look at Models

Have you ever built a model using toy bricks or blocks? Scientists and engineers build models, too. Some models show something in nature. Others show how to solve a problem.

Space engineers build models of rovers needed to explore Mars. Rovers are designed to solve the problem of how scientists can explore Mars from Earth. The models, or prototypes, are tested on Earth. When all the problems are fixed, the real rover is built and will be ready to go to Mars.



26

LITERAL—What is the purpose of a model?

» to show something in nature or how to solve a problem

LITERAL—What problem does the model in the picture help show how to solve?

» how to explore Mars when the scientists are back on Earth

Have students ask questions about the model in the photo, such as the following: What materials is the model made of? What purpose do certain parts have? How will the rover get to the surface of Mars?

Point out that the model shown was used to build the rovers Opportunity and Spirit. Sent into space separately, the rovers landed on opposite sides of the planet Mars and explored the surface of Mars for several years.

Page 27 **Ask students to look at the images as you read aloud.**

The Mars rover models are three-dimensional (3D) models. You can turn a 3D model over or walk around it to see all its parts. This glass tank with water, rocks, and animals is a 3D model of a pond habitat. Scientists can use it to predict how water temperature affects pond animals.

Some 3D models are used to show people things they cannot see. This model brain is the same size and shape as an adult human brain.

27

LITERAL—What is the purpose of the model pond habitat?

» Scientists can use it to test how changes in water temperature affect the animals in the pond.

INFERENTIAL—How do you know the tank and the parts inside are a **three-dimensional** model?

» because you can walk around a tank and look at it from all sides

SUPPORT—Have students look around the classroom or think of other examples of 3D models, such as a model clock or a model car. Discuss what makes each three-dimensional.

INFERENTIAL—What other body parts would be useful to see as models because they cannot be seen?

» Sample answers: the heart, the lungs, the spine, the stomach

Page 28 **Ask students to look at the images as you read aloud.**

Some models are used to show patterns. Models of the solar system show how planets travel around the sun.

Three-dimensional models are not the only kinds of models. What is another way to model where the planets are in space?

28

Remind students that a pattern can be an arrangement of parts that shows repetition.

INFERENTIAL—In what way is the movement of planets around the sun a pattern?

» It is a pattern because the planets repeat their motion around the sun.

Online Resources

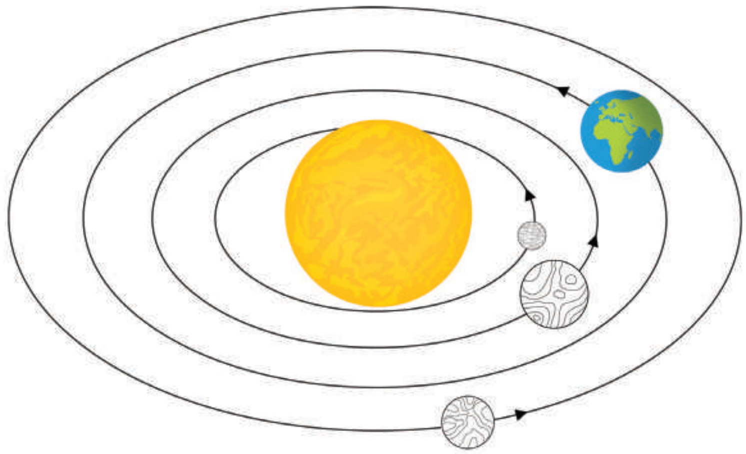
SUPPORT—Show students online video animations that make the pattern of planetary motion around the sun clear. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

INFERENTIAL—What should the students in the top photo do with their models to show a pattern?

» They should hold the model planets and walk around a model of the sun.

Page 29 **Ask students to look at the diagram as you read aloud.**

You could draw a picture with labels and arrows. Models that are drawings or diagrams are called two-dimensional (2D) models.



Put your fingertip on the line in the drawing that represents Earth's orbit. Trace the pattern by following the arrow. How does this 2D model show a pattern?

29

Point out that models can be useful without showing the sizes of objects. For example, this diagram helps us imagine how planets orbit the sun. But it does not show us their relative sizes or how far apart they really are. The diagram is not to scale.

INFERENTIAL—What is the difference between the three-dimensional models of the planets and solar system on page 28 and the two-dimensional model on this page?

» You can see around all sides of the three-dimensional planet models, but if you walk behind the two-dimensional diagram, you don't see anything.

EVALAUTIVE—Which type of model do you prefer for showing the solar system, 3D or 2D? Why?

» Sample answer: I prefer the 2-D model because it has the names of the planets on it.

Call attention to the text question that ends this page. Discuss the pattern the diagram shows, especially the oval shapes of the orbital paths and that the planets all move in the same direction around the sun.

Page 30 **Ask students to look at the image as you read aloud.** Invite them to share what they notice in the natural history museum pictured.

Blue whales are the largest animals on Earth. But how much larger is a blue whale than an elephant? In this museum, all the 3D animal models are actual size. They are the same size as the animals are in real life.

In the picture, find the humans visiting the museum. You can compare the animal models to the people by size.

30

Have the students follow the text directions to figure out how much bigger one kind of animal is than another kind.

INFERENTIAL—How many elephants could stand nose-to-tail alongside the part of the whale showing in the photo?

» three or more

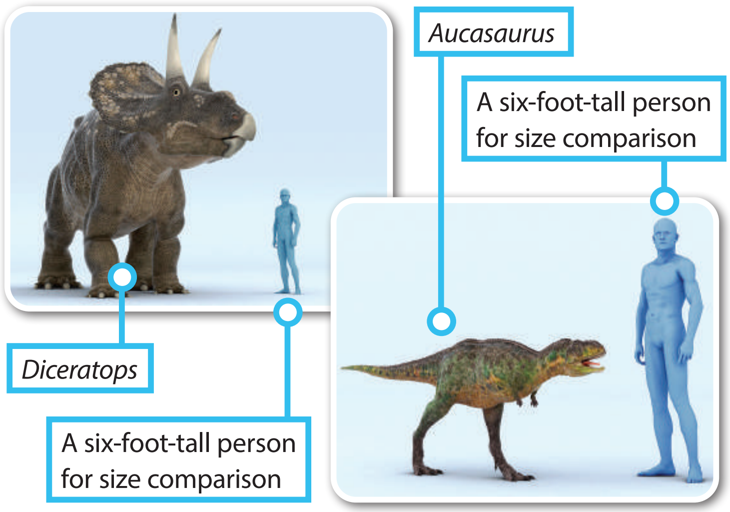
INFERENTIAL—How many humans could stand side by side alongside the elephant in the center of the photo?

» five or six

CHALLENGE—Have students use the size clues in the photo to estimate how much space one of the elephants would take up in the classroom.

Page 31 **Ask students to look at the images as you read aloud.**

Picture models can be used for comparing sizes, too. There are no dinosaurs like these alive today, but with models, you can compare the sizes of the dinosaurs to each other and to humans.



The person shown in blue is two meters tall in both models. Which dinosaur is much larger than two meters?

Main Science Idea

Models can be three-dimensional objects or two-dimensional pictures. Models can help us understand the parts of things, what they are like, and how they work.

31

Guide students to interpret the models, answer the text question, and provide an explanation.

INFERENTIAL—Which dinosaur is much larger than six feet?

» the one with the two horns on the left, because it is far taller than the human model

Online Resources

Show students online 2D models that also show size relationships of different species of animals. (See the Online Resources Guide for a link to a recommended resource. **www.coreknowledge.org/cksci-online-resources**)

3. Check for understanding.

Activity Page

AP 5

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 5, discuss the scenario, and consider having students work in pairs.

See the Answer Key for sample or correct answers.

LESSON 6

Ahn's Evaluation

At a Glance

Lesson Question

How can we tell if a solution will solve a problem?

Learning Objectives

- ✓ Express why evaluation of a design is important.
- ✓ Identify features of sample design solutions that are relevant for evaluation.
- ✓ Identify features of sample design solutions that are not relevant for evaluation.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- hands-on engineering activity

Main Science Idea

After designing a solution to a problem, science tests the solution to evaluate if the solution solves the problem.

NGSS and CCSS References

SEP3. Planning and Carrying Out Investigations: Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.

RI.2.3. Key Ideas and Details: Describe the connection between a series of steps in technical procedures in a text. (Also **RI.2.6**)

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

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evaluating **evaluation**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

observe

Instructional Resources

Student Book

Ch. 6

Student Book, Chapter 6
"Ahn's Evaluation"

Activity Page

AP 6

Activity Page
Make Your Own Squishy Putty (AP 6)

Materials and Equipment

Collect or prepare the following items:

- folded paper airplane
- cornstarch
- clear dish soap
- spoon
- bowl
- food dyes

Advance Preparation:

Make a simple paper airplane.

The Core Lesson

1. Focus attention on the Lesson Question.

Show students a folded paper airplane, then ask, "How can I tell if this plane will do what I want it to do?" Have students discuss what they would want the paper airplane to do (fly), and then explain that the only way to know if it works is to throw it to see if it flies.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How can we tell if a solution will solve a problem?

2. Read together: "Ahn's Evaluation."

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 6 on page 32. Tell students that the title of this chapter is "Ahn's Evaluation," and tell them to pay special attention to how Ahn and her mom solve problems as you read.

Page 32

Guide students to look at the illustration as you read aloud. Talk about what they notice Ahn and her mother are doing together.

CHAPTER 6

Ahn's Evaluation

Ahn and her mom are home in their kitchen on a rainy day. "I wish I had a new egg of squishy putty to play with," says Ahn with a sigh.

"It's too stormy to go to the store, but maybe we can solve the problem ourselves and make something like it at home," her mom says.

Ahn's mom takes out a kitchen bowl and spoon. She finds a box of cornstarch. She gets the bottle of liquid dish soap from the kitchen sink.

32

LITERAL—What is the problem Ahn and her mother plan to solve?

» how to make their own squishy putty

INFERENTIAL—What is the next step, after they have defined the problem?

» Ahn's mother gets out a bowl, a spoon, cornstarch, and dish soap.

ALERT—Point out to students that designing a solution to a problem that requires kitchen materials should always be done with an adult.

INFERENTIAL—Is the color of the bowl Ahn's mom chooses important? Explain.

» No, the color of the bowl does not change the materials they use.

Page 33 **Ask students to look at the illustration as you read aloud.** Talk about what they notice Ahn is doing and her mom is doing.

Ahn's mom shows her a list of materials needed to make a squishy putty.

$\frac{2}{3}$ cup cornstarch

$\frac{1}{2}$ cup liquid dish soap

4 drops water

"This stuff is nothing like squishy putty," Ahn says. "How do we know if this is going to work?"

"Well," her mom says, "what do we need to look for to decide if this recipe is good or not?"

Ahn thinks about it and then replies, "The putty has to be soft and stretchy but not stick to our hands."

"OK," replies her mom. "Let's get started."

They measure the amounts of cornstarch and dish soap and put them in the bowl. Ahn stirs with the spoon.

Ahn uses her finger to add four drops of water to the mixture. Then she puts her hands in the bowl and stirs and squeezes the mixture.

33

LITERAL—What do they do with the materials first?

» They measure the cornstarch and soap and put them in the bowl.

INFERENTIAL—How will Ahn know if the stuff they make will solve the problem?

» if it comes out soft and stretchy and doesn't stick to her hands

INFERENTIAL—How can you use your finger to move a drop of water?

» You can put the water in a cup and dip one finger in the water. About a drop will stick while you move your hand over the bowl with the other materials in it.

Page 34 **Ask students to look at the illustration as you read aloud.**

Ahn's face looks a little sad.

"The mixture is too crumbly. It's not smooth and squishy, like I expected, " she says.

"Let's see if we can make the mixture more like you want it. Try adding more soap," her mom replies.

Ahn lets a few drops of liquid soap drip into the bowl. Then she squeezes the mixture again.

34

Point out that Ahn is evaluating her solution when she says, "The mixture is too crumbly." Explain that evaluating is important because then she can make changes to the mixture to get what she wants.

LITERAL—What does Ahn add to the crumbly mixture?

» more liquid soap

Have students observe the illustration and decide how the mixture looks to them.

Know the Standards

SEP3. Planning and Carrying Out Investigations When students make observations of a solution to determine if it solves a problem or meets a goal, the observations can be qualitative, as in Ahn's story, or quantitative, requiring measurement or counting. In later grades, students will test two different models designed to test the same solution and record their data.

Page 35 **Have students look at the illustration as you read aloud.**

"It feels more like squishy putty now! But there is some soap at the bottom of the bowl that will not mix in."

Ahn's mom sprinkles a spoonful of cornstarch into the bowl and says, "Try squeezing again."

Ahn has a big grin on her face now. "That's more like it! I'm glad I said what was wrong with it. Now it's better!"

35

Ask students to recall what Ahn wants the mixture to feel like. If students are not sure, turn back to page 33 to find the properties that will solve the problem ("soft and stretchy but not stick to our hands").

INFERENTIAL—Why is it important that Ahn tells her mom there is some soap at the bottom of the bowl?

» The mixture is not like squishy putty. She wants to make it better

INFERENTIAL—Why is Ahn glad she said what was wrong with the mixture?

» because how the mixture feels is very important

Online Resources

EXTEND—Other materials can also be used to make a stretchy, bouncy putty. Demonstrate by mixing one part liquid starch to two parts glue, adding a drop of food dye, and then stirring. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 36 **Ask students to look at the illustration as you read aloud.** Talk about what Ahn is doing with the putty mixture.

Ahn takes the blob of putty out of the bowl and plays with it.

"It looks a little blue, Mom. Is that important?"

"Maybe it is blue from the blue-colored dish soap. Is the color important to you?" Ahn's mom asks.

"Not really. I'm just happy that it is fun to play with," Ahn replies.

36

LITERAL—What feature of the mixture is not important to Ahn's evaluation?

» the color

INFERENTIAL—What features of the mixture are important to Ahn's evaluation?

» that it is smooth and squishy and doesn't stick to her hands

EVALUATIVE—If you made squish putty, what color would you like it to be?

» Accept all answers for this opinion question.

EXTEND—Have students continue the story by explaining how Ahn solves the problem of how to store her squishy putty. Ask students how they will evaluate her solutions.

Page 37 **Ask students to look at the list that describes how Ahn solved a problem as you read aloud.**

Ahn and her mom solved a problem by making something fun to play with. Ahn was concerned about whether the idea would work or not. She thought about things that mattered to her and other things that did not matter. Carefully considering something and how it works is called evaluating it.

How did Ahn evaluate the squishy putty project?

- [x] She learned that it is important to think about how well a solution solves a problem.
- [x] She was able to say which details about the solution were important to her.
- [x] She was able to explain which details about the solution were not important to her.

Main Science Idea

Evaluating something means deciding whether or not it works the way it is supposed to. Some features matter in an evaluation, but other features might not.

37

INFERENTIAL—What problem did Ahn and her mom solve?

» how to make squishy putty at home that is like the toy you can buy in a store

Have students answer the text question.

INFERENTIAL—How did Ahn evaluate the squishy putty project?

» She evaluated it by feeling it with her hands and looking at it in the bowl.

3. Check for understanding.

Activity Page

AP 6

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms.

Group students depending on the quantities of materials you have on hand. Distribute Activity Page 6 and the materials. After students have followed the directions to make their putty, have them use the checklist to guide a discussion. Cleanup should include all students washing their hands.

LESSON 7

Using Data

At a Glance

Lesson Question

What does it mean to analyze and interpret data?

Learning Objective

✓ Describe collection and use of data in example life, Earth, and physical science scenarios.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- data analysis activity

Main Science Idea

Scientists analyze data to find patterns and relationships. Scientists also interpret the data to identify what information can be understood from the data.

NGSS and CCSS References

SEP4. Analyzing and Interpreting Data: Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.

RI.2.10. Range of Reading and Level of Text Complexity: By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2–3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

analyze **data** **interpret**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

information

Instructional Resources

Student Book

Ch. 7

Student Book, Chapter 7
"Using Data"

Activity Page

AP 7

Activity Page
Using Weather Data (AP 7)

Materials and Equipment

Collect or prepare the following items:

- colored beads or markers to display a pattern

The Core Lesson

1. Focus attention on the Lesson Question.

Show students a simple pattern that can be used to make a bracelet, such as red-red-red-yellow-red-red-red-yellow. Ask them what pattern they observe. Then ask whether they will need to find more red or yellow beads to make a bracelet with this pattern. Point out that they have just used data!

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What does it mean to analyze and interpret data?

2. Read together: "Using Data."

Student Book

Ch. 7

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 7 on page 38. Tell students that the title of this chapter is "Using Data," and tell them to pay special attention to what people do with data in science as you read.

Page 38 **Ask students to look at each image as you read aloud the accompanying text.**

CHAPTER 7

Using Data

Data are information. When you take a photo, draw what you see, count the number of things, or measure, you are collecting data.

What if you want to know which tree in your local park is widest around? You could measure around the trunk of each tree. If you write down each measurement, you can compare all the trees. Comparing measurements is one way to analyze data.

The tree with the biggest trunk is often the oldest tree. When you want to answer a question such as “Which tree is oldest?” you collect data, study the data, and then you interpret the data.

38

INFERENTIAL—What kind of **data**, or information, is the girl collecting?

» the number of inches or centimeters around the tree’s trunk

INFERENTIAL—Once the girl has measured and written down all the tree sizes, how will she decide which tree is the widest around?

» She will look at all the numbers and find the biggest one.

Point out that when she looks for the largest number in a list, the girl is **analyzing** data.

Explain that when you use the data to explain “which tree is oldest,” you **interpret** the data.

Page 39

Ask students to compare the images as you read aloud. Talk about the similarities and differences they notice.

A scientist spent a year in a tundra habitat. She took this photo of an arctic hare.

Later in the year, she took this photo of an arctic hare.

Interpret the data. Why are these hares brown part of the year and white part of the year?

39

INFERENTIAL—What form of data did the scientist collect?

» The scientist collected data in the form of photos.

If students are unsure what *interpret* means, explain that when they interpret something, they make sense of it.

INFERENTIAL—Why are these hares brown part of the year and white part of the year?

» Their hair color changes so that they match the place where they live.

Discuss how an arctic hare's fur color makes it difficult for animals that eat hares to find them. Explain that this is called *camouflage*. Point out that in winter the hare's habitat is snow covered and that in summer the snow has mostly melted and the hare's habitat is colored brown, gray, and green.

Page 40 **Ask students to look at the image as you read aloud.** Talk about what they notice.

The water in this lake is warmed by heat from the earth. The temperature of the water is about 100 degrees Fahrenheit in winter, as well as in summer.

Scientists collect data on the water temperature here and in other hot springs.

40

INFERENTIAL—How might scientists collect water temperature data from hot springs?

» They could visit the spring every week or month and put a thermometer in the water.

INFERENTIAL—Let's say they collect data for a whole year. What would they look for when they analyze the temperatures?

» They could see if all the numbers are always 100 or if they change during the year.

The image shows the Blue Lagoon in Iceland, a human-made lake surrounded by rock that formed from a volcanic lava flow. The water is a mix of seawater and groundwater heated by volcanic activity. The water is used to turn electrical turbines and heat municipal water. The wastewater from those processes supplies the water for the lagoon.

Page 41 **Have students look at the image and table as you read aloud.**

Most people enjoy soaking in water that is between 95 and 104 degrees Fahrenheit.

These hot springs in Yellowstone National Park are too hot to sit in. But other hot springs are just right!

Read and analyze the data in the chart.

Name of Hot Spring	State	Temperature in Degrees Fahrenheit
Sand Spring	Massachusetts	75
Hot Springs	Arkansas	147
Warm Springs	Nevada	95
Rocky Point Spring	California	90
Stinking Springs	California	101
Quinn's Hot Springs	Montana	109
Big Creek Hot Springs	Idaho	199

The data have been collected. When you look at data closely, you are analyzing it. Now interpret the data. Which springs are good for people to soak in? Which are too cool? Which are too hot?

41

LITERAL—What is the temperature of the water in Stinking Springs, California?

» 101 degrees Fahrenheit

INFERENTIAL—Which hot spring has the hottest water? Which one has the coolest water?

» Big Creek Hot Springs has the hottest; Sand Spring has the coolest.

Have students analyze the data and answer the text questions. Remind them that the temperatures people enjoy are at the top of the page.

EXTEND—Point out that the water in the Grand Prismatic Spring of Yellowstone National Park, shown in the photo, can be 189 degrees Fahrenheit at the center. Have students use the data to decide if the Grand Prismatic Spring is too cool, too hot, or just right for soaking.

Page 42

Have students look at the illustrations as you read aloud. Point to the materials shown as you read about them.

You can collect data, too. Let's say you want to know which material is best for wrapping a sandwich. In your kitchen, you find rolls of metal foil, plastic wrap, and parchment paper. You tear off squares of each that are the same size.

Next, you test each material in three ways. First, you fold and unfold the squares. Second, you drip some water on the squares. Third, you try to tear each square. You write down your observations after each test.

42

INFERENTIAL—What data is the student collecting?

» how the three materials change when they are folded, when water drips on them, and when they are torn

Point out to students that, if they were to do this investigation, they should fold and unfold all the materials the same number of times, place the same number of drops of water on them, and tear with the same amount of force.

Online Resources

If you wish to carry out this investigation with your students, note that there is a detailed lesson plan with video on the American Chemical Society (ACS) website called "Testing Materials to Learn About Their Properties." (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 43 **Have students look at the illustration as you read aloud.**

It's time to analyze your data. Which material can be folded and unfolded more than once? Which does not tear too easily? Which does not let water pass through?

Finally, you interpret your data to answer your question. Which material will work best for wrapping a sandwich?

Main Science Idea

In science, people use data to learn about Earth and space, living things, and materials and objects.

43

LITERAL—How would you recall which materials do not let water pass through?

» I would check the observations I wrote down.

INFERENTIAL—How would you decide which materials work best to wrap a sandwich?

» I would interpret the data, looking for a material that does all three things—fold and unfold, not tear easily, and not let water pass through.

3. Check for understanding.

Activity Page

AP 7

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Distribute Activity Page 7, and read the directions and scenario to students. Point out that the data they need are in the weather forecast table.

See the Answer Key for sample or correct answers.

LESSON 8

Patterns in Numbers

At a Glance

Lesson Question

How can numbers show patterns?

Learning Objectives

- ✓ Describe patterns in provided sample data sets from life, Earth, and physical science scenarios.
- ✓ Spot a trend in a provided sample data set, and describe how knowing that information is useful.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- analyzing graphs worksheet

Main Science Idea

We can spot patterns in data when we look at organized arrangements of numbers.

NGSS and CCSS References

SEP5. Using Mathematical and Computational Thinking: Science utilizes math and computation to organize, display, and understand data. These enable scientists to predict, test, and explain phenomena.

RI.3.7. Integration of Knowledge and Ideas: Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.

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Core Vocabulary and Language of Instruction

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pattern **trend**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

data **observation** **graph** **table**

Instructional Resources

Student Book

Ch. 8

Student Book, Chapter 8
"Patterns in Numbers"

Activity Page

AP 8

Activity Page
Ice Cream Sales (AP 8)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Ask students to tell their favorite ice cream flavor or favorite type of fruit. Using tally marks, record their answers in a chart on the board. Then, make a simple bar graph using the data. Ask students to describe what they see.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How can numbers show patterns?

2. Read together: "Patterns in Numbers."

Student Book

Ch. 8

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 8 on page 44. Tell students that the title of this chapter is "Patterns in Numbers," and tell them to pay special attention to anything they notice that repeats as you read.

Read Aloud Support

Page 44

Ask students to look at the chart as you read aloud. Talk about if they notice anything interesting about the chart.

CHAPTER 8

Patterns in Numbers

Scientists keep track of data. They often record information in the form of numbers. When scientists look at sets of recorded numbers, they can often spot patterns. You can, too. Let's look at some examples.

Carmen recorded air temperatures over two full days. He recorded the temperature at 8:00 a.m. and p.m. and 2:00 a.m. and p.m. Can you see a pattern in the numbers?

Temperatures over Two Days

	Temperature in Degrees Fahrenheit
Monday 8:00 a.m.	65°F
Monday 2:00 p.m.	80°F
Monday 8:00 p.m.	75°F
Tuesday 2:00 a.m.	60°F
Tuesday 8:00 a.m.	65°F
Tuesday 2:00 p.m.	75°F
Tuesday 8:00 p.m.	65°F

The temperature goes up.

Then the temperature goes down.

Then it goes up again.

Then it goes down again.

44

INFERENTIAL—This chart shows *data* that someone collected. What are data?

» Data are observations that someone made.

Point out that data can be in the form of numbers, writing, pictures, or drawings. One measurement is a datum. All the measurements in a set are called data. In this chapter, we will be working with data that are numbers and how to understand the data.

EVALUATIVE—What is the **pattern**?

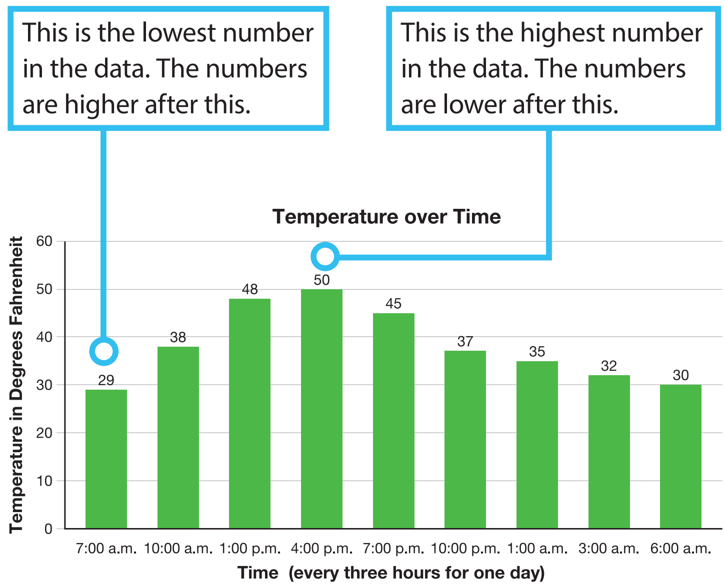
» Each morning, the temperature goes up, then it goes down, and then it goes up again. Finally, it goes back down again.

INFERENTIAL—Why could it be useful to know about this pattern?

» so you know how to dress or what weather to expect in that area

Page 45 **Ask students to look at the image as you read aloud.** Talk about what they notice about the graph and its shape.

Putting data on a graph can make a pattern easier to see. Here's a different set of air temperatures.



45

INFERENTIAL—How are these data similar to the data on the previous page?

» They both show how temperature changes throughout the day, just in different days.

LITERAL—What patterns do you see in the graph?

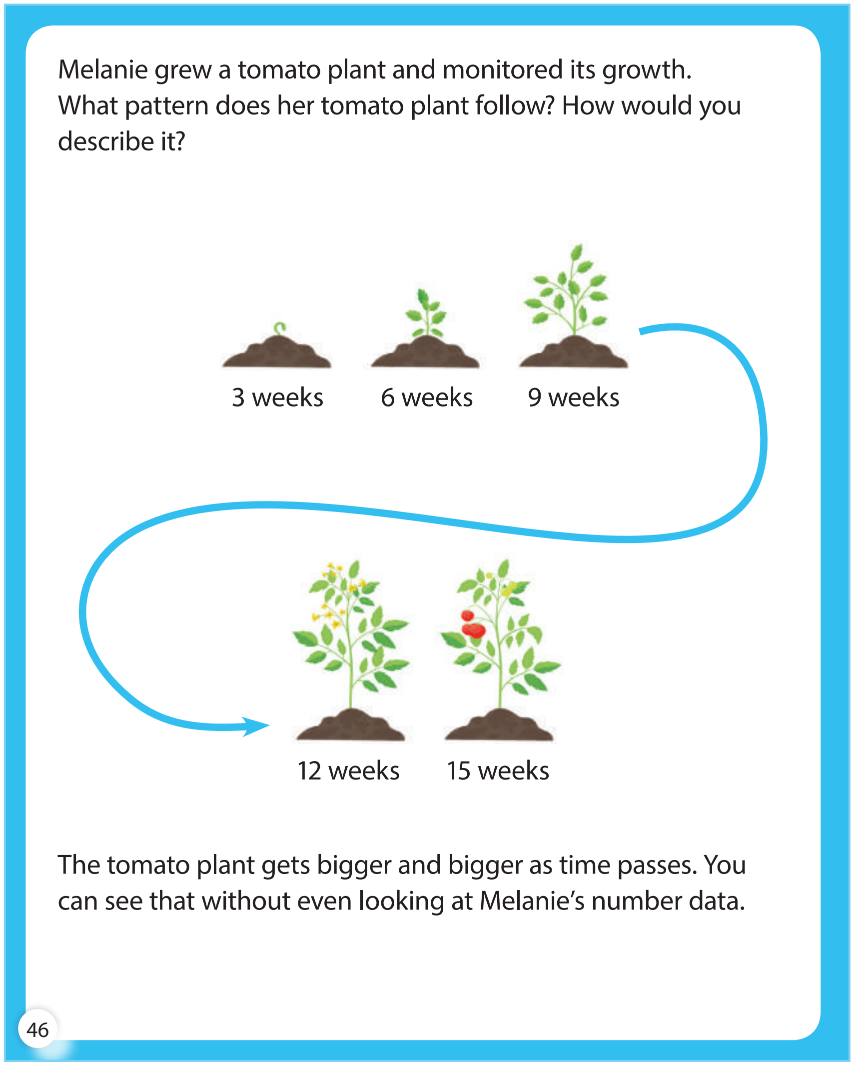
» I see that the morning temperatures are low, the afternoon temperatures are high, and then the evening temperatures are low again.

LITERAL—Describe how temperatures change from morning to afternoon. What about from evening back to morning?

» From morning to afternoon, temperatures go up. From evening back to morning, they go down.

Tell students that when they describe the changes in data as they did in the last question, they are describing **trends**.

Page 46 **Ask students to look at the image as you read aloud.** Talk about any changes they see.


Melanie grew a tomato plant and monitored its growth. What pattern does her tomato plant follow? How would you describe it?

3 weeks
6 weeks
9 weeks
12 weeks
15 weeks

The tomato plant gets bigger and bigger as time passes. You can see that without even looking at Melanie's number data.

46

After reading the section prior to the image, ask students to talk to a neighbor and answer the prompt in the text.

LITERAL—What pattern does her tomato plant follow? How would you describe it?

» The plant is getting bigger as time passes.

Remind students that when they are describing change, they are describing trends.

INFERENTIAL—Do we need to have bar graphs to see patterns?

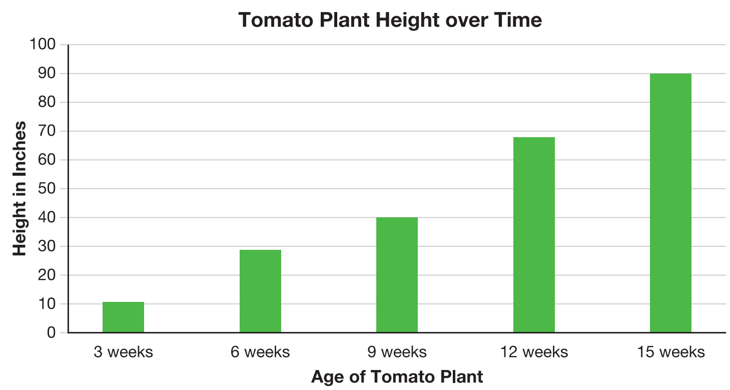
» No, we can see patterns in pictures and in tables with written data like numbers.

Page 47 **Ask students to look at the images as you read aloud.** Talk about what they notice about the two different ways the data are shown. Ask students if they can see patterns in both images.

Let's look at another pattern in numbers. The height number increases with each time measurement.

Tomato Plant Growth

Growing Time	Height in Inches
3 weeks	11 in
6 weeks	29 in
9 weeks	40 in
12 weeks	68 in
15 weeks	90 in



Again, a graph of the data can make the pattern easier to see and understand.

47

EVALUATIVE—Describe the trend you see.

» The plants are growing taller.

INFERENTIAL—Why is it important to know about patterns in tomato growth?

» It can tell you where to grow them so they have enough space to grow.

INFERENTIAL—Why is it useful to have data displayed in both the table and the graph?

» The table makes it easier to see exact numbers. The graph makes it easier to see patterns and trends.

Page 48 **Ask students to look at the chart as you read aloud.** Talk about what they notice about the data that were gathered in the table.

Julian kept track of the animals he saw in his backyard in the last year. How can you describe the pattern in the numbers in his data table?

Compare the numbers for the months of May through September to the numbers for the rest of the months. May through September are the months of spring and summer. What claim could you make based on the pattern that you see in these numbers?

Backyard Animals

Month	**Number of Animals**
January	5
February	4
March	6
April	8
May	12
June	14
July	14
August	15
September	14
October	9
November	8
December	5

48

EVALUATIVE—What pattern do you see?

» I see that the months of May through September have a high number of animals and that, the rest of the months have a low number.

INFERENTIAL—What claim could you make based on the pattern?

» You could say that more babies are born in spring and summer. You could also say that fewer babies are born in fall and winter.

INFERENTIAL—Why might this be important or helpful to Julian?

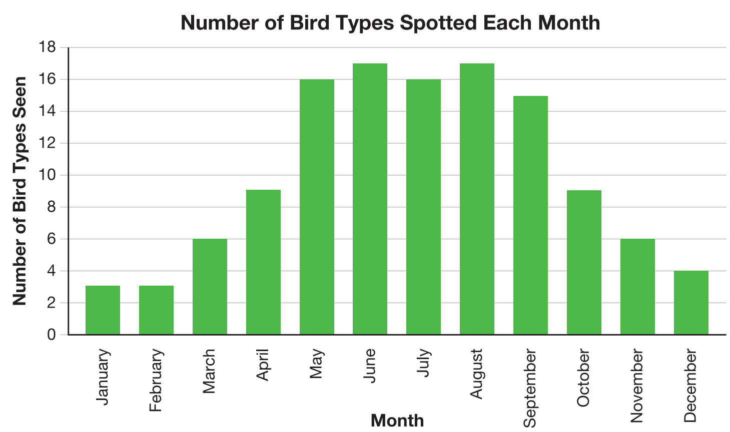
» It could be helpful if he wants to know when to put out animal feed. Julian might also order more animal feed in the months when there are more animals.

Page 49

Ask students to look at the graph as you read aloud. Talk about what they notice about the title and labels. What do you think the graph is about?

Garvick tracked how many different types of birds he saw each month. He graphed the numbers after a year. What do you notice about the pattern?

Compare the numbers for the months of May through September to the numbers for the rest of the months. May through September are the months of spring and summer. What claim could you make based on the pattern that you see in these numbers?



Main Science Idea

We can spot patterns in data when we look at organized arrangements of numbers.

49

Ask students the following questions:

EVALUATIVE—What patterns or trends do you notice?

» I notice that the months of April through September have a lot of birds. The winter months have fewer birds. one trend I see is that during spring and summer the numbers rise and that during fall and winter the numbers get lower.

EVALUATIVE—What claim can you make?

» I can claim that spring and summer months have a greater number of birds.

3. Check for understanding.

Activity Page

AP 8

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Arranging data in tables, and graphs can make it easier to spot patterns.

See the Answer Key for sample or correct answers.

LESSON 9

Will It Work?

At a Glance

Lesson Question

How do we know whether a design solution to a problem will work?

Learning Objectives

- ✓ Explain the intended outcomes of solutions from examining their design plans.
- ✓ Identify criteria that would qualify solutions as successful.
- ✓ Describe ways to test prototypes of design solutions.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- design solution

Main Science Idea

You can tell how a device is intended to work by looking at a diagram of it. Building a practice version, or prototype, is a good way to test a design.

NGSS and CCSS References

SEP6. Constructing Explanations and Designing Solutions: The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing criteria. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

RI.2.1. Key Ideas and Details: Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

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

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criteria **design** **prototype**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

problem **solution**

Instructional Resources

Student Book

Ch. 9

Student Book, Chapter 9
"Will It Work?"

Activity Page

AP 9

Activity Page
Designing a Solution (AP 9)

Materials and Equipment

Collect or prepare the following items:

- reference books and other research materials
- internet access and the means to project images/video for whole-class viewing
- materials for drawing, such as pencils, markers, crayons, and paper

The Core Lesson

1. Focus attention on the Lesson Question.

Lead a discussion on things we use every day that have been made to solve problems. For example, ask students to look at their shoes, especially the laces or hook-and-loop closures on them. These were put on their shoes to solve a problem. What problem might they have solved? (They keep the shoes closed and tight!) How do students think engineers came up with this solution? What steps did they have to take? Ask students to look around the room and find something that is a solution to a problem. They might mention that electricity provides light all the time and that computers can be used to store information or show movies. Encourage them to think about the steps scientists and engineers had to take to create these solutions.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How do we know whether a design solution to a problem will work?

2. Read together: "Will It Work?"

Student Book

Ch. 9

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 9 on page 50. Tell students that the title of this chapter is "Will It Work?" and tell them to pay special attention to the steps that were taken to solve the problem as you read.

Read Aloud Support

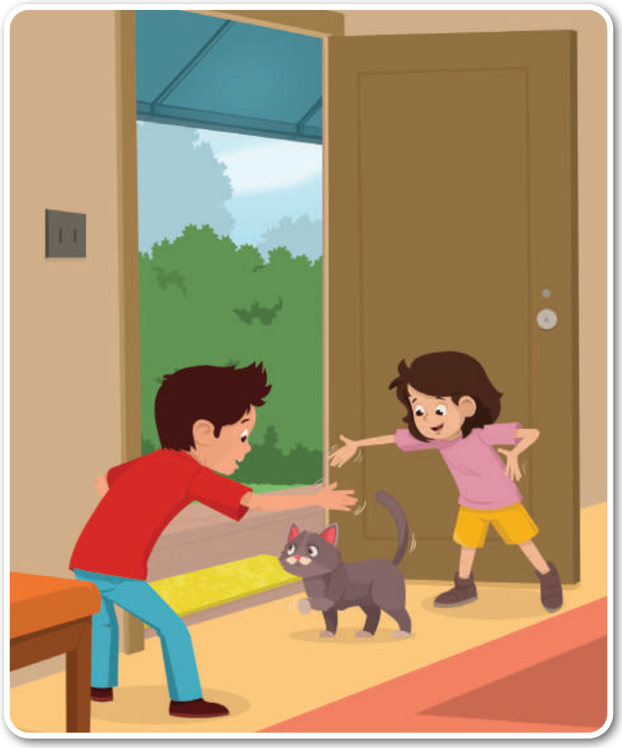
Page 50

Ask students to look at the image as you read aloud. Talk about what they notice about how the two children are helping the cat get outside.

CHAPTER
9

Will It Work?

Maya and Aiden's cat is named Whiskers. She likes to go out on the porch. Whiskers goes in and out all day! Their mom wants to build a special pet door for Whiskers.



50

Point out that pets have a lot of needs! Briefly talk to students about the different things pets need to be safe, healthy, and clean.

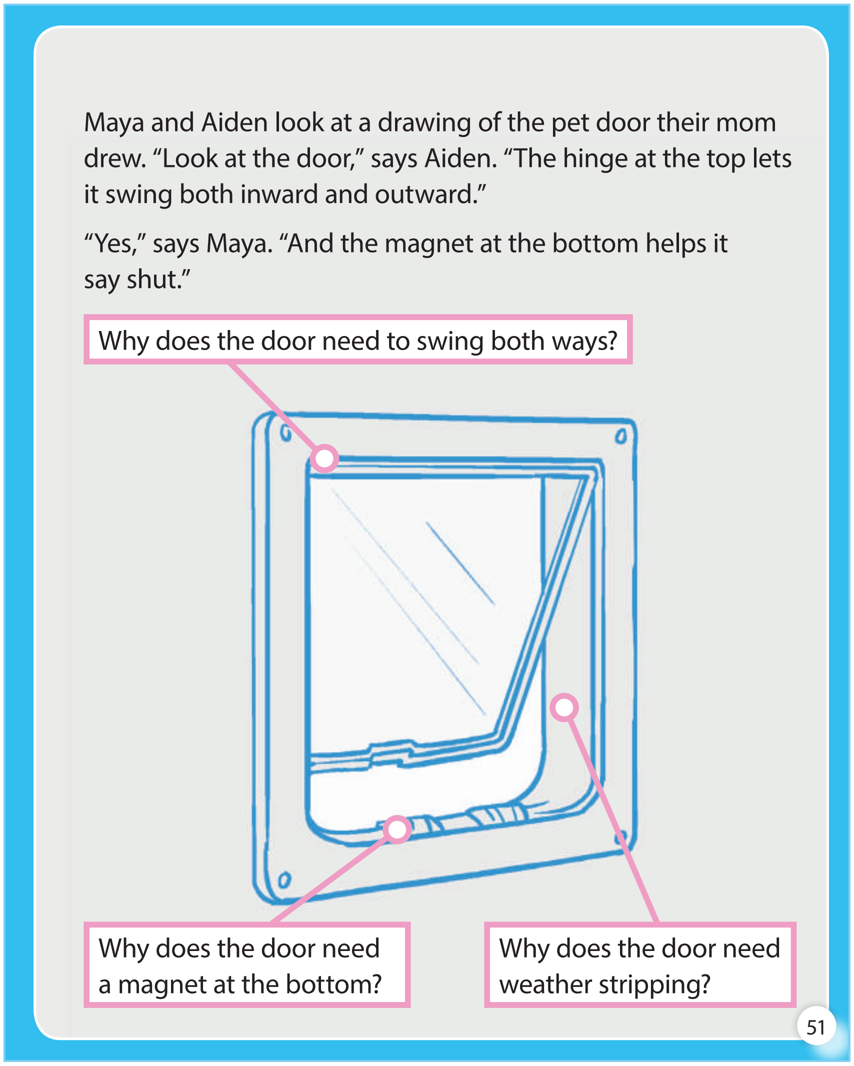
INFERENTIAL—Are there any tools or tricks that make pet care easier or faster?

» Yes, we use things like pooper scoopers, automatic feeders or water suppliers, and doggie doors.

LITERAL—What is the problem that Maya and Aiden have? What is their mom's solution?

» They have to open the door every time Whiskers wants to go in or out. Mom wants to build a pet door for Whiskers.

Page 51 **Ask students to look at the image as you read aloud.** Talk about what they notice about the picture—what is it a drawing of?



Maya and Aiden look at a drawing of the pet door their mom drew. “Look at the door,” says Aiden. “The hinge at the top lets it swing both inward and outward.”

“Yes,” says Maya. “And the magnet at the bottom helps it say shut.”

51

Tells students that the **criteria** are the things the **design** needs to do in order to be successful—its requirements.

Guide students to think about the solutions Mom included in her design. Have them pair-share with a neighbor on the prompts in the text.

INFERENTIAL—Why does the door need to swing both ways? Why does the door need a magnet at the bottom? Why does the door need weather stripping?

» The cat needs to be able to go in and out (both ways), and the cat can only push the door. It needs a magnet to stay shut but still open easily when the cat pushes. It needs weather stripping to keep weather out.

EVALUATIVE—What are the criteria for this design?

» The door must let the cat go in and out. The door must stay shut when not in use. It must be weatherproof.

Page 52 **Ask students to look at the image as you read aloud.** Talk about what they notice about how the pet door solves the problem.

INFERENTIAL—How is weather stripping part of the criteria for the design?

» It is part of the criteria because the pet door needs to be able to close and keep bad weather out of the house.

INFERENTIAL—Think of all the criteria and solutions in the design plan. Why is each important to the design?

» Without these criteria and solutions, the pet door wouldn't work well.

SUPPORT—Have students think of a design solution as a puzzle: there are lots of different parts, each part has a purpose, there are only certain spots for each part (there are criteria), and the puzzle or design isn't completed successfully unless all the parts are there.

Page 53 **Ask students to look at the image as you read aloud.** Talk about what they notice about the looks on Maya's and Aiden's faces. Why are they concerned?

INFERENTIAL—Why is Maya's question helpful?

» It is helpful because it shows another possible problem that they need to think about.

Have students chat with a neighbor about the following prompt:

INFERENTIAL—What are some possible solutions to Maya's problem?

» We could make a hole in something else and see if Whiskers will walk through.

Page 54 **Ask students to look at the image as you read aloud.** Talk about what they notice about…

LITERAL—What is a **prototype**? Why is it important?

» It is a practice version of a design. It helps people see if their ideas will work before they build the real version.

INFERENTIAL—Think of the criteria for the design plan. Which does the prototype test? Which does it not test?

» The prototype tests if the cat can go in and out. It doesn't test if the pet door can keep the weather out or stay closed.

Page 55

Ask students to look at the image as you read aloud. Talk about what they notice about the finished product. Do they think it was successful?

Whiskers watches as they gently encourage her to push through the cardboard door. Maya and Aiden are excited when Whiskers reaches the treat on the other side! After a few more treats, Whiskers is going in and out the door with ease.

Maya and Aiden tested the idea of a pet door by using a prototype, and it worked.

Time to build the real thing!

Main Science Idea

You can tell how a device is intended to work by looking at a diagram of it. Building a practice version, or prototype, is a good way to test a design.

55

Ask students the following questions:

INFERENTIAL—Do you think the real pet door is going to work and meet all the criteria? Why or why not?

» I think it will work because it has met each of the criteria.

Call attention to the steps the family took while developing their design plan. When people have a problem, come up with an idea, and try out their idea, they are being scientists and engineers.

3. Check for understanding.

Activity Page

AP 9

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Use the activity page to assess student learning on designing solutions.

Consider having students use materials in the classroom to make their designs.

See the Answer Key for sample or correct answers.

LESSON 10

A Friendly Challenge

AT A GLANCE

Lesson Question

What does it mean to argue using evidence and reasoning?

Learning Objectives

- ✓ Associate argument with debate (as opposed to quarrel or altercation).
- ✓ Recognize dispute of ideas as a healthy part of the scientific process.
- ✓ Practice respectful and congenial disagreement.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- claims, evidence, reasoning activity

Main Science Idea

In science, to argue does not mean to fight. Argument is a respectful process of working through people's different ideas when they disagree. Evidence is what determines whether an idea is correct or not.

NGSS and CCSS References

SEP7. Engaging in Argument from Evidence: In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Argumentation is used to listen to, compare, and evaluate competing ideas and methods based on merits.

RI.K.10. Range of Reading and Level of Text Complexity: Actively engage in group reading activities with purpose and understanding.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

argument **claim** **evidence** **reasoning**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

data **respectful**

Instructional Resources

Student Book

Ch. 10

Student Book, Chapter 10
"A Friendly Challenge"

Activity Page

AP 10

Activity Page
Claims, Evidence, and Reasoning (AP 10)

Materials and Equipment

Collect or prepare the following items:

- reference books and other research materials
- internet access and the means to project images/video for whole-class viewing

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Watch the recommended video of a commercial with students. Ask students to describe what the person wants them to believe. What proof is he giving, and do they believe him? Center the conversation on argumentation by asking what the students would say to the presenter if they didn't believe him. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What does it mean to argue using evidence and reasoning?

2. Read together: "A Friendly Challenge."

Student Book

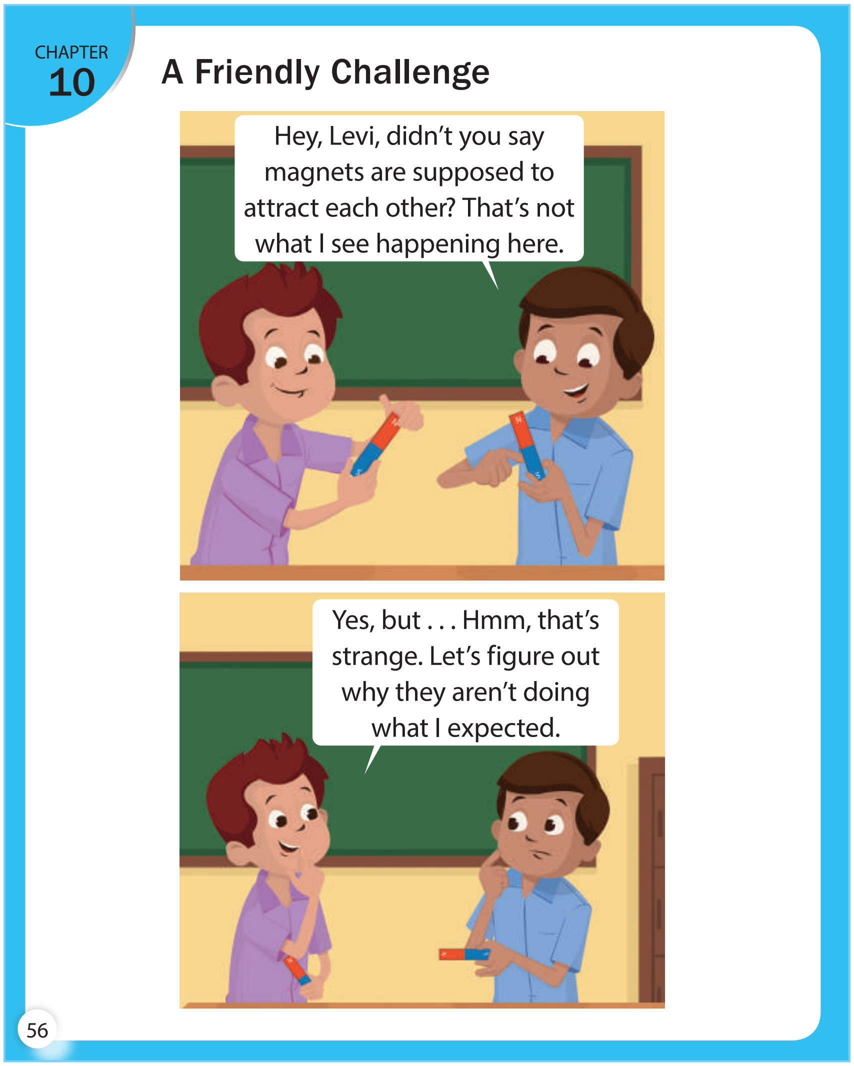
Ch. 10

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 10 on page 56. Tell students that the title of this chapter is "A Friendly Challenge," and tell them to pay special attention to how the characters talk to each other as you read.

Read Aloud Support

Page 56 **Ask students to look at the images as you read aloud.** Talk about what they notice about what the students might be investigating. What might they be trying to find out?



LITERAL—What is Levi's **claim**?

» He says that magnets are supposed to attract each other.

INFERENTIAL—What do you think might have happened right before these pictures?

» I think Levi said magnets attract and tested his idea.

Tell students that *attract* means pulling toward. Magnets that go toward each other are said to attract.

INFERENTIAL—Have you ever disagreed with someone before? Was it similar to or different from how Levi and Jax disagree here?

» It was different! We yelled at each other, but Jax and Levi are just talking.

Page 57 **Ask students to look at the images as you read aloud.** Talk about what they notice about what Jax and Levi are doing to test their claims.

LITERAL—What **evidence** did Levi and Jax collect in the first picture?

» The evidence was that the magnets did not attract if they were far apart.

EVALUATIVE—Does this evidence support his claim that magnets attract each other?

» No, it doesn't support the claim. The magnets did not attract each other.

INFERENTIAL—What does the word **argument** mean? Do you think Jax and Levi are doing this?

» It means to fight! No, I don't think they're arguing; they just seem to be talking!

Tell students that in science, we use the word *argument* in a different way. In science, when we make an argument, we are saying a claim, telling someone our evidence, and then explaining why this evidence is important.

Page 58 **Ask students to look at the image as you read aloud.** Talk about what they notice about the new test Jax and Levi are trying.

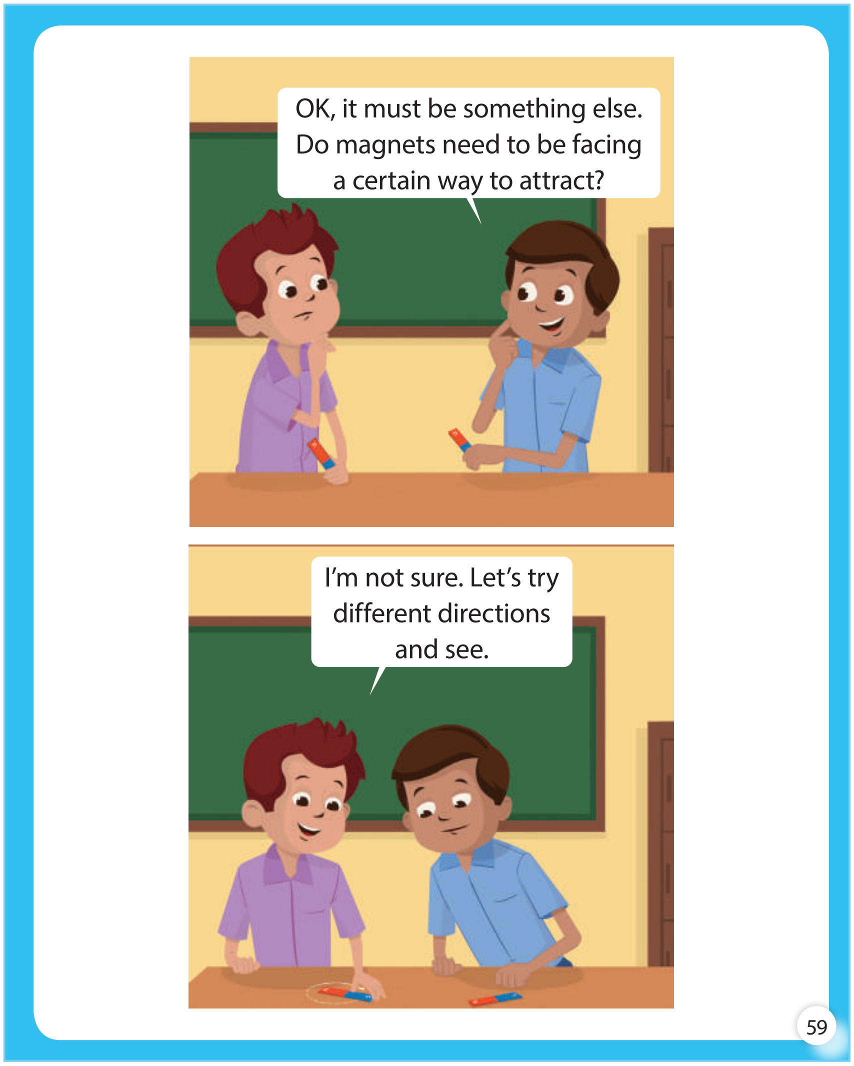
INFERENTIAL—Jax and Levi keep trying new ideas to test Jax's claim. Why is this better than quarreling or fighting?

» This is better because they are working together and learning together to try new things. They may not have had these ideas if they weren't working with each other.

INFERENTIAL—Jax and Levi didn't agree on Jax's claim, so they started doing tests. How is this doing science?

» They had a problem, and they did tests to gather data. They talked to each other about their ideas using evidence.

Page 59 **Ask students to look at the images as you read aloud.** Talk about what they notice about the latest test they are trying.



INFERENTIAL—How have Jax and Levi been respectful to each other?

» They have not been yelling or been mean to each other. They are considering each other's ideas and talking kindly about them.

INFERENTIAL—Why is it important to be respectful when doing science?

» It's important because you listen to each other's ideas and learn new ideas.

INFERENTIAL—How did Jax and Levi respectfully disagree?

» They respectfully disagreed because they listened to each other and thought about each other's ideas.

Page 60 **Ask students to look at the image as you read aloud.** Talk about what they notice about what is happening in their exploration of magnets.

EVALUATIVE—What is Jax and Levi's final claim?

» Their claim is that magnets need to be facing a certain way to attract.

EVALUATIVE—What is their evidence?

» Their evidence showed that the magnets don't attract if they are far from or near each other but rather only when they were turned in certain ways.

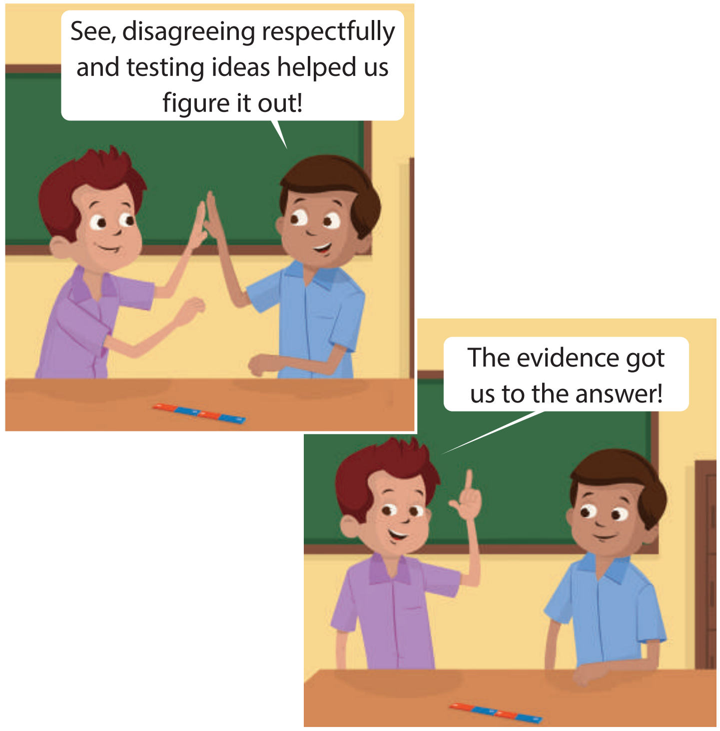
Explain to students that when scientists argue, they make claims, show their evidence, and then talk about why the evidence is important. This is the **reasoning**.

INFERENTIAL—What is their reasoning?

» The evidence shows that magnets can only attract when they are facing a certain way toward each other.

Page 61

Ask students to look at the images as you read aloud. Talk about what they notice about how the boys are feeling about their work.



Main Science Idea

In science, to argue does not mean to fight. Argument is a respectful process of working through people's different ideas when they disagree. Evidence is what determines whether an idea is correct or not.

61

Ask students the following questions:

LITERAL—What does Jax say helped them to figure out their problem? Do you agree or disagree?

» He says that disagreeing respectfully and testing ideas helped them. I agree because they shared ideas and tested them together.

3. Check for understanding.

Activity Page

AP 10

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. In science, to argue does not mean to fight. Argument is a respectful process of working through people's different ideas when they disagree. Evidence is what determines whether an idea is correct or not.

Have students first make claims, find evidence, and write the reasoning for their claim. Then have students debate their arguments

See the Answer Key for sample or correct answers.

LESSON 11

Sparky Shares Evidence

AT A GLANCE

Lesson Question

How can we communicate our science ideas to others?

Learning Objectives

✓ Use sentence frames to construct statements expressing a scientific hypothesis and prediction.

✓ Use sentence frames to construct statements expressing scientific claims with evidence.

✓ Identify relevant details to include in a mock science presentation.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- gummy bear demonstration

Main Science Idea

The science process starts with an idea you are unsure about. Then you say what you think will happen and do tests to gather evidence to see if you are correct. Finally, you share what you discover with others.

NGSS and CCSS References

SEP8. Obtaining, Evaluating, and Communicating Information: Scientists must be able to clearly communicate the ideas and methods they generate. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through discussions.

RI.2.2. Key Ideas and Details: Identify the main topic of a multiparagraph text as well as the focus of specific paragraphs within the text.

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

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Core Vocabulary and Language of Instruction

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prediction **question**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

claim **data** **evidence** **guess** **test**

Instructional Resources

Student Book

Ch. 11

Student Book, Chapter 11
"Sparky Shares Evidence"

Activity Page

AP 11

Activity Page
Growing Gummies (AP 11)

Materials and Equipment

Collect or prepare the following items:

- gummy bear candies
- small bowls
- plastic spoon
- paper towels
- water
- ruler (optional)

THE CORE LESSON

1. Focus attention on the Lesson Question.

Conduct a short science talk with students. Hold up a piece of paper and a book. Tell students that you want to know what might happen if you dropped the two items at the same time. Use a verbal sentence frame, such as "If__________, then__________," to encourage students to make predictions. For example, "If we drop the book and paper at the same time, then the book will land first." Emphasize that students will be learning about how scientists communicate their ideas in certain ways in this chapter.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How can we communicate our science ideas to others?

2. Read together: "Sparky Shares Evidence."

Student Book

Ch. 11

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 11 on page 62. Tell students that the title of this chapter is "Sparky Shares Evidence," and tell them to pay special attention to how the student thinks about his problem and the steps he uses to understand it as you read.

Read Aloud Support

Page 62

Ask students to look at the image as you read aloud. Talk about what they notice and what they are wondering about. Tell students that scientists always begin their work by noticing and wondering about things.

CHAPTER 11

Sparky Shares Evidence

Sparky loves science. He loves learning about how things work and discovering new things. One day, while getting ready to go outside to play, Sparky felt a little shock when he touched his bedroom doorknob.

62

INFERENTIAL—Have you ever noticed a shock when you touched a doorknob before? What might scientists wonder about if they noticed these shocks?

» Yes, I have! Scientists might wonder what causes the shock.

INFERENTIAL—What do you think caused the shock?

» I think that the air had a lot of electricity in it and it hit the door.

Page 63 **Ask students to look at the image as you read aloud.** Talk about what they notice about what Sparky is holding and why he is doing that.

LITERAL—What **question** was Sparky trying to answer?

» He wondered why he was getting shocked.

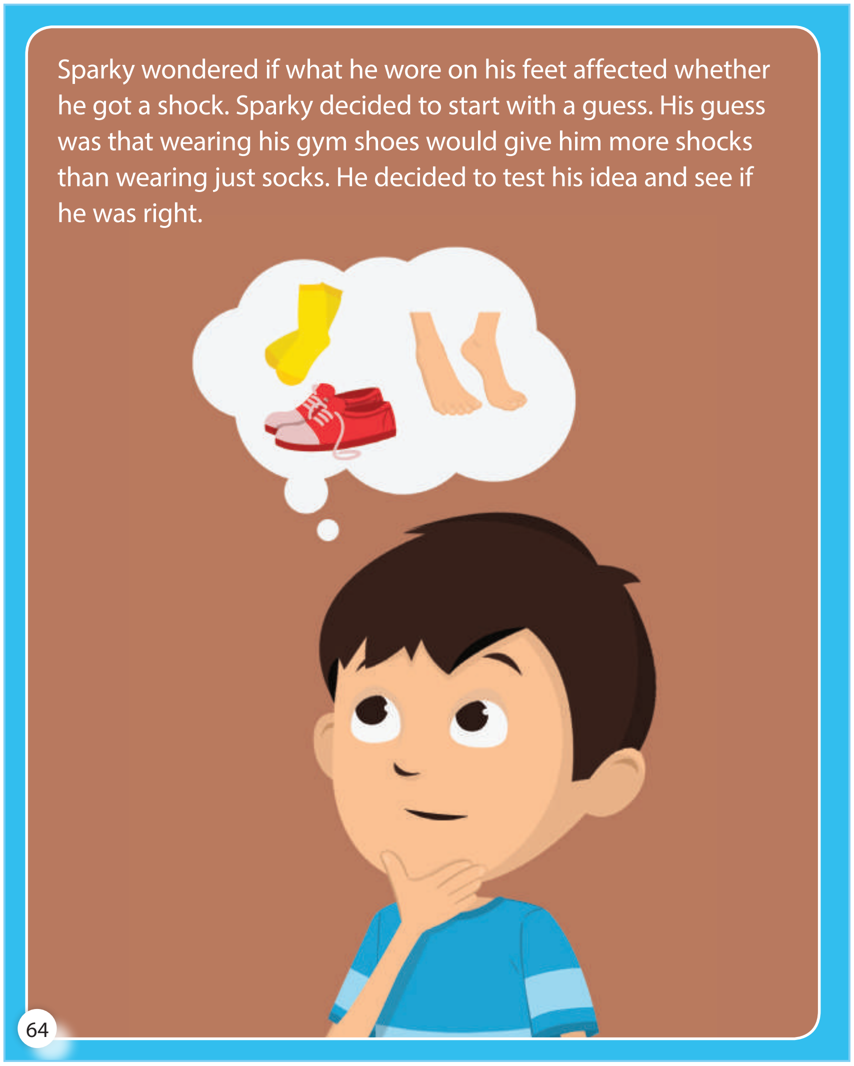
LITERAL—Sparky made observations and gathered data. Name some data he gathered.

» He saw that he was getting shocked when he touched the door. It happened again and again. Sometimes it happens but not all the time.

LITERAL—Sparky had an idea about the cause. What was his idea?

» He thought that it had something to do with his shoes and socks.

Page 64 **Ask students to look at the image as you read aloud.** Talk about what they notice about what Sparky is thinking about.


Sparky wondered if what he wore on his feet affected whether he got a shock. Sparky decided to start with a guess. His guess was that wearing his gym shoes would give him more shocks than wearing just socks. He decided to test his idea and see if he was right.

64

Tell students that in science, we say our guesses like, "I think ____ because ______" or "My guess is ______ because ______"

LITERAL—What was Sparky's guess?

» He thought that what he wore on his feet affected whether he got a shock. He thought this because sometimes he wears his shoes and sometimes he doesn't.

Explain to students that in science, we test our guesses. But before we test our guesses, we make **predictions** about what we think will happen.

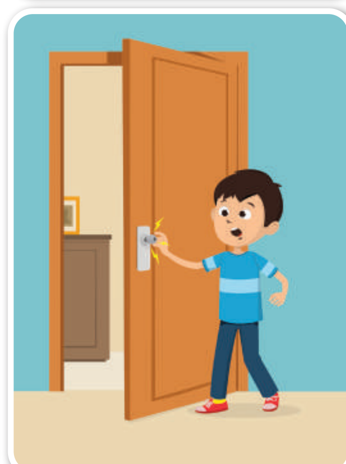
LITERAL—What was Sparky's prediction? Use the sentence frame "If________, then ____________" to say his prediction.

» If he wears gym shoes, then he will get more shocks than when he wears just socks.

Point out that so far, Sparky has 1) had a question, 2) made a guess about the answer, and 3) made a prediction. Write the words *question*, *guess*, and *prediction* on the board.

Page 65 **Ask students to look at the images as you read aloud.** Talk about what they notice about how Sparky is testing his guess.

Sparky gathered evidence. He decided to walk in and out of his room with different things on his feet. First, he walked barefoot. Then, he wore just socks. Finally, Sparky put on his gym shoes. Sparky realized that he got more shocks every time he wore just his socks. This changed his guess that shoes made more shocks!



65

LITERAL—How did Sparky test his guess? Name the three tests he did.

» He walked in and out of his room with different things on his feet. He walked barefoot, then he wore just socks, and then he put on his gym shoes.

LITERAL—What new evidence did he gather?

» He found that he got more shocks when he wore just socks.

INFERENTIAL—Why did Sparky change his guess?

» He had to change his guess because he learned more and realized his previous guess was wrong.

Page 66 **Ask students to look at the image as you read aloud.** Talk about what they notice about what Sparky might be excited about.

INFERENTIAL—What is Sparky going to share?

» He is going to talk about his investigation about the shocks.

INFERENTIAL—What do you think Sparky should say?

» I think he should talk about why he had the question and the steps he took to figure it out.

EVALUATIVE—Now that he has done his tests, Sparky should end with a claim, which is the answer to his question. What is his claim?

» His claim is that wearing just socks causes more shocks.

Page 67 **Ask students to look at the image as you read aloud.** Talk about what they notice about what Sparky is doing. Is he doing science right now?

Sparky stood in front of his class. He talked about his "shocky" doorknob. He talked about his guess. Then he told the class that he needed to test his guess. He described the evidence he collected. He showed pictures he had drawn to show how he investigated. Sparky's presentation helped his classmates understand how he observed, made a guess, tested his guess, and came to a scientific conclusion.

Main Science Idea

The science process starts with an idea you are unsure about. Then you say what you think will happen and do tests to gather evidence to see if you are correct. Finally, you share what you discover with others.

67

Ask students the following question:

INFERENTIAL—How is Sparky doing science?

» He is talking about his test and what he learned.

Emphasize that part of doing science and acting as a scientist is talking to and learning from each other by sharing ideas and tests.

3. Check for understanding.

Activity Page

AP 11

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms.

In this experiment, students will observe and compare gummy bears left in water with those left in air and develop a claim based on their observations.

This activity is intended to be conducted as a whole-class demonstration. If desired, individuals or small groups can also carry out this simple investigation.

See the Answer Key for sample or correct answers.

LESSON 12

Patterns and Designs

At a Glance

Lesson Question

How do people use patterns in designs?

Learning Objectives

✓ Identify patterns in human-designed objects.

✓ Identify patterns in human events.

✓ Summarize the purposes of patterns in human-made designs.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- pattern search

Main Science Idea

Spotting a pattern can help you understand why something is made the way it is or how it works the way it does.

NGSS and CCSS References

CCC1. Patterns: Observed patterns prompt questions and answers about the factors that influence these patterns. The existence of a pattern naturally suggests an underlying cause for the pattern. Identifying the pattern often supports the development of explanations and solutions to problems.

RI.2.6. Craft and Structure: Identify the main purpose of a text, including what the author wants to answer, explain, or describe.

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design **pattern**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

explain

Instructional Resources

Student Book

Ch. 12

Student Book, Chapter 12
"Patterns and Designs"

Activity Page

AP 12

Activity Page
Patterns in Your School (AP 12)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Online Resources

Show students online images of a bird's-nest bed, a baby snuggler, dog beds, and real birds' nests. Ask students to think about anything that is similar in all of the beds. Why were the human-made beds made that way? (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How do people use patterns in designs?

2. Read together: "Patterns and Designs."

Student Book

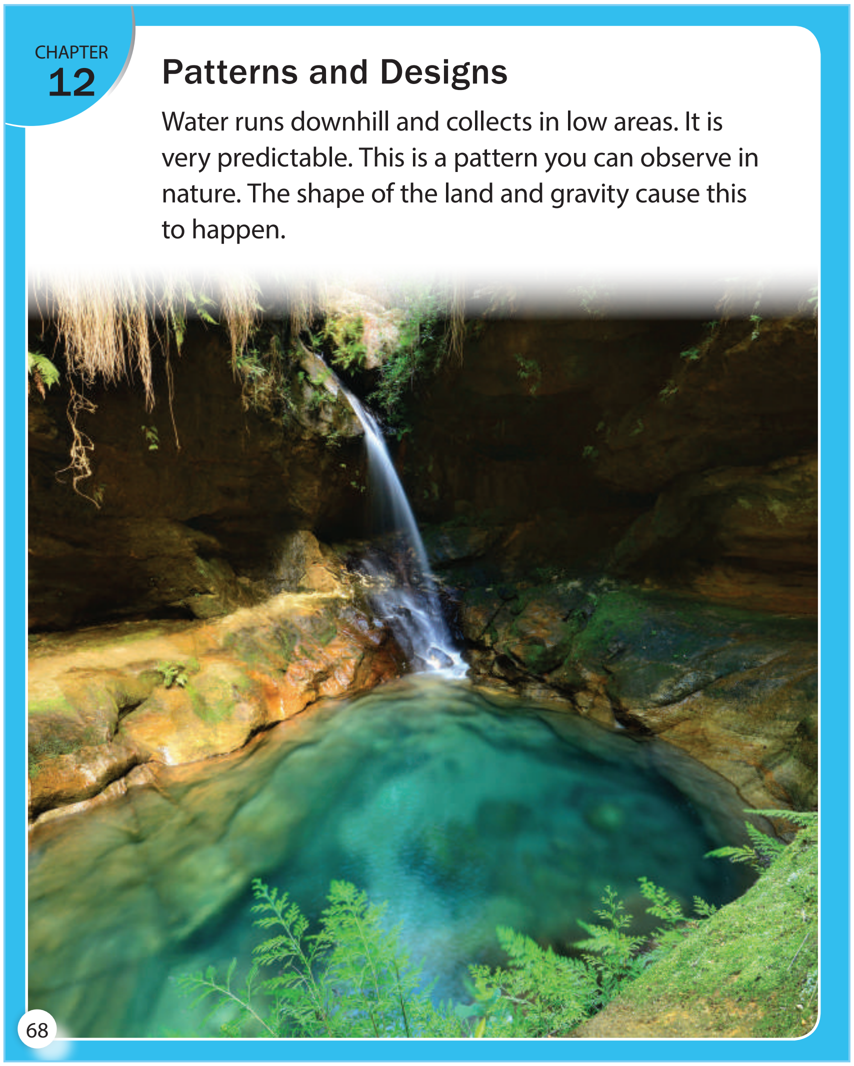
Ch. 12

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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 12 on page 68. Tell students that the title of this chapter is "Patterns and Designs," and tell them to pay special attention to how patterns helped in building things we use as you read.

Read Aloud Support

Page 68 **Ask students to look at the image as you read aloud.** Talk about what they notice about the direction the water is flowing.



CHAPTER 12

Patterns and Designs

Water runs downhill and collects in low areas. It is very predictable. This is a pattern you can observe in nature. The shape of the land and gravity cause this to happen.

68

LITERAL—Where else have you seen water running or flowing down and collecting somewhere?

» I've seen water flow down from the water faucet in my sink, down from a waterfall into a pool of water, down from the sky into a puddle, or over rocks in a stream into a lake.

INFERENTIAL—Do you ever see water flowing or moving up?

» No, I've never seen that.

Point out to students that this is a **pattern**. Water flows down because of gravity and then collects somewhere when it can't continue flowing. We see this happen over and over again.

Page 69 **Ask students to look at the image as you read aloud.** Emphasize that the purpose of this chapter is to help us see patterns in the things that people have made.

Trees grow straight upward. Their trunks are thicker than their branches. The thickest branches grow directly from the trunk. Thinner branches grow from the thicker branches. Leaves grow from the thinner branches. This is a pattern you can observe in nature.

There are patterns in the ways that people design, make, and do things, too. When you see patterns repeated in things that people have designed, you can think of the reasons the objects were made that way. Let's look for patterns in things that people make and do.

69

LITERAL—What is the pattern?

» The pattern is the following: Trees grow up. Trunks are thicker than branches. The thickest branches are closest to the trunk. Thin branches grow from thick ones. Leaves grow from thin branches.

SUPPORT—To better visualize this pattern, draw a simple stick figure of a tree as you walk through the different parts of the pattern. Point to each element as you talk.

INFERENTIAL—What are some things that people have designed? Can you see any patterns in these designed objects?

» People have designed almost everything we use! They designed our desks, the books, the lights, the classroom, our clothes, and our shoes.

Page 70 **Ask students to look at the image as you read aloud.** Talk about what they notice about the furniture.

Look at tables and chairs indoors and outdoors. There's a pattern in how they are made. Tables and chairs usually have four legs. It's possible for them to have three legs. And it's possible for them to stand on one sturdy leg in the center. But four legs make a table or chair the most stable. It's a pattern people use in their designs.

70

LITERAL—What is the usual pattern for tables and chairs?

» They usually have four legs.

INFERENTIAL—Why is the four-leg pattern important? What is its purpose?

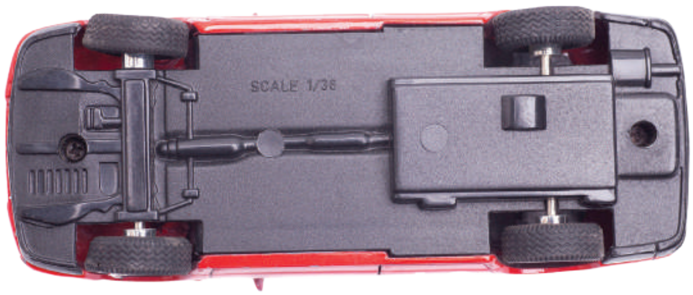
» Four legs make a table or chair the most stable.

EVALUATIVE—These chairs follow the four-leg pattern. Are they good **designs**?

» Sample answers: These chairs look like a good design. The design is good if the chairs are sturdy and safe.

Page 71 **Ask students to look at the images as you read aloud.** Talk about what they notice about the underside of the car and any patterns they see there.

Four wheels make a car the most stable, too. It's possible for a motor vehicle to have three wheels or even two. But most motor vehicles are built with four wheels. It's a pattern people use in their designs.



71

Online Resources

Ask students to close their eyes and picture cars they see on the road. Then, share an image of a motorcycle with three wheels, a motorcycle with two wheels, and a unicycle. Emphasize how most cars we see on the road have four wheels and that that is for a reason. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

LITERAL—What pattern for car wheels do most cars follow?

» Most cars have four wheels.

INFERENTIAL—Why do people use this pattern in their designs?

» They use this pattern because it is the most stable and safest.

Point out that just like the table, people design things we use to be as safe and stable as possible. So, they look at patterns to help them know what is the most stable.

Page 72 **Ask students to look at the images as you read aloud.** Talk about what they notice about any patterns in the desks or walls.

Look at the windows in most houses, schools, and other buildings. Most of the windows are squares or rectangles. They have straight edges on all sides. Why? Because sheets of glass are much easier to cut to the right size with straight edges. So, glass windows usually have straight edges. It's a pattern people use in their designs.

Look at a piece of notebook paper. What pattern do you see on it? Why do you think the paper is designed the way that it is?

72

LITERAL—What is the pattern?

» Windows are squares or rectangles. They have straight edges on all sides.

INFERENTIAL—Why do people use this pattern in their designs?

» Sheets of glass are easier to cut if they have straight edges.

Point out that in this case, the window design uses a pattern not because of safety or stability but because it makes things easier to make. Designers have lots of different things to think about when designing things.

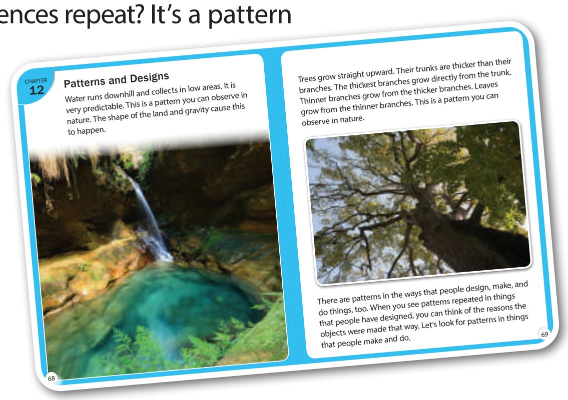
INFERENTIAL—What pattern do you see on the notebook paper? Why is it designed like that?

» The pattern is the straight lines. The straight lines help make sure the writing is neat and easy to read and that the writing is a good size.

Page 73 **Ask students to look at the image as you read aloud.** Talk about what they notice about any patterns in any of the images.

Look at a shelf full of books. What do they have in common? What pattern does their design share? Why do you think they were designed that way?

This book chapter was designed by a person, too. A writer picked the words to go on the pages. Can you spot a word that appears in every paragraph? Can you spot a sentence that appears in several paragraphs? Why do you think these words and sentences repeat? It's a pattern the writer used to help you learn *about patterns*!



Main Science Idea

Spotting a pattern can help you understand why something is made the way it is or how it works the way it does.

73

Have students pair-share with a neighbor, discussing their ideas on the prompts in the text.

3. Check for understanding.

Activity Page

AP 12

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Spotting a pattern can help you understand why something is made the way it is or how it works the way it does. In the activity, students practice identifying patterns in designed objects. They will then be asked to think about and explain why that pattern is important in the design of the object.

See the Answer Key for sample or correct answers.

LESSON 13

What's a Theory?

At a Glance

Lesson Question

What is a theory?

Learning Objectives

- ✓ Explain what a theory is (a testable explanation).
- ✓ Use close reading strategies to identify theories and their supporting patterns and/or cause-and-effect factors in provided science scenario passages.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- theory worksheet

Main Science Idea

A theory is a scientific idea about why or how something happens. It is based on observation and uses facts to support it.

NGSS and CCSS References

CCC2. Cause and Effect: Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text.

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evidence **theory**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

cause **effect** **pattern**

Instructional Resources

Student Book

Ch. 13

Student Book, Chapter 13
"What's a Theory?"

Activity Page

AP 13

Activity Page
Theories (AP 13)

Materials and Equipment

Collect or prepare the following items:

- computers or tablets for research
- internet access and the means to project images/video for whole-class viewing

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Show students images of different scientists. Prompt a conversation about the images. Can the students tell what each scientist studied? Why might their work be important? Ask them to think about how they went about their work. What steps did they take? (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What is a theory?

2. Read together: "What's a Theory?"

Student Book

Ch. 13

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Guide students to open their books to Chapter 13 on page 74. Tell students that the title of this chapter is "What's a Theory?" and tell them to pay special attention to evidence and explanations as you read.

Read Aloud Support

Page 74

Ask students to look at the image as you read aloud. Talk about what they notice that makes it seem like this is a person from a long time ago. Is our scientific knowledge now the same as it was during the time of the picture?

CHAPTER 13

What's a Theory?

Nicolaus Copernicus was a famous scientist from Poland. He lived about five hundred years ago.

He studied astronomy. He collected many facts. He did his best to make sense of all his facts. Copernicus then announced his theory. A science theory is an explanation for how or why something works based on a lot of facts.

Copernicus announced that Earth moves around the sun. In the past, most people thought it was the other way around. People believed the sun moves and Earth doesn't.

74

LITERAL—What was Copernicus's **theory**? What was the previous theory?

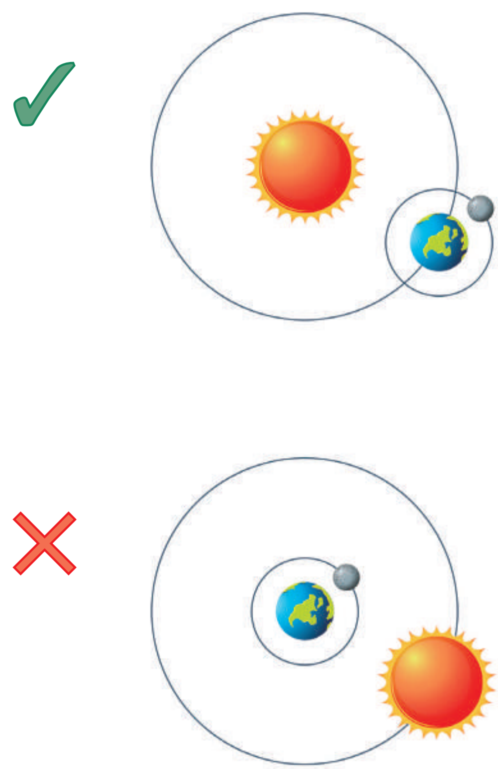
» His theory was that Earth moved around the sun. Previously, people thought that the sun and planets moved around Earth (Earth didn't move).

Emphasize that a theory is something that explains how or why something happens based on many facts. We call these facts **evidence**.

INFERENTIAL—Why was it important that Copernicus collect facts before announcing his theory?

» He had to collect a lot of facts to support his theory, or else people wouldn't believe him. They believed that the sun moved around Earth. They needed evidence.

Page 75 **Ask students to look at the images as you read aloud.** Talk about what they notice about what is different or similar about the images. Remind students that the diagrams are not to scale. They do not show the sizes of these objects compared to each other nor the distances between them.



Copernicus recorded observations to support his theory. He knew that it was not enough to have just an idea. Copernicus observed carefully so he knew his facts were correct. Today we have many more facts, and we know that his theory is right.

75

INFERENTIAL—Why was it not enough to have just an idea?

» You need observations and facts to support the theory.

Remind students that facts are evidence.

Tell students that Copernicus died without his theory being accepted, but we now know that he was right.

INFERENTIAL—What do you think happened after Copernicus died so that we now accept his theory?

» Other scientists must have collected more evidence.

Page 76 **Ask students to look at the image as you read aloud.** Talk about what they think it may have felt like to be a scientist trying to develop new theories long ago.

Louis Pasteur was a famous scientist from France. He was born about two hundred years ago. In those days, people often got sick drinking spoiled milk. Pasteur developed a theory about why milk spoils. His theory was based on his knowledge of tiny living organisms called bacteria. He collected facts that showed some bacteria cause milk to go bad.

76

INFERENTIAL—What question did Louis Pasteur have?

» He wanted to know what was causing people to get sick.

Remind students that when scientists have a question, they start an investigation by making a guess about the answer. The guess is usually based on information or observations they had made before.

LITERAL—What was his guess? Why did he think this?

» He guessed that some bacteria caused milk to go bad. He thought this because he knew about bacteria.

Point out that scientists often follow these steps: 1) have a question, 2) make a guess based on previous knowledge, 3) make observations/collect evidence, 4) try to make sense of their observations, and 5) come up with an explanation, or theory, that explains why these things happen.

Page 77 **Ask students to look at the image as you read aloud.** Explain to students this is an image of milk in a machine that is based on Louis Pasteur's theory. Ask them if they think this is what labs looked like hundreds of years ago during the time of Louis Pasteur.

To develop his theory, Pasteur conducted experiments to collect information. He wrote down his many facts about bacteria.

Once he announced his theory, he put it to the test. He said if we heat milk, we could kill the harmful bacteria. Today almost all milk is heated before it is sold.

77

LITERAL—How did Louis Pasteur collect evidence?

» He conducted experiments and, made observations to collect evidence.

Point out that after collecting evidence, scientists have to analyze it, or make sense of it. They do this by looking for patterns—things that happened over and over again in their tests.

INFERENTIAL—How did Louis Pasteur's theory change the way we do things?

» Now we know that we need to heat milk before we drink it. That will get rid of bacteria that could get us sick.

Share that the process of heating milk to eliminate the bacteria in it is called pasteurization, and ask them where they think the name comes from.

Page 78 **Ask students to look at the image as you read aloud.**

Marie Tharp was a scientist from the United States. Tharp supported a theory that large areas of the ocean floor move. But any theory needs many facts. She collected facts. She helped create the first detailed map of the ocean floor.

78

LITERAL—What theory did Marie Tharp work on?

» the theory that large areas of the ocean floor move

LITERAL—What did she do to try to prove this theory?

» She collected facts. She created a detailed map of the ocean floor.

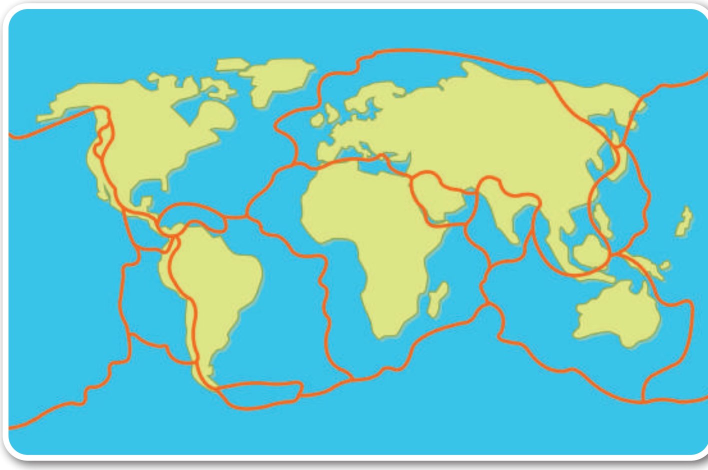
Point out that Tharp first collected lots of facts about the ocean floor. Then she looked at her observations, made sense of them, and used this information to create a detailed map of the ocean floor.

Know the Standards

Cause and Effect In Grade 2, students should be working toward understanding that explanations for scientific phenomena can and should be based on finding patterns or identifying causes and effects.

Page 79 **Ask students to look at the image as you read aloud.** Talk about what they notice about how the map looks like a puzzle.

Tharp took measurements of the ocean floor. Her data showed that there are deep cracks where enormous pieces of ocean floor are moving. She revealed that Earth's crust is made up of giant sections like puzzle pieces. These pieces are called plates. When plates move, it can cause earthquakes and volcanic eruptions. Tharp's map and research helped scientists better understand how our planet changes.



Main Science Idea

A theory is a scientific idea about why or how something happens. It is based on observation and uses facts to support it.

79

EVALUATIVE—Marie Tharp took measurements and saw there were deep cracks around enormous pieces of ocean floor. She noticed a pattern about all the pieces. What was the pattern?

» She noticed they fit together like puzzle pieces.

Point out that often, theories have causes (like plates moving) and effects (earthquakes and volcanic eruptions).

3. Check for understanding.

Activity Page

AP 13

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A theory is a scientific idea about why or how something happens. It is based on observation and uses facts to support it.

See the Answer Key for sample or correct answers.

LESSON 14

Parts of Whole Amounts

At a Glance

Lesson Question

What does *proportion* mean?

Learning Objectives

✓ Interpret simple proportions from visual graphics.

✓ Group examples that reflect the same proportion.

✓ Describe proportions represented in examples.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- proportion examples

Main Science Idea

A proportion is a part or share of a whole number or thing.

NGSS and CCSS References

CCC3. Scale, Proportion, and Quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2, RI.2.4** and **2.G.A.3**)

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

half **quarter**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

equal **meters** **quantity**

Instructional Resources

Student Book

Ch. 14

Student Book, Chapter 14
"Parts of Whole Amounts"

Activity Page

AP 14

Activity Page
Half, Quarter, Whole (AP 14)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Show students a video about sharing halves. Talk about times they have had to share what they had and how important it is to share fairly. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What does *proportion* mean?

2. Read together: "Parts of Whole Amounts."

Student Book

Ch. 14

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 14 on page 80. Tell students that the title of this chapter is "Parts of Whole Amounts" and that it is about how quantities can be compared.

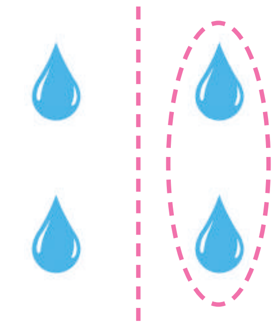
Read Aloud Support

Page 80 **Ask students to look at the images as you read aloud.** Ask them to think about when they have had to divide something in half.

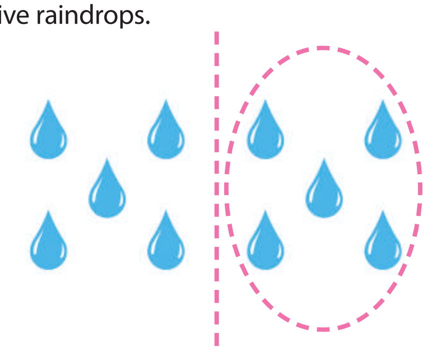
CHAPTER 14

Parts of Whole Amounts

Here are four raindrops. Half of four raindrops is two raindrops. Half means one of two equal parts.



Here are ten raindrops. Half of ten raindrops is five raindrops.



Two raindrops and five raindrops are different numbers of raindrops. But in the groups shown here, two and five both represent half of the whole quantity.

80

LITERAL—What does **half** mean?

» either of two parts that are equal

INFERENTIAL—How do you split things in half?

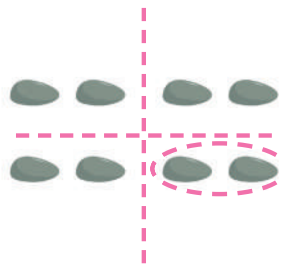
» If you can count it, you can count equal parts. If it is one thing, you have to break it in half so the two parts are equal.

SUPPORT—Discuss the word *half,* which is one of two parts of a whole thing. Review geometric shapes, including circle, square, rectangle, and triangle. Have students demonstrate how to divide each shape into two halves. Relate this understanding to natural phenomena, including a wooded area that is half the size of another area, and ask students to describe how big each area is.

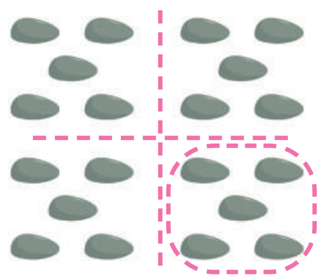
Page 81 **Ask students to look at the pictures as you read aloud.** Ask them to think about a time they had to divide something in quarters.

Here are eight pebbles. One quarter of eight pebbles is two pebbles.

A quarter is one of four equal parts when a quantity or measurement is divided. One quarter is the same thing as one-fourth, or one part out of four.



Here are twenty pebbles. One quarter of twenty pebbles is five pebbles.



Two pebbles and five pebbles are different numbers of pebbles. But in the groups shown here, two and five both represent a quarter of the whole quantity.

81

LITERAL—What does **quarter** mean?

» one of four equal parts of a whole thing

INFERENTIAL—What are some examples of quarters?

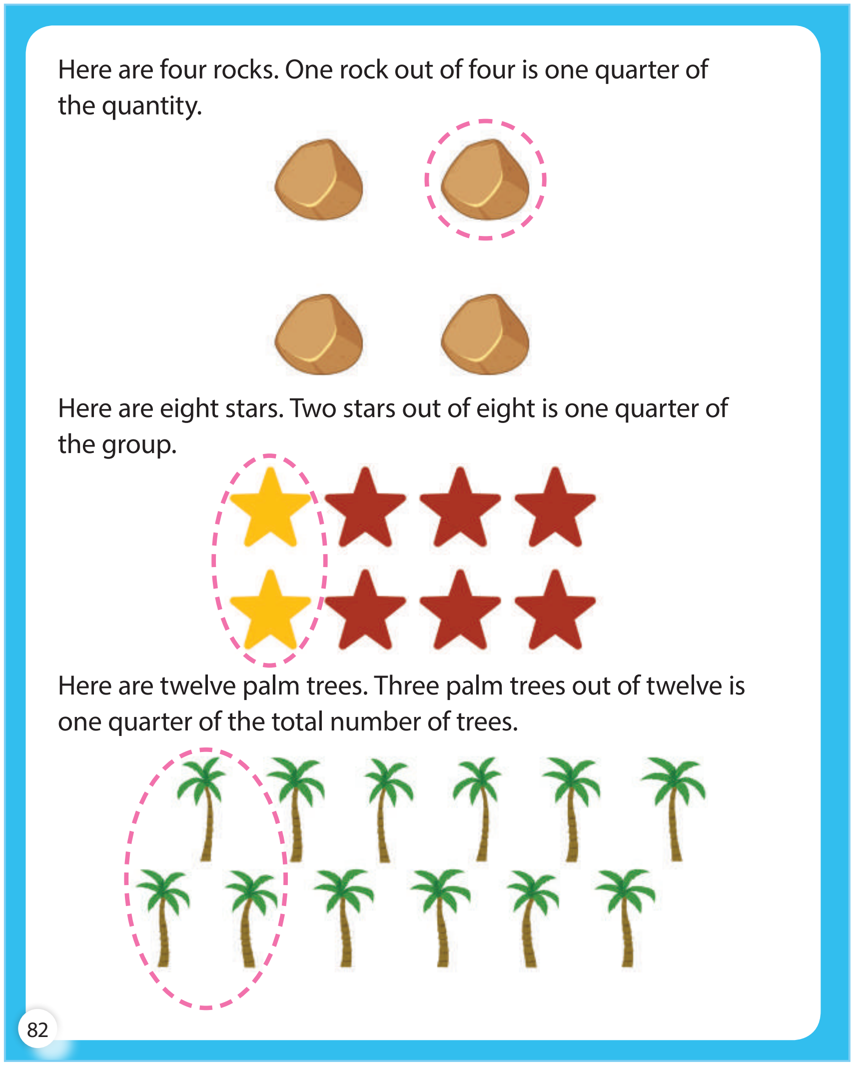
» A quarter coin is worth ¼ of a dollar. 15 minutes is ¼ of an hour. If a dog has 4 puppies, each puppy is ¼ of the total.

EVALUATIVE—When is it fair to divide an amount into quarters to give everyone an equal share?

» If there are four people, each person would get an equal share.

CHALLENGE—Challenge students to pick an item, such as a piece of paper or a number of pencils, and demonstrate how to divide it in half and in quarters.

Page 82 **Ask students to look at the images as you read aloud.** Have them think about how to divide different numbers of things into quarters.


Here are four rocks. One rock out of four is one quarter of the quantity.

Here are eight stars. Two stars out of eight is one quarter of the group.

Here are twelve palm trees. Three palm trees out of twelve is one quarter of the total number of trees.

82

LITERAL—How many would one quarter of twelve seashells be?

» three

INFERENTIAL—How would you divide thirteen leaves into quarters?

» I would put three in each group and cut one leaf into four pieces.

EVALUATIVE—Are quarters bigger or smaller than halves?

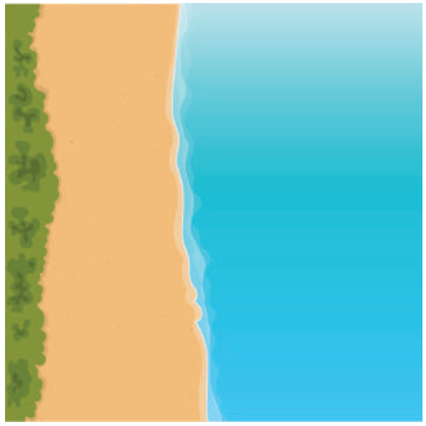
» A quarter is smaller than half of the same thing. A quarter is half of a half. But a quarter of a large thing could be bigger than half of a small thing.

Know the Standards TEACHER DEVELOPMENT

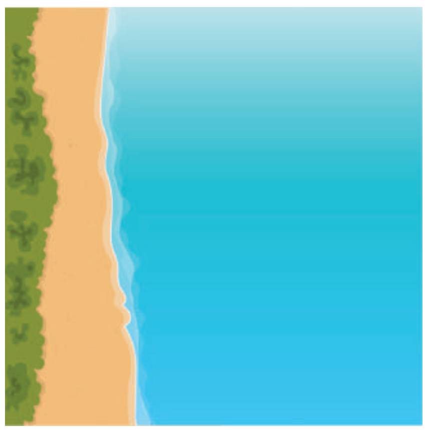
CCC3. Scale, Proportion, and Quantity Scale, proportion, and quantity are essential considerations when deciding how to model a phenomenon. In this lesson, students explore how observable quantities can be described in proportion to the whole.

Page 83 **Ask students to look at the images as you read aloud.** Ask them to think about measuring things in nature to describe proportions.

You can notice halves and quarters of measurements, too.



This beach is about 100 meters wide when the tide is low.



The beach is only about 50 meters wide when the tide is high.

At high tide, the beach is half the width that it is at low tide.

83

LITERAL—If a puddle has twelve liters of water after a heavy rain, how much would it have if half of the water dried up?

» six liters

INFERENTIAL—How much water would be left if a quarter of twelve liters of water dried up?

» nine liters

INFERENTIAL—How can you measure areas of land and water?

» You can measure a small area with a tape measure. If you wanted to measure a large area, you could drive the distance in a car and record the mileage.

INFERENTIAL—How can a map show you the size of a land or water area?

» You can see that one area is bigger than another on a map when you compare them.

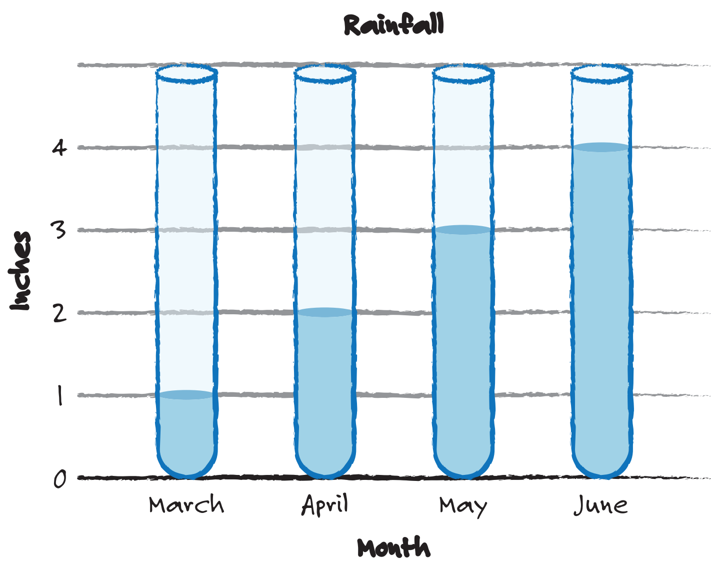
Page 84 **Ask students to look at the image as you read aloud.** Have them think about how they use numbers and parts of wholes to understand the world.

Science uses numbers and math. Comparing amounts can be useful in an investigation.

You can think about halves and quarters when you compare amounts. Look at the graph of rainfall.

- March had half the amount of rain that fell in April.
- March had a quarter of the amount of rain that fell in June.

Which month had half as much rain as June?



84

INFERENTIAL—What can you learn by measuring rainfall and comparing the amounts from month to month?

» You would learn if there were certain months that got more rain or less rain and if the pattern was the same year after year.

INFERENTIAL—What would happen if plants got half as much rain as they got the year before?

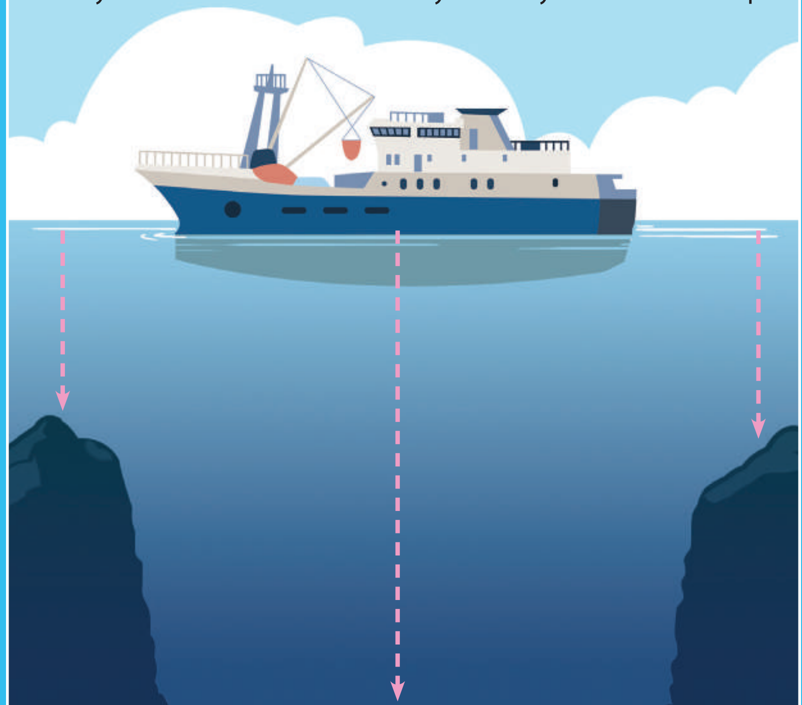
» Some plants might not sprout or grow well.

INFERENTIAL—How could people respond if they learned the rain patterns had changed and less rain was expected?

» They might move or find ways to water plants.

Page 85 **Ask students to look at the image as you read aloud.** Have them think about the relative sizes of land and water.

Look at the deeper part of the ocean here. It is an underwater canyon. The water outside the canyon is only about half as deep.



Main Science Idea

Half of an amount is one of the parts when the whole is equally divided in two. A quarter of an amount is one of the parts when the whole is equally divided into four parts.

85

INFERENTIAL—Show a picture of the Great Lakes between Canada and the United States. Lake Superior is 616 kilometers long. Lake Ontario is about half that length. Describe which lake is bigger.

» Lake Superior is much larger than Lake Ontario. Lake Ontario is half the length of Lake Superior, and because Lake Ontario is more narrow, it is about a quarter of the size of Lake Superior.

3. Check for understanding.

Activity Page

AP 14

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A proportion is a part or share of a whole number or thing.

Use the activity page to compare whole, halves, and quarters.

After students complete the activity page, discuss the part of the whole that each picture represents.

See the Answer Key for sample or correct answers.

LESSON 15

Learning from Models

At a Glance

Lesson Question

What can you learn from a model?

Learning Objectives

✓ Extract grade-appropriate observations from depictions of multiple science models.

✓ With support of sentence frames, describe how the observations they extract from models are useful.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- sentence frames about useful models

Main Science Idea

Models can be objects or pictures. They can show how processes happen or the parts things are made of.

NGSS and CCSS References

CCC4. Systems and System Models: Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4.**)

For detailed information about the NGSS and CCSS 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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Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

cross section **diagram** **model**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

ecosystem **life cycle** **terrarium**

Instructional Resources

Student Book

Ch. 15

Student Book, Chapter 15
"Learning from Models"

Activity Page

AP 15

Activity Page
Learning from Models (AP 15)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Show students a video about a type of model you can learn from. Talk about what they can learn about the four different models of plants in the experiment. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What can you learn from a model?

2. Read together: "Learning From Models."

Student Book

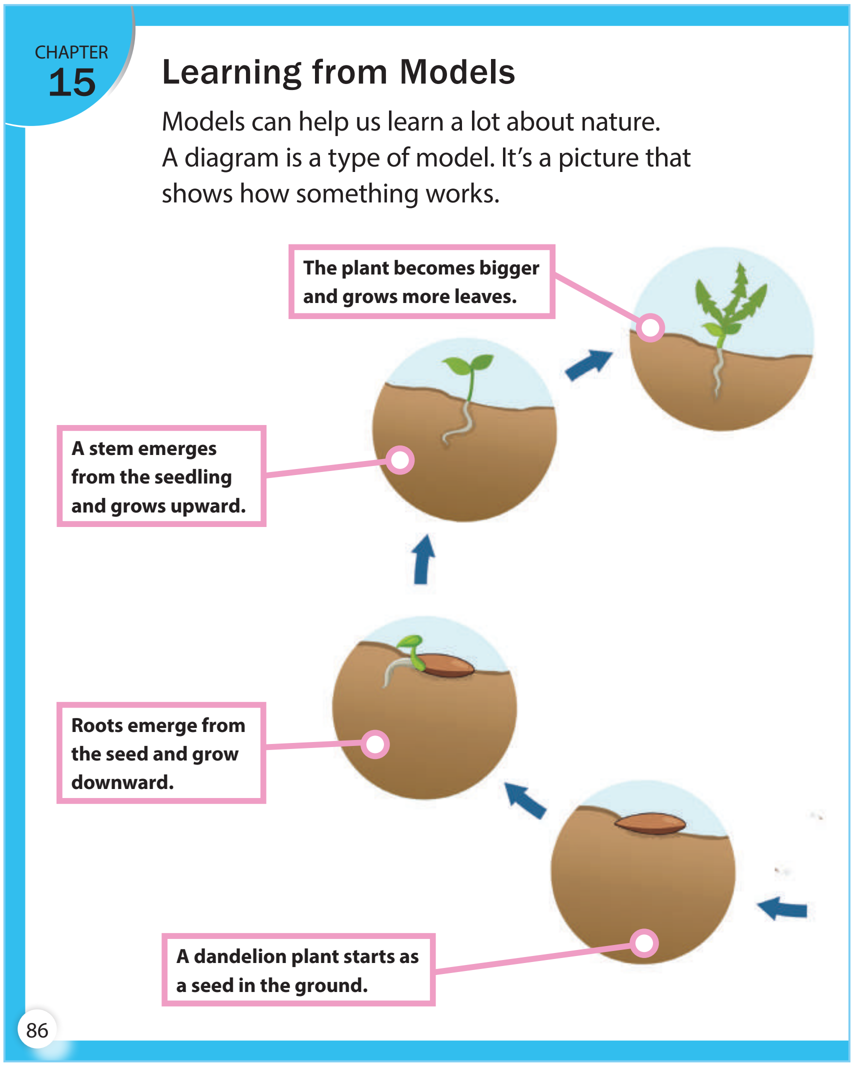
Ch. 15

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 15 on page 86. Tell students that the title of this chapter is "Learning from Models" and that it is about how there are different types of models you can learn from.

Page 86

Ask students to look at the images as you read aloud. Ask them to think about pictures they have seen that help explain things.


CHAPTER 15

Learning from Models

Models can help us learn a lot about nature.
A diagram is a type of model. It's a picture that shows how something works.

LITERAL—What is a **diagram**?

» a picture model that shows how something works

INFERENTIAL—What does the diagram of a plant life cycle teach you about plants?

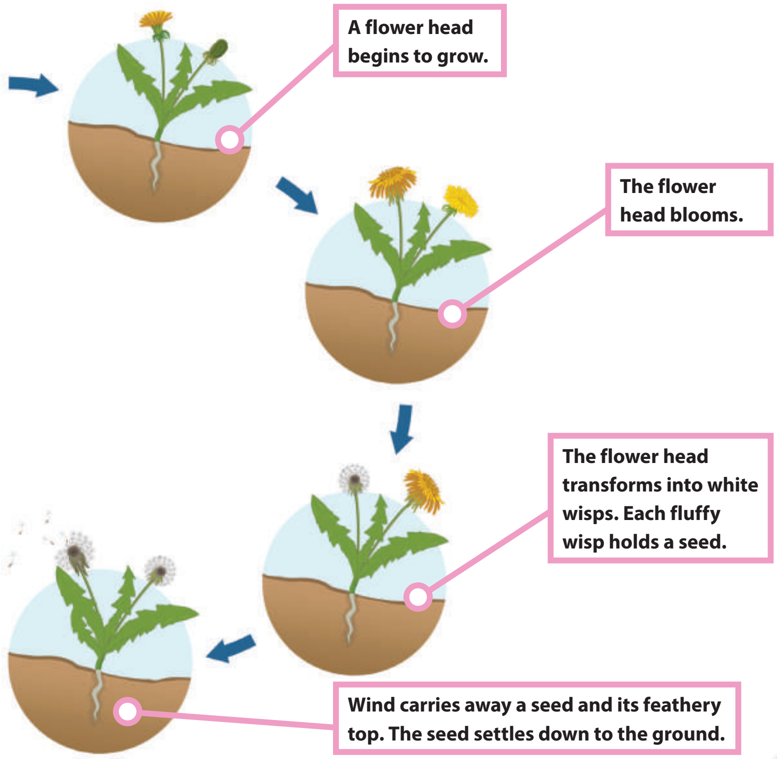
» It shows how a plant grows from a seed to a small plant to a flowering plant that produces seeds and starts over again.

SUPPORT—Discuss the word **model**, which is a copy of a thing often used to make or explain the real thing. Talk about models students have seen or used. Some may have made model plants or played with realistic models of trees. Ask students to explain what models have taught them about the real things. For example, they may have learned about different parts of a flowering plant.

Page 87

Ask students to continue to look at the pictures as you read aloud. Have them think about different diagrams they have seen.

This is a diagram that shows the life cycle of a dandelion. Have you ever blown dandelion seeds into the wind? If so, then you have been a part of its life cycle.



87

LITERAL—Describe the diagram on these pages.

» It shows a picture of each stage of growth of a dandelion as it grows, and it has callouts to tell more about each stage.

INFERENTIAL—What other diagram models have you seen and learned from?

» Possible answers: instructions to make something, an explanation of how something works, a picture of the parts of a toy

Online Resources

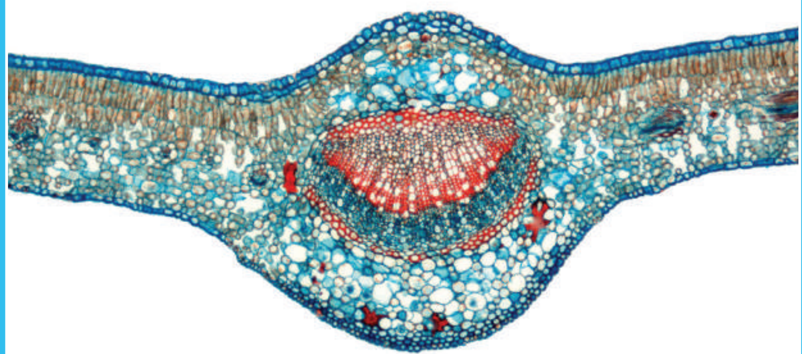
EVALUATIVE—Show a time-lapse video of a flowering plant life cycle. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**) Is a diagram a better model than a video?

» No, it is different but not better or worse. A video is harder to create and takes more time, but you can learn from both.

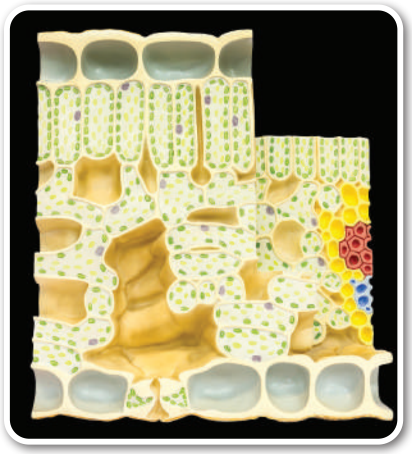
CHALLENGE—Challenge students to create a diagram of some type of plant they have seen.

Page 88 **Ask students to look at the images as you read aloud.** Have them think about what the inside of an apple or orange looks like.

Imagine taking a leaf and cutting it crosswise. If you looked with a microscope, this is what you would see. The colors here were added to make the parts stand out.



Once you know what the inside of a leaf looks like, you can make a model of it. You can make the model quite large so that you can clearly see the inside parts of a leaf.



88

LITERAL—What is a **cross section**?

» a cutting so you can see the inside structure of something

INFERENTIAL—What does a cross section model show you that a diagram of outside parts does not?

» It shows how something is structured. You would not be able to see this in a diagram, which might only show the outside.

INFERENTIAL—What would a cross section of a tree show you?

» It would show the inside rings of the tree and how water moves up from the roots.

Know the Standards

CCC4. Systems and System Models In grades K–2, students understand that objects and organisms can be described in terms of their parts and that systems in the natural and designed worlds have parts that work together. In this lesson, students explore what different types of models can teach them.

Page 89

Ask students to look at the images as you read aloud. Have them think about different objects they have used as models.

Many models are objects instead of pictures. Some models can help you learn about the parts inside the bodies of living things. You can handle the models, take them apart, and put them back together

You can also build your own moving models to show how a process works. For example, these wind turbine models show how a real turbine's propellers turn in the wind.

89

LITERAL—Describe the models in the pictures.

» They are objects, not pictures. They are made of plastic and paper or other materials. They can be taken apart and have some parts that move.

INFERENTIAL—What are the advantages of models that are objects?

» You can touch and feel the parts as well as see them.

INFERENTIAL—What kinds of object models have you seen?

» Sample answers: plastic or wooden trees that go with a playset, clay shapes, paper or cardboard cutouts

INFERENTIAL—What can object models teach you that diagrams and cross sections cannot?

» You can see and feel how the parts fit together and how they work instead of just look at a picture.

Page 90

Ask students to look at the image as you read aloud. Have them think about how house plants and gardens can be models.

A terrarium is a miniature living environment where plants grow inside a glass enclosure. A terrarium is a model of an entire ecosystem. What parts of the terrarium are just like parts of the natural world, such as in a forest?

Plants in forests need sunlight to grow. Terrarium plants get sunlight that shines through the glass.

Plants take in water from the soil.

It has everything the organisms need to survive inside a container. The captions added on these pages make this photo of a terrarium function like a diagram, explaining the process that happens inside the working model.

90

LITERAL—What is a *terrarium*?

» a miniature living environment, a model of an ecosystem

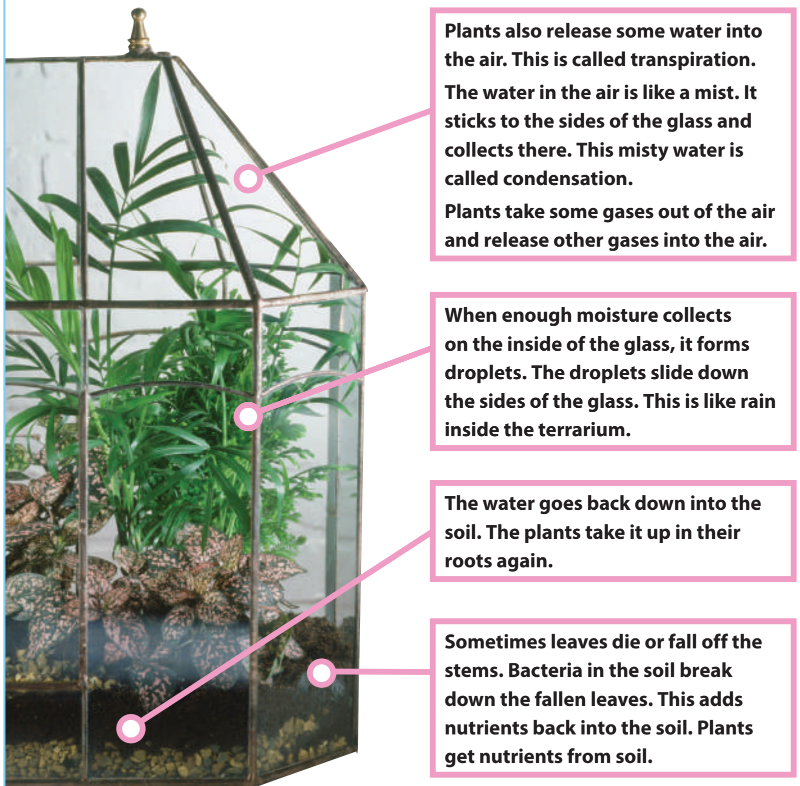
INFERENTIAL—What are the advantages of having a terrarium model?

» You can see how living things grow and how they interact with the ecosystem.

INFERENTIAL—What are the disadvantages of having a terrarium model?

» You have to take care of it, making sure that it has sunlight and water and that it is a real model of an ecosystem. You have to make sure things don't die because of neglect.

Page 91 **Ask students to continue to look at the image as you read aloud.** Have them think about what they learn from studying living things.



Main Science Idea

Models can be objects or pictures. They can show how processes happen or the parts things are made of.

91

INFERENTIAL—What can you learn from a terrarium?

» You can learn about how much water certain plants need and how much they give off under different temperatures and conditions.

EVALUATIVE—What is the best model to learn from, diagrams, cross sections, objects, or living models?

» It depends on what you want to learn. A diagram is best for explaining how something works. A living model is best for modeling how something grows.

3. Check for understanding.

Activity Page

AP 15

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Models can be objects or pictures. They can show how processes happen or the parts things are made of.

Use the activity page to compare the different types of models in this lesson. After students complete the activity page, review the completed sentence frames and what each type of model can teach you.

See the Answer Key for sample or correct answers.

LESSON 16

Single-Sheet Creativity

At a Glance

Lesson Question

How many things can we build with the same set of materials?

Learning Objectives

✓ Recognize that a flat piece of material can be folded into a functional shape.

✓ Summarize uses of flexible fabrics versus rigid sheet materials.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- materials worksheet

Main Science Idea

A flat shape of a material can be folded and transformed into many useful shapes.

NGSS and CCSS References

CCC5. Energy and Matter—Flows, Cycles, and Conservation: Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. Energy and matter are basic to any systems model, whether of a natural or a designed system. Systems are described in terms of matter and energy.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4**)

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

flexible **rigid**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

material **triangle**

Instructional Resources

Student Book

Ch. 16

Student Book, Chapter 16
"Single-Sheet Creativity"

Activity Page

AP 16

Activity Page
Flexible and Rigid (AP 16)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Show students a video showing how to make paper flowers from a sheet of paper. Talk about the many different ways they can fold a piece of paper. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How many things can we build with the same set of materials?

2. Read together: "Single-Sheet Creativity."

Student Book

Ch. 16

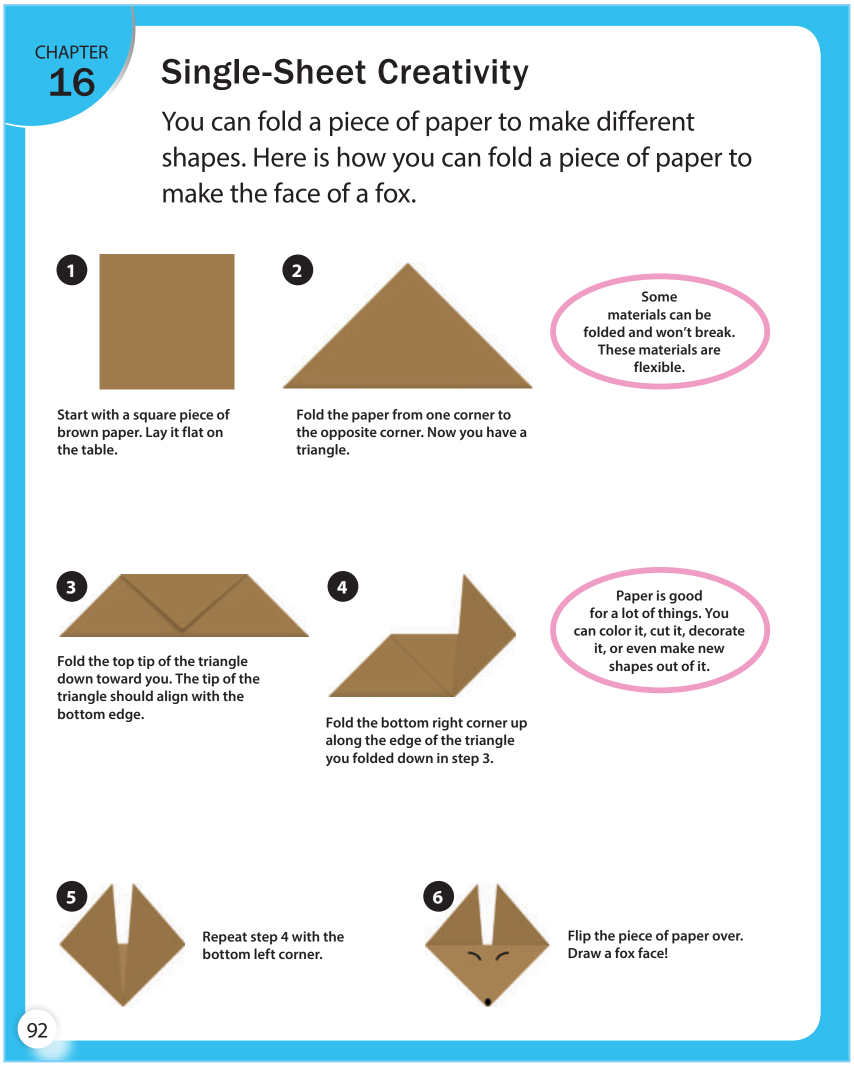
While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 16 on page 92. Tell students that the title of this chapter is "Single-Sheet Creativity" and that it is about how they can make many different things from materials.

Read Aloud Support

Page 92

Ask students to look at the images as you read aloud. Have them think about different things that are made from paper.



CHAPTER 16

Single-Sheet Creativity

You can fold a piece of paper to make different shapes. Here is how you can fold a piece of paper to make the face of a fox.

1. Start with a square piece of brown paper. Lay it flat on the table.
2. Fold the paper from one corner to the opposite corner. Now you have a triangle.
3. Fold the top tip of the triangle down toward you. The tip of the triangle should align with the bottom edge.
4. Fold the bottom right corner up along the edge of the triangle you folded down in step 3.
5. Repeat step 4 with the bottom left corner.
6. Flip the piece of paper over. Draw a fox face!

Some materials can be folded and won't break. These materials are flexible.

Paper is good for a lot of things. You can color it, cut it, decorate it, or even make new shapes out of it.

92

LITERAL—What is a *diagram*?

» a picture model that shows how something works

INFERENTIAL—Have the class make the paper fox with a single sheet of square paper. What makes it look like a fox?

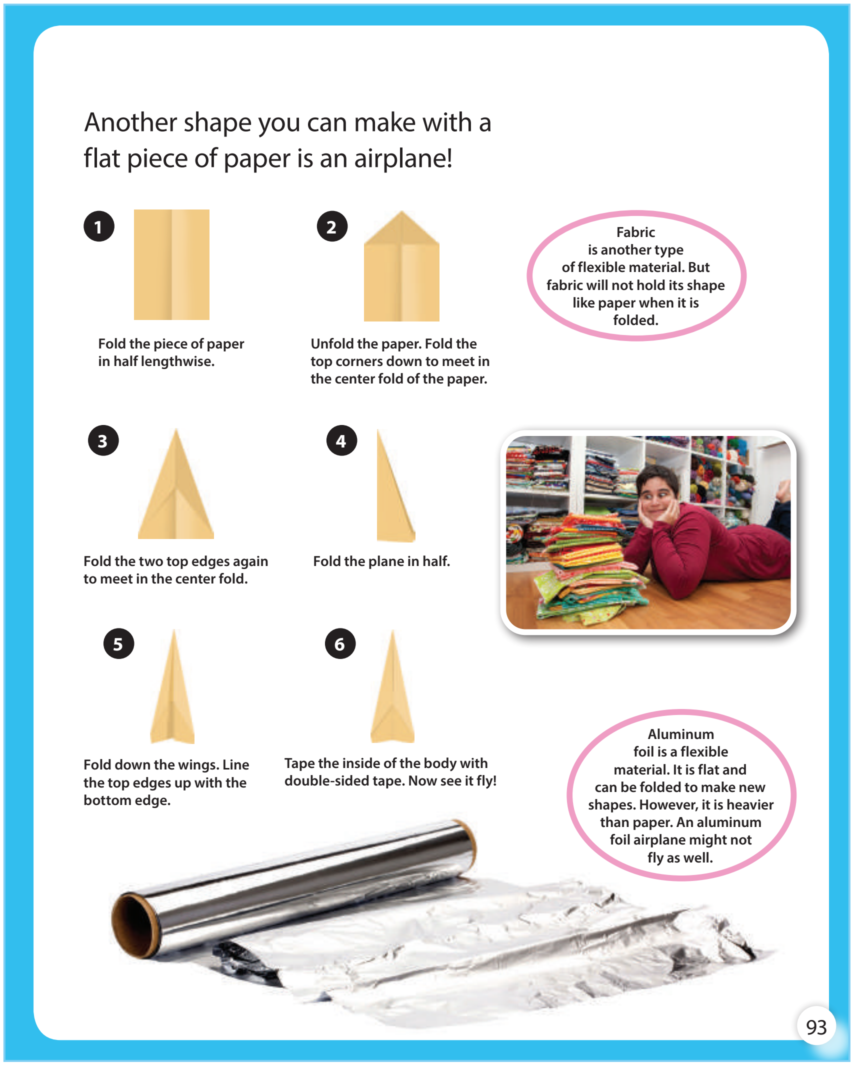
» The shape of the face and the ears make it look like a fox.

INFERENTIAL—What are some things that are made of paper?

» Sample answers: envelopes, sticky notes, wrapping paper, newspaper, place mats

SUPPORT—Discuss the words **flexible**, able to bend, and **rigid**, not able to bend. Talk about plants that are and are not flexible. For example, grass is flexible, but older tree trunks are rigid and cannot be bent. Green tree leaves are flexible, but as they get older, they do not bend but crack. Tree branches are less flexible but can be somewhat flexible in the wind.

Page 93 **Ask students to look at the pictures as you read aloud.** Have them think about different ways materials are flexible.


Another shape you can make with a flat piece of paper is an airplane!

1 Fold the piece of paper in half lengthwise.

2 Unfold the paper. Fold the top corners down to meet in the center fold of the paper.

3 Fold the two top edges again to meet in the center fold.

4 Fold the plane in half.

5 Fold down the wings. Line the top edges up with the bottom edge.

6 Tape the inside of the body with double-sided tape. Now see it fly!

Fabric is another type of flexible material. But fabric will not hold its shape like paper when it is folded.

Aluminum foil is a flexible material. It is flat and can be folded to make new shapes. However, it is heavier than paper. An aluminum foil airplane might not fly as well.

93

LITERAL—Describe the three different types of flexible materials on this page.

» Paper is thin and can be folded and can keep its shape. Fabric is more flexible than paper. It can be folded, but it does not hold its shape very well. Foil is also flexible, and it can be folded and hold its shape, but it doesn't act in the same way as paper.

EVALUATIVE—Have students follow the directions and make airplanes out of the same shapes of paper, cotton fabric, and foil. What is the best material for airplanes?

» Paper is the best. It is lightweight and holds its shape. Fabric does not stay folded, and foil tears easily and does not fly very well.

INFERENTIAL—What are fabric and foil made of?

» Fabric is usually made of plants like cotton, and foil is made from very thin sheets of metal.

Page 94 **Ask students to look at the images as you read aloud.** Have them think about how cardboard is different from paper.

Cardboard is a flat material. If you fold and cut cardboard a certain way, you can make a box!

You will need:
cardboard ruler double-sided tape
scissors (and an adult to do the cutting!)

Step 1: Place the cardboard so the long ends are on the top and bottom and the short ends are on the left and right. Draw a straight line down each side. Use a ruler. Make a border that is the width of the ruler from the edge.

Step 2: Use one blade of the scissors to trace over the lines. Do not cut all the way through the cardboard.

Step 3: Fold all the lines up and in.

Step 4: Fold the short end of the cardboard to meet the top fold mark.

Step 5: Trace the new fold with one blade of the scissors. Do not cut through the cardboard.

94

LITERAL—What are the advantages of making boxes out of cardboard instead of paper?

» Cardboard can be folded and cut like paper, but it is more rigid and sturdier.

EVALUATIVE—Have some students follow the directions to make a box out of cardboard, and have other students make a box out of paper. What is better for making boxes, paper or cardboard?

» It depends on what you want to use it for. A paper box is good for a temporary use. A cardboard box is probably better for a long-term use and for storing things that are not flat.

EVALUATIVE—Would paper or cardboard be better for mailing?

» Paper is better for mailing letters or other pieces of paper because it is lightweight and holds its shape. Cardboard is better for mailing things you need to protect.

Page 95 **Ask students to continue to look at the images as you read aloud.** Have them think about different uses of cardboard.

Step 6: With scissors, cut the fold lines that go up and down on both long ends of the cardboard. Only cut as far as the first fold line.

Step 7: Start with the bottom part of the box. Put double-sided tape on the outside of the tabs.

Step 8: Fold the bottom parts into the shape of a box. Press the tabs together at the corners where the tape is. They should stick together.

Step 9: Repeat step 7 with the top part of the box.

Step 10: Fold the top part of the box into a box shape.

Step 11: Now the box can open and close!

Cardboard is a good material for making boxes. It can be folded and cut like paper, but it is more rigid and sturdier than paper.

Cardboard has many uses. It can be used as a background prop in a school play or a puppet theater. Large pieces of cardboard can be cut and glued together to make cardboard rocket ships.

Rigid materials like hard plastic or glass cannot be bent or folded. This is why they are not used for making boxes. They have many other uses, though.

95

INFERENTIAL—What are some things that are made of cardboard?

» Sample answers: shipping boxes, food packages, the backs of pads of paper

EVALUATIVE—Why would cardboard be good or bad for making clothes?

» It would be good because you could make something to cover your body. It would be bad because it is not flexible and would fall apart if it got wet.

EVALUATIVE—When is a sheet of plastic a better material to use than a same-size sheet of cardboard?

» when you don't want something to get wet or you want something that will last longer and is more rigid

EVALUATIVE—When is glass a better material to use than a same-size sheet of plastic or cardboard?

» when you want to be able to see through it

Page 96 **Ask students to look at the images as you read aloud.** Have them think about how materials can be reused.

Do you have an old tank-top shirt at home that you've outgrown? You can turn the fabric into a tote bag. The best part is that you don't even have to sew it!

You will need:
a tank top scissors ruler pencil

Step 1: Turn the tank top inside out. Lay it flat on a table, and smooth it with your hands.

Step 2: Find the bottom seam. Use the ruler to measure 2 inches up from the bottom. Mark the fabric straight across with the pencil.

Step 3: Use your scissors to make a fringe all along the bottom of the tank top. Cut from the bottom to the 2-inch line that you marked. Each fringe piece should be about 1 inch wide.

Fabric is soft and flexible. It can be cut, knotted, stitched, or stapled to make a new shape.

96

INFERENTIAL—What is fabric made from?

» It can be made from plants like cotton. It can also be made from wool, silk, leather, plastic, and other materials.

INFERENTIAL—What are things you can make with fabric?

» Possible answers: clothing, blankets, sheets, towels, furniture coverings, coats, rope, art

INFERENTIAL—What are the advantages of making things with fabric?

» It's very flexible but lasts a long time. It doesn't fall apart when it gets wet.

Page 97 **Ask students to continue to look at the images as you read aloud.** Have them think about different things they can make with fabric.

Step 4: Now tie each front and back pair of fringe strips together, making tight knots. The knots hold the front side and the back side together along the bottom.

Step 5: Continue tying knots all the way along the bottom edge.

Step 6: Turn the tote right side out. Now the tote bag is ready to go!

Fabric has many uses. It is good for making clothes and bags. It is also used for making curtains. Fabric is used to make umbrellas. You can even cover outdoor plants with fabric to keep them warm in cold weather or to give them shade in the sun.

Main Science Idea

A flat piece of material can be folded into many useful shapes. Whether the material is stiff or soft determines what it can best be used for.

97

INFERENTIAL—Demonstrate, or have volunteers demonstrate by following the directions, how to make a tote bag from an old tank top. Talk about the advantages of making a new thing out of worn-out clothing.

» Instead of throwing something away, you can use it in a new way. Sometimes instead of buying something new, you can make what you need out of materials you already have.

3. Check for understanding.

Activity Page

AP 16

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A flat shape of a material can be folded and transformed into many useful shapes.

After students complete the activity page, discuss their answers. Accept good reasoning for different rankings. Then compare functional uses of different types of materials.

See the Answer Key for sample or correct answers.

LESSON 17

Working Parts

At a Glance

Lesson Question

What are structure and function?

Learning Objectives

✓ Define *function.*

✓ Define *structure* using the word *function.*

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- structures and functions worksheet

Main Science Idea

Function means the task something performs. Structures are parts of things that carry out specific functions.

NGSS and CCSS References

CCC6. Structure and Function: The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. Structure and function can be thought of as a special case of cause and effect. Whether the structures in question are living tissue or molecules in the atmosphere, understanding their structure is essential to making causal inferences.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4**)

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

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function **structure**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

branches **pollen** **roots** **stem**

Instructional Resources

Student Book

Ch. 17

Student Book, Chapter 17
"Working Parts"

Activity Page

AP 17

Activity Page
Structures and Functions
(AP 17)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Show students a video about a plant's parts. Talk about the plants that students can see or are familiar with and what parts they have. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What are structure and function?

2. Read together: "Working Parts."

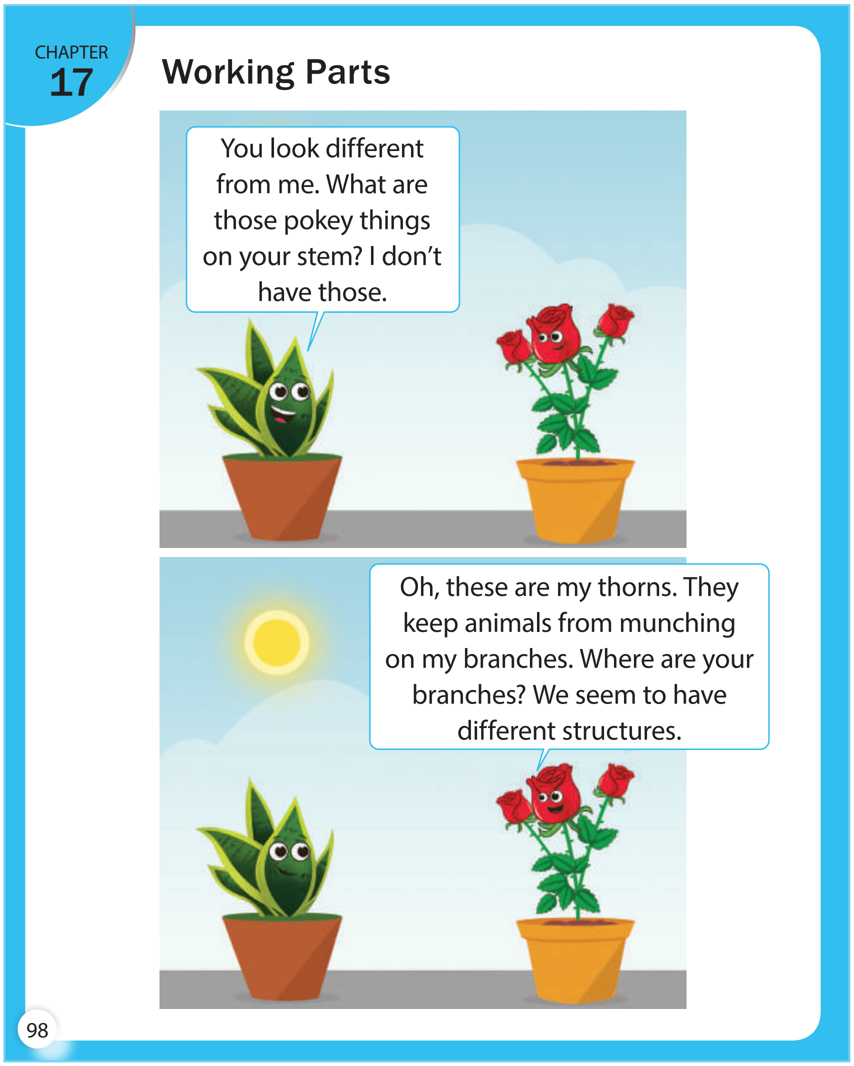
Student Book

Ch. 17

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 17 on page 98. Tell students that the title of this chapter is "Working Parts" and that it is about how the way things are made determines how they work.

Page 98 **Ask students to look at the images as you read aloud.** Ask them to think about familiar plants.



INFERENTIAL—What are plants?

» a group of living things that grow everywhere

LITERAL—What plant parts are different in the two plants?

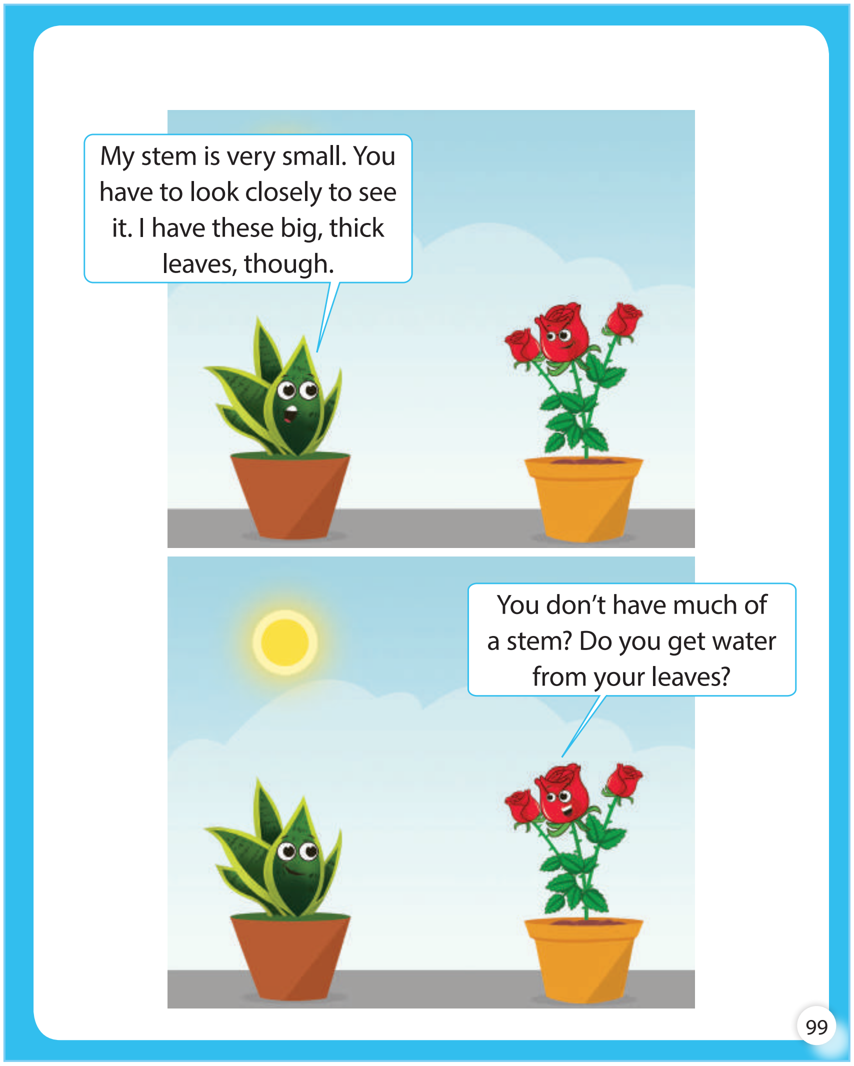
» The rose has thorns and branches, but the snake plant does not.

INFERENTIAL—What are branches?

» a part of a plant that grows from the stem and holds the plant leaves

SUPPORT—Discuss the word **structure**, which is the arrangement of parts. Talk about the structure of plants, and extend that concept to the structure of buildings and animals. Explain that everything has parts and the way the parts of something are arranged or organized is the structure. Even a book or a piece of music has a structure.

Page 99 **Ask students to look at the pictures as you read aloud.** Have them think about different plant stems they have seen.



LITERAL—Describe the stems of the two plants.

» The snake plant has a small stem. The rose has a thicker, stronger stem.

INFERENTIAL—What is a stem?

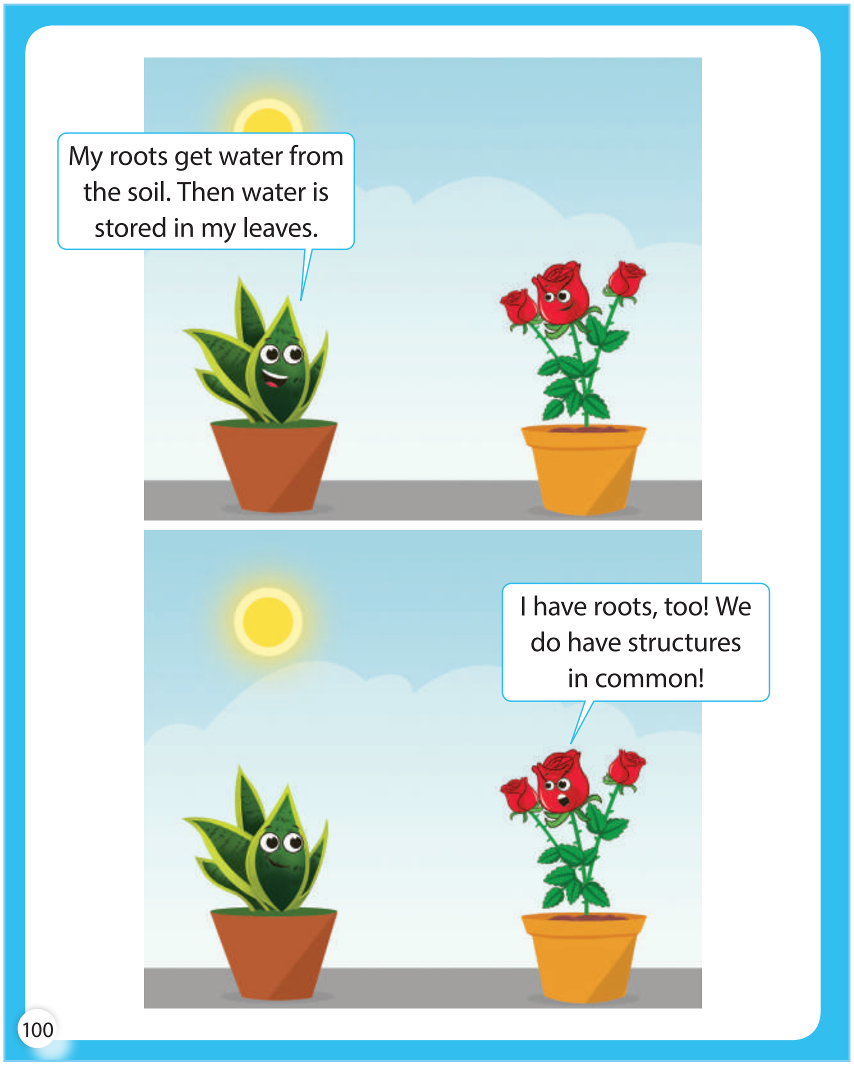
» It is a part of a plant that moves water from the roots to the plant leaves.

INFERENTIAL—How are the leaves of the two plants different?

» The snake plant has large, narrow, long, thick leaves, and the rose has thin, small, round leaves.

CHALLENGE—Challenge students to learn more about leaves by collecting a variety of plant leaves, including deciduous and evergreen leaves. Have them share their collections with the class and describe how the leaf structures are different.

Page 100 **Ask students to look at the images as you read aloud.** Have them think about what roots look like.



LITERAL—What are plant roots?

» They usually grow from a seed underground and absorb water from the soil.

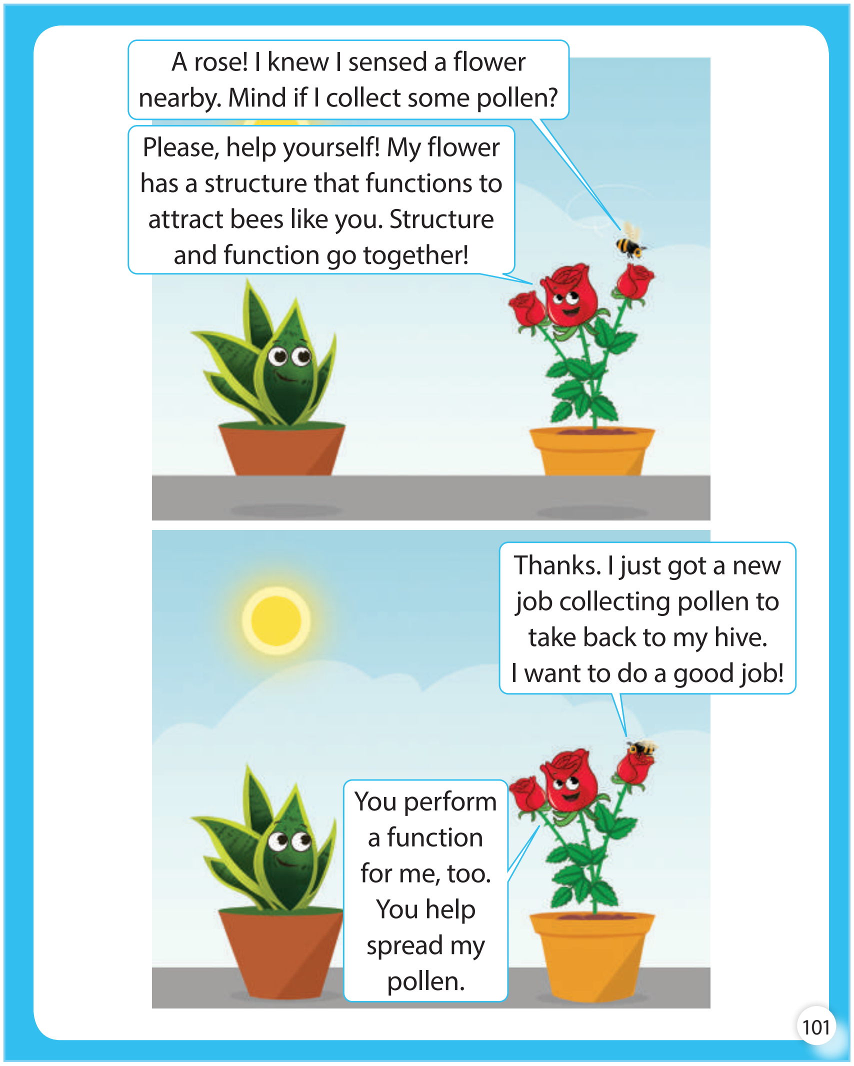
INFERENTIAL—What is the purpose of roots?

» They send water from the soil to the rest of the plant to keep it alive. They also help to stabilize a plant.

Know the Standards

CCC6. Structure and Function In grades K–2, students observe that the shapes and stability of structures of natural and designed objects are related to their functions. In this lesson, students explore the structures and functions of plant parts, including stems, roots, leaves, and flowers.

Page 101 **Ask students to look at the images as you read aloud.** Have them think about different flowers they have seen.



LITERAL—What is a flower?

» A flower is the part of a plant that blooms.

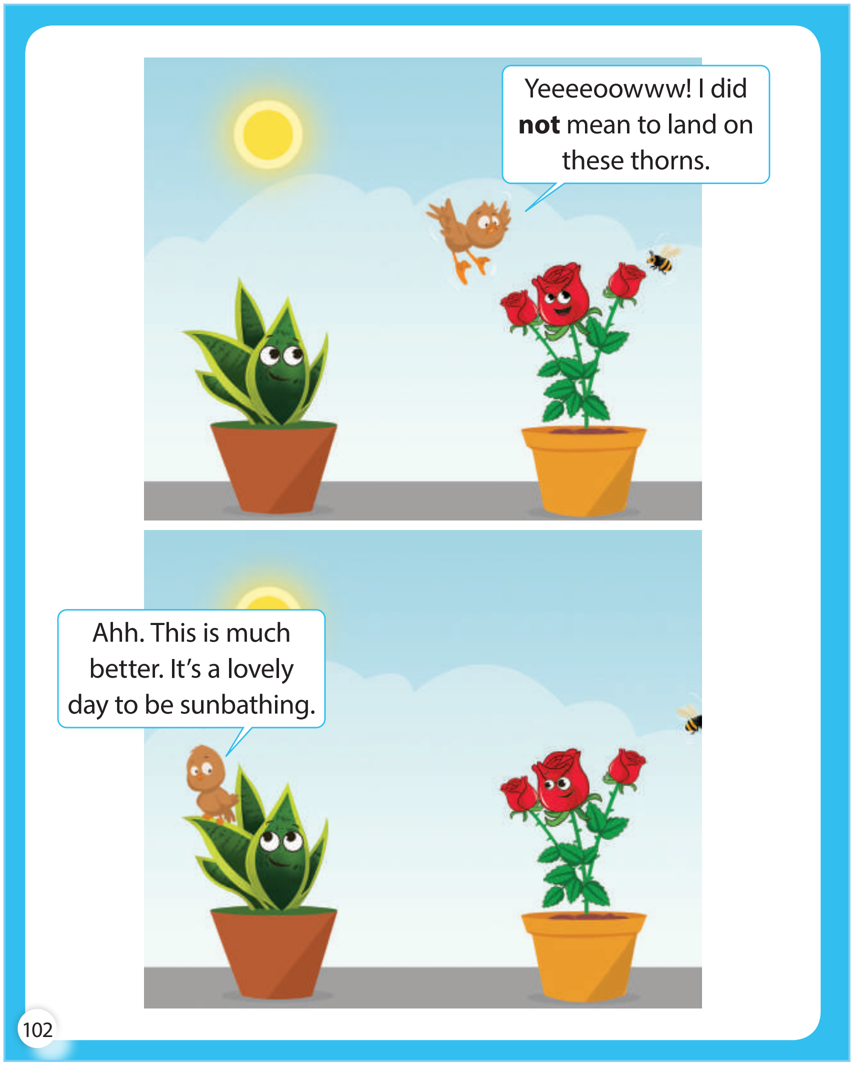
INFERENTIAL—What is the purpose of a plant flower?

» Flowers make pollen and produce fruit that makes seeds that become new plants.

Online Resources

SUPPORT—Show a short video about structure and function in science. Discuss the word **function**. Talk about the function of common things, such as a book to store information that many people can experience. Relate the definition of *function* to the structures of plants. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Page 102 **Ask students to look at the images as you read aloud.** Have them think about how birds, bees, and other animals help plants make new plants.



INFERENTIAL—What is pollen?

» a fine powdery substance from flowers that wind, insects, and other animals move from plant to plant, causing plants to form seeds and new plants

INFERENTIAL—Do thorns on other plants have the same function as they do on roses?

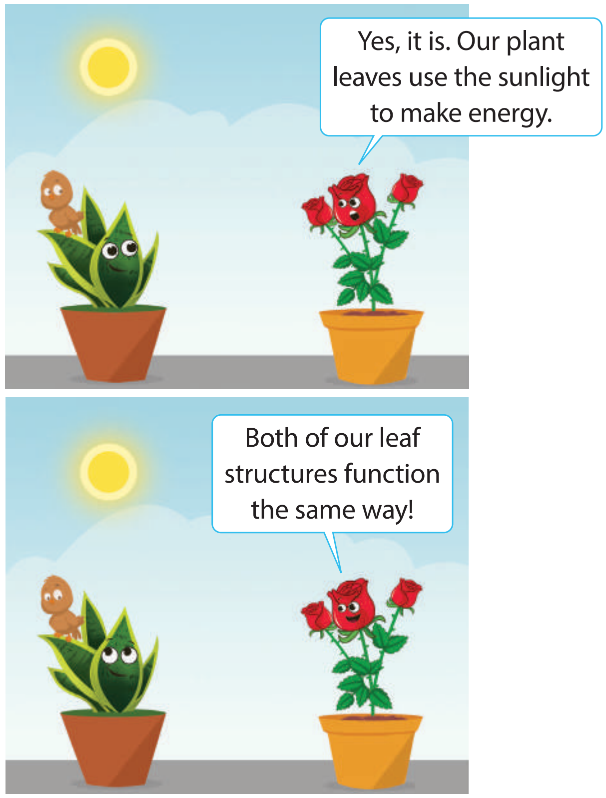
» Yes, they protect the plant from being eaten.

INFERENTIAL—What outside covering protects your body?

» skin

SUPPORT—Show a picture of an apple, or bring in an apple. Examine the stem that was attached to a branch of the tree as leaves are. Cut open the apple, and examine the seeds. Discuss how each part is part of the structure of the apple tree and that each part has a function.

Page 103 **Ask students to continue to look at the images as you read aloud.** Have them think about the structure and function of plants.



Main Science Idea

A function is the task something performs. Structures are parts of things that carry out specific functions.

103

INFERENTIAL—What are leaves?

» They are the parts of plants that store water and energy from the sun to make energy for themselves as well as animals that eat them.

EVALUATIVE—What is the most important part of the structure of a plant, the roots, stem, leaves, flowers, or branches?

» They are all equally important. The plant would not live or be able to make new plants if a part were missing.

3. Check for understanding.

Activity Page

AP 17

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. *Function* means the task something performs. Structures are parts of things that carry out specific functions.

Use the activity page to determine if students understand the relationship between structure and function. After students complete the activity page, discuss the connection between each structure and its function.

See the Answer Key for sample or correct answers.

LESSON 18

Stable Mabel

At a Glance

Lesson Question

What is stability?

Learning Objectives

- ✓ Distinguish examples of things that are stable from things that are not.
- ✓ From provided examples, identify elements that are desired to remain unchanged or unchanging.
- ✓ Describe why maintaining stability (avoiding change) is desirable in given examples.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- stable and unstable examples

Main Science Idea

Stable means steady. It doesn't mean completely unchanging, but rather, something that is stable might change a little yet remain predictable.

NGSS and CCSS References

CCC7. Stability and Change: Stability and change are ways of describing how a system functions. Whether studying ecosystems or engineered systems, the question is often to determine how the system is changing over time, and which factors are causing the system to become unstable.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4**)

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change **stability** **stable**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

predictable **reliable** **unstable**

Instructional Resources

Student Book

Ch. 18

Student Book, Chapter 18
"Stable Mabel"

Activity Page

AP 18

Activity Page
Are You Able to Label the Fable? (AP 18)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Show students a video about what stability means. Then have a student or all students stand on one leg. Talk about how a person is stable when they can continue standing on one leg but that as soon as they get wobbly and have to hold on to a table or put the other leg down, they become unstable.

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: What is stability?

2. Read together: "Stable Mabel."

Student Book

Ch. 18

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 18 on page 104. Tell students that the title of this chapter is "Stable Mabel" and that it is about what it means to be stable.

Read Aloud Support

Page 104 **Ask students to look at the image as you read aloud.** Ask them to think about how long they might be able to remain stable doing a handstand.

CHAPTER 18

Stable Mabel

Mabel is in gymnastics class. The teacher challenges the young gymnasts. "Let's see who can do the longest handstand!"

All the students plant their hands on the floor and kick their feet toward the ceiling. A couple students wobble on their hands and collapse within a few seconds. Some others' handstands are steadier. These gymnasts stand on their hands for twenty to thirty seconds. They grow tired, though. One by one, their feet return to the floor. But not Mabel. She stands on her hands as if she were a planted tree. She does not grow weary. She does not wobble. "I can do this all day," she says with an upside-down grin.

104

INFERENTIAL—Describe what happened at a time when you fell.

» Sample answers: I lost my balance and fell off my bike and skinned my arm. I slipped on a wet floor and bruised my knee.

LITERAL—Describe how Mabel's handstand is different from the others.

» She can hold the handstand for a much longer time than the others can.

INFERENTIAL—What causes other children to wobble and collapse?

» Their arms get tired, or they lose their balance.

SUPPORT—Discuss the word **stable**, which means steady or sturdy. Contrast the words *stable* and *unstable*. If something is unstable, the opposite of stable, it is shaky or wobbly. Explain that *stable* can also mean in balance or predictable. Systems are stable when everything is in balance and things work at a steady pace. They become unstable when something breaks or doesn't work correctly.

Page 105 **Ask students to look at the picture as you read aloud.** Have them think about ways in which they are stable.

The teacher says, "Let's get motivated by this challenge! Everybody keep practicing handstands. Your strength and balance will improve." She adds, "We'll repeat a friendly contest at the end of every class to see if anyone can out-balance our champion, Stable Mabel!"

Mabel returns to her feet. Gymnastics class is over, and Dad is waiting. On the ride home, she proudly tells him about her winning handstand. "I'm not sure about my new nickname, though," she says.

"What's that?" Dad asks.

"Stable Mabel," she replies. Dad returns a big smile.

105

LITERAL—What does Mabel's nickname, Stable Mabel, mean?

» She can hold the handstand without falling.

EVALUATIVE—Is it always good to be stable?

» No, you eventually have to do something else. Sometimes you have to change something to improve.

INFERENTIAL—What does *stable* mean?

» steady and balanced

Know the Standards

CCC7. Stability and Change In grades K–2, students observe that some things stay the same while other things change and that things may change slowly or rapidly. In this lesson, students explore different examples of stability and change.

Page 106 **Ask students to look at the image as you read aloud.** Have them think of examples of **stability**.

"Your gymnastics teacher is paying you a compliment with the nickname Stable Mabel," Dad explains. "Stable means steady. Stable describes things that are likely to last or continue in the same way. It means your balance is good and your handstand is solid. You can hold that position without changing for a long time."

"We'll look for some other examples at home to help you understand what stable means," Dad says. As they pull into the driveway, he continues, "You can find stability everywhere. I've spotted two examples already!"

Mom is finishing a painting project. She is standing on a ladder beside the house. Dad explains, "The ladder Mom is standing on is propped in a stable position. To be safe, it can't wobble or move easily."

106

LITERAL—Describe something that is unstable, the opposite of stable.

» It is wobbly or shaky and can fall or break or lose its balance.

INFERENTIAL—What are some examples of stability in the classroom?

» Possible answers: The chairs are stable because they don't wobble. The door is stable because it opens and closes without a problem. The clock is stable because it moves predictably.

INFERENTIAL—How would you describe an unstable chair or door?

» The chair would wobble or break if you sat on it. The door would fall off or not stay closed.

CHALLENGE—Challenge students to write about or draw examples of stable and unstable things and share them with the class.

Page 107 **Ask students to look at the image as you read aloud.** Have them think about examples of **change**.

He goes on, "Our house is built of stable materials. They remain unchanged in all kinds of weather. That's another kind of stability."

"Stable doesn't only mean that a thing doesn't change, though. It also means reliable and predictable. For example, the heating and air conditioning inside our home keep it at a stable temperature where we can live. But it is not exactly the same temperature all the time. Your body keeps a stable temperature, too. You might get hot when you exercise, but you cool back down."

107

Online Resources

INFERENTIAL—Show a video of the story "The Three Little Pigs." Then discuss the most stable and least stable house materials. What would an unstable house be made of? (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

» straw, paper, sticks

INFERENTIAL—How is a stable house like Stable Mabel?

» It can hold itself up without falling.

SUPPORT—Discuss the word *change,* which means to make or become different. Talk about the changes they have experienced in things like changing seasons, growing, moving, or having a new sibling. Emphasize that even though there is a lot of stability in the world, things are always changing. But the changes are expected, predictable, and reliable. That is a stable system.

Page 108 **Ask students to look at the images as you read aloud. Have them think about how a school or playground can be stable.**

Dad continues, "Objects can be stable. Processes can be stable. Here's another example. Our yard is part of a stable habitat. It's not exactly the same every day, but the squirrels, rabbits, birds, and plants that live here always have what they need. Even systems that are constantly changing can be called stable if they keep working in the expected way."

"Things that are unstable are easily disrupted," he adds.

Mabel isn't easily disrupted. She is already thinking about being the most stable gymnast in her class again next week. "I can definitely keep working in the expected way!" she tells Dad.

108

LITERAL—How can a habitat be stable?

» if it works in an expected way

INFERENTIAL—How can a stable habitat change?

» Plants and animals grow and find what they need to live in a healthy way.

INFERENTIAL—What would make an unstable habitat?

» if a flood or storm destroyed the plants and animal homes, if one plant or animal took over and changed everything

SUPPORT—Emphasize the idea of *balance* in a habitat, ecosystem, or other system that reflects the stability of that system. Having inputs and outputs in balance and the system working in a steady, reliable state describes a stable system. A sudden disruption, such as a storm, an invasive species in a habitat, or the malfunction of a part in a car engine, makes the whole system unstable.

Page 109 **Ask students to continue to look at the images as you read aloud.** Have them think about stability and change in their life experiences.

Next week, Mabel is ready to out-balance everyone in gymnastics class again. This time, the teacher has the gymnasts balance on one leg. Mabel makes it look easy. She stands on one leg far past the time when everyone else wobbles and gives up. Stable Mabel wins again!

Week after week, Stable Mabel lasts the longest in every balance contest. She has decided she loves her gymnastics nickname!

Main Science Idea

Stable means steady. It doesn't mean completely unchanging, but rather, something that is stable might change a little yet remain predictable.

109

INFERENTIAL—How can something that is unstable become stable?

» if you fix the broken part, if you work and practice to be better, if you replace the unstable thing with a different system

EVALUATIVE—Is change good or bad?

» It is not good or bad. It is constantly happening even in stable environments.

3. Check for understanding.

Activity Page

AP 18

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. *Stable* means steady. It doesn't mean completely unchanging, but rather, something that is stable might change a little yet remain predictable.

Use the activity page to determine if students understand the difference between stable and unstable. After students complete the activity page, discuss the answers they provided for the label.

See the Answer Key for sample or correct answers.

LESSON 19

Test That Tech!

At a Glance

Lesson Question

How do we know if an engineered solution (technology) works?

Learning Objectives

✓ Describe testing processes depicted in multiple provided examples.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- tests of design solutions

Main Science Idea

There are many ways to test a design solution to make sure it solves the problem.

NGSS and CCSS References

ED.A. Defining and Delimiting Engineering Problems: Defining and delimiting engineering problems involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits. (Also **ED.B** and **ED.C**)

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4**)

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary and Language of Instruction

The Glossary at the end of this Teacher Guide lists definitions for Core Vocabulary and selected Language of Instruction.

Core Vocabulary terms are those that students should learn to use accurately in discussion. During instruction, expose students repeatedly to these terms but not through isolated drill or memorization.

problem **solution** **test**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

design **technology**

Instructional Resources

Student Book

Ch. 19

Student Book, Chapter 19
"Test That Tech!"

Activity Page

AP 19

Activity Page
Best Test (AP 19)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Online Resources

Show students a video about where testing fits in the engineering process. Talk about things like toys that they have had that did not work or broke. Introduce the idea that the product was not well tested before it was available for sale. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How do we know if an engineered solution (technology) works?

2. Read together: "Test That Tech!"

Student Book

Ch. 19

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 19 on page 110. Tell students that the title of this chapter is "Test That Tech!" and that it is about how testing helps people figure out if an idea is going to work.

Read Aloud Support

Page 110

Ask students to look at the image as you read aloud. Ask them to think about what they want in a toy, for example, that it doesn't break, that it is engaging, and that it is safe.

CHAPTER 19

Test That Tech!

New machines and technologies must be tested. Even toys! Testing helps people make sure products are safe to use and work the way they are supposed to. There are many ways to test solutions.

Tests can determine how good a design is. Testing certain factors helps determine answers to design questions.

Safety	Can the solution be used without hurting anyone?
Effectiveness	Does the solution do what it is supposed to do?
Reliability	Does the solution work the same way every time?
Convenience	Is the solution easy to use?

110

LITERAL—What do engineers test when they create new designs?

» safety, effectiveness, reliability, convenience

INFERENTIAL—Why are those things important to test?

» to make sure the products are safe, are easy to use, work as intended, and solve the problem they are designed to solve

SUPPORT—Discuss how the terms **problem**, **solution**, and **test** are related. Emphasize that a new product idea attempts to solve a problem and that the solution is the product idea that solves the problem. These solutions then go through tests to make sure they actually solve the problem and do not create other problems.

Page 111 **Ask students to look at the picture as you read aloud.** Have them think about ways they have been tested.

Noise-canceling headphones block out unwanted sounds. They can also protect people's ears from noises that are too loud.

To know if noise-canceling headphones work, they are tested to see how well they can block loud noises. They are also tested to see how comfortable they are to wear and use.

111

LITERAL—What problem do noise-canceling headphones attempt to solve?

» to block loud noises like the sound of jackhammers or chain saws that could hurt your ears or make people really irritated

INFERENTIAL—What concerns do people have when choosing noise-canceling headphones?

» Are they comfortable? Do they really block loud noises?

EVALUATIVE—How would you know if a pair of noise-canceling headphones was effective?

» I would try them on to see if they were comfortable. I would try wearing them near loud noises and see if they really blocked the sound. I would read what other people said about them.

Point out that in this lesson, students will explore different ways to test design solutions.

Page 112 **Ask students to look at the image as you read aloud.** Have them think of examples of product tests.

This insulated bottle is supposed to keep drinks cold. How would you know if this solution works? It needs to be tested.

Here's a plan for such a test:

- Pour a cold liquid into the bottle.
- Measure the temperature of the cold liquid.
- Measure the temperature of the liquid again and again as time passes.

The measurements show how the liquid becomes warmer. You can see how long the drink can stay cold. That lets you know how well the bottle works.

112

LITERAL—What problem do insulated bottles try to solve?

» to keep drinks cold

INFERENTIAL—What concerns do people have when choosing an insulated bottle?

» How much does it hold? How long does it keep drinks cold? Is it easy to use and carry?

EVALUATIVE—How would you know if an insulated bottle was effective?

» I would measure the temperature of a cold liquid when I put it in the bottle and measure it some time later. I would compare it to other bottles and read what other people said about it.

CHALLENGE—Challenge students to conduct a test to find out how effective different insulated water bottles are, following the directions on the page. Have them present their findings to the class.

Page 113 **Ask students to look at the image as you read aloud.** Have them think about examples of product tests.

A car jack lets people lift cars to change tires with minimal effort. People draw a design and build a prototype car jack. Then the jack needs to be tested for safety.

Several jacks are used to lift loads heavier than cars. When they are all successful, the designers know the jack design can hold a car safely.

The designers also test the jack by observing people using it. They see if people find it easy to use.

113

LITERAL—What problem do car jacks attempt to solve?

» to lift a car so you can change a flat tire

INFERENTIAL—What concerns do people have when choosing a car jack?

» Is it safe? Is it easy to use to lift the car? Is it stable so it doesn't let the car fall down while you are changing the tire?

EVALUATIVE—How would you know if a car jack was effective?

» I would watch someone try to use it and see if it worked and did not let the car fall down.

SUPPORT—Explain that design testing is done *before* a product reaches the market, before anyone can buy it. Products undergo extensive testing to make sure they will not harm the users. Discuss how consumers would react if designs had not been tested before they got them.

Page 114 **Ask students to look at the image as you read aloud.** Have them think about how many design solutions are intended to make us safer.

Smoke detectors alert people of smoke to keep them safe from fires. Before they are sold, the detectors are tested to make sure they are sensitive and reliable enough. Testers use smoke from sources they can control. Makers of smoke detectors need to be sure the detectors can quickly sense a very small amount of smoke and make the alarm sound.

114

LITERAL—What problem do smoke detectors attempt to solve?

» to sound a loud alarm if a house is on fire

INFERENTIAL—What concerns do people have when choosing a smoke detector?

» Is it sensitive to different kinds of smoke from different kinds of fires? Does it make a loud noise that will wake people up from a deep sleep? Is it too sensitive, annoying people by going off when there is no fire danger?

SUPPORT—Discuss what happens if products are not tested before they are sold. For example, they may not work properly or at all. They may not solve the problem they are designed to solve. This could be life-threatening. Companies that produce faulty products can be sued for damages if their products are faulty.

Page 115 **Ask students to continue to look at the images as you read aloud.** Have them think about how all technology needs to be tested.

An automatic dispenser provides a convenient way to clean hands. It uses sensors to release hand sanitizer without the user having to touch anything. The less surfaces you touch, the fewer germs you encounter. The dispensers are tested to see how quickly they can detect a user's hands and then how quickly the sanitizer is released. These tests consider the factor of convenience.

Main Science Idea

Testing a design helps us figure out how well it works.

115

LITERAL—What problem do automatic soap dispensers attempt to solve?

» to provide the right amount of soap to wash hands without having to touch anything that might spread germs

INFERENTIAL—What concerns do people have when choosing a soap dispenser?

» Is it easy to install? Does it release the right amount of soap?

EVALUATIVE—How would you know if a soap dispenser was effective?

» I would try it out to see if it was easy to use and released the right amount of soap. I would read about how it was tested.

3. Check for understanding.

Activity Page

AP 19

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. There are many ways to test a design solution to make sure it solves the problem. Use the activity page to determine if students understand the concept of appropriate designed solution testing.

See the Answer Key for sample or correct answers.

LESSON 20

Nature's Building Supplies

At a Glance

Lesson Question

How do design and engineering depend on nature?

Learning Objectives

✓ Trace built objects and their materials to raw materials that occur naturally on Earth.

✓ Recognize that all designed solutions are subject to natural environmental conditions.

Instructional Activities

- teacher Read Aloud
- class discussion
- vocabulary exploration
- products and raw materials worksheet

Main Science Idea

Products are made from or inspired by raw materials found on Earth.

NGSS and CCSS References

STSE1. Interdependence of Science, Engineering, and Technology: Science and engineering involve the use of tools to observe and measure things.

RI.2.1. Key Ideas and Details: Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (Also **RI.2.2** and **RI.2.4**)

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nature **raw material**

Language of Instruction consists of additional terms that you should use when talking about concepts in the lesson. Students benefit from your modeling the use of these words without the expectation that students themselves will use or explain the words.

design **engineering** **technology**

Instructional Resources

Student Book

Ch. 20

Student Book, Chapter 20
"Nature's Building Supplies"

Activity Page

AP 20

Activity Page
Raw Materials (AP 20)

Materials and Equipment

Collect or prepare the following items:

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

THE CORE LESSON

1. Focus attention on the Lesson Question.

Online Resources

Show students a video about materials. Talk about what the things they can see are made from. (See the Online Resources Guide for a link to a recommended video. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as you move forward to read the chapter: How do design and engineering depend on nature?

2. Read together: "Nature's Building Supplies."

Student Book

Ch. 20

While some advanced students may be able to read words on a given page of the Student Book, as a 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 adults can read it when sharing the Student Book with students.

Guide students to open their books to Chapter 20 on page 116. Tell students that the title of this chapter is "Nature's Building Supplies" and that it is about materials things are made of and where the materials come from.

Read Aloud Support

Page 116 **Ask students to look at the image as you read aloud.** Ask them to think about what their houses and buildings are made from.

CHAPTER 20

Nature's Building Supplies

A person can build a jungle hut with nothing but a big knife. The wood and leaves for the hut are found in nature. They come directly from the trees.

Long, dried leaves can make rope to tie parts together. Wood branches can be carved into pegs to hold parts together.

116

LITERAL—What are houses in rainforests made from?

» trees

INFERENTIAL—Why would people who live in rainforests make houses out of trees?

» because it is what is available

INFERENTIAL—What is **nature**?

» all living and nonliving things that are not made by people

SUPPORT—Ask students what **raw materials**, natural unfinished materials that come from nature, are. Make a class list of raw materials that come from nature: trees, river water, rocks, plants, birds, insects, animals, soil. Introduce the idea that things people make come from raw materials in nature because they are all around us.

Page 117 **Ask students to look at the picture as you read aloud.** Have them think about what buildings are made of where they live.

People can build mud houses using materials found in nature. Mud and grass are materials that are fairly easy to find. In the building, the materials are not changed very much from the way they are found in nature.

117

LITERAL—What is this house made of?

» mud and grass

INFERENTIAL—Why would people make a house of grass and mud?

» because it is what is available

INFERENTIAL—What would you make a shelter out of if you were lost in a forest?

» wood and leaves

Point out that in this lesson, students will explore raw materials from the natural world that people use to make things.

Page 118 **Ask students to look at the images as you read aloud.** Have them think about things that are made from clay.

Clay is a raw material in nature. People have found many uses for clay because it can be baked to make it very hard. Baked clay holds up well to outdoor weather. It is waterproof.

Bricks are made from clay and are used to construct homes and buildings.

Clay is used to make roof tiles. They stand up well to direct sunlight and weather.

Clay is also used to make tile flooring. It holds up well to people walking on it.

118

LITERAL—What are the products on this page made from?

» clay

INFERENTIAL—Where does clay come from?

» soil

EVALUATIVE—What makes clay a good material to make things with?

» When it dries, it becomes hard and solid, and it can protect against hot sun and rain.

SUPPORT—Discuss the importance of using raw materials that are readily available in an area. Talk about how someone who wanted to build a wood house in a desert would get the materials. They would have to ship them in at great expense, if they could get them at all.

Page 119 **Ask students to look at the image as you read aloud.** Have them think about why stones are used for buildings in some places but not in others.

Stone is another material that people use to build. It is a strong material that can withstand rain, wind, and other weather conditions. Stone buildings can last for thousands of years!

Each natural stone is its own size, shape, and color. No two stones are exactly alike. Stone can be cut into uniform shapes, though. The shingles on this roof are slate, a type of rock. Slate breaks apart into flat sheets. These slate pieces were chipped into rectangle shapes.

119

LITERAL—What is this house made of?

» stone

INFERENTIAL—Why would a house be made of stone?

» Stone is strong and can withstand weather conditions. You would make a house of stone if it were readily available, but it would be too expensive to ship from far away.

EVALUATIVE—What would be the advantages and disadvantages of making a house of stone?

» It would be heavy and strong to withstand weather conditions, but you would have to find the stones and fit them together or cut them.

CHALLENGE—Discuss what makes the best shelter in different environments and where the raw materials to make buildings would be most readily available.

Page 120

Ask students to look at the image as you read aloud. Have them think about how different raw materials are used in living spaces.

Homes have many furnishings made from natural materials like wood, cotton, and wool.

Wood, wool, and cotton are materials that need little change to make them useful. They are easily transformed into furniture, rugs, and blankets.

Many furnishings in the picture are made from materials found in nature. How many can you spot?

120

INFERENTIAL—What kinds of things can be made from plants?

» Sample answers: wooden paneling, furniture, frames, cotton blankets, baskets

INFERENTIAL—What kinds of things can be made from animals?

» Sample answers: wool blanket, leather seat, hair on a child's rocking horse

EVALUATIVE—What are the advantages of making things from living things?

» People don't have to just depend on what is available in the local environment. They can raise sheep for wool or plant cotton and trees.

SUPPORT—Make a list of the steps involved in making something out of a tree. For example, the tree must be cut down and cut into a particular size and shape. Then the parts must be organized, put together, sanded, and finished.

Page 121 **Ask students to continue to look at the images as you read aloud.** Have them think about how raw materials are developed to produce other materials.

Metal, plastic, and glass are modern building materials. They still come from nature. But they have been transformed from the raw materials they come from. They look different from the raw materials. They function differently, too.

Steel beams, plastic pipes, and glass windows are very durable materials. They can last a long time and hold up well in harsh conditions.

Main Science Idea

All materials can be traced back to something that occurs naturally on Earth.

121

INFERENTIAL—What raw material is plastic made from?

» oil pumped from underground

INFERENTIAL—What raw material does glass come from?

» sand

3. Check for understanding.

Activity Page

AP 20

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Products are made from or inspired by raw materials found on Earth.

Use the activity page to determine if students are able to connect products to the raw materials they come from. After students complete the activity page, discuss their answers.

See the Answer Key for sample or correct answers.

GRADE 2

Teacher Resources

Activity Pages

- Work in Space! 176
- Draw Your Own Comic About Nature 177
- What Do You Say? 178
- What's the Problem? 179
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- Learning from Models 191
- Flexible and Rigid 193
- Structures and Functions 194
- Are You Able to Label the Fable? 195
- Best Test 196
- Raw Materials 197

Answer Key 198

Name ____________________ Date ____________

Activity Page 1 Use with Lesson 1

Work in Space!

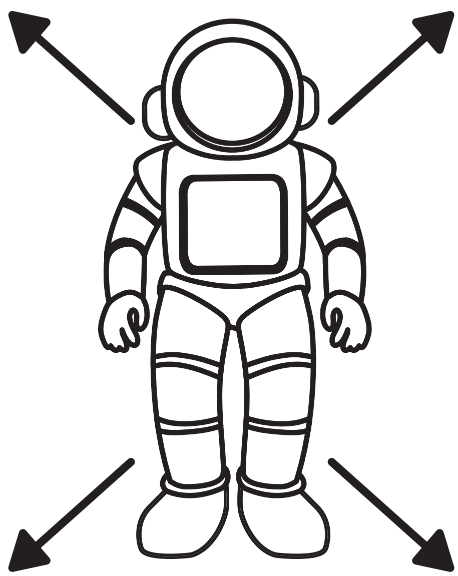
More people are needed to work in space. Complete the job poster telling four things that a scientist could do in space to investigate.

ASTRONAUTS NEEDED! YOU COULD WORK IN SPACE!

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________



______________________________ ______________________________

______________________________ ______________________________

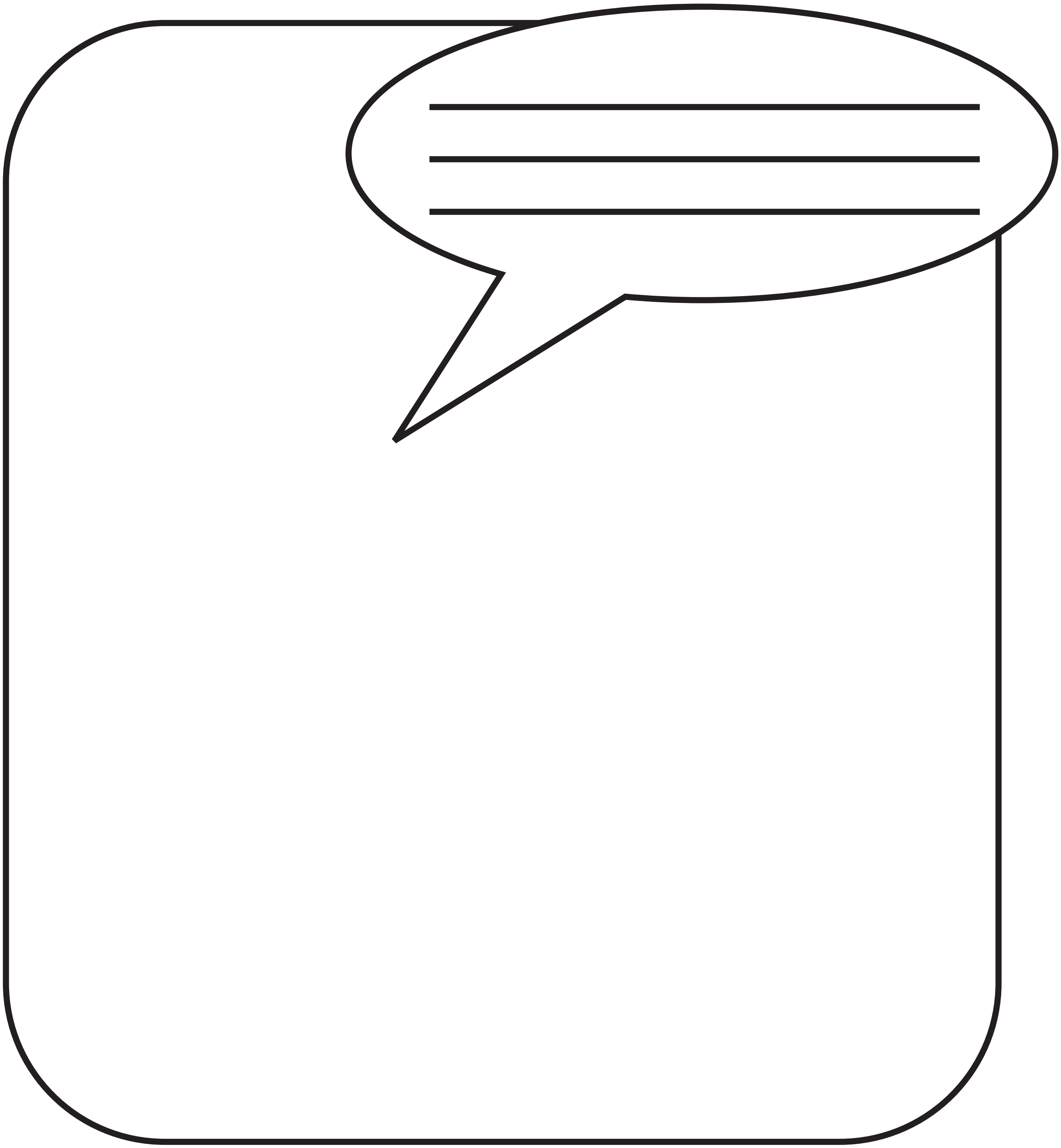
______________________________ ______________________________

Name ______________________________ Date ____________________

Activity Page 2 Use with Lesson 2

Draw Your Own Comic About Nature

Draw yourself as a cartoon character. In the speech bubble, write one thing in nature that repeats.

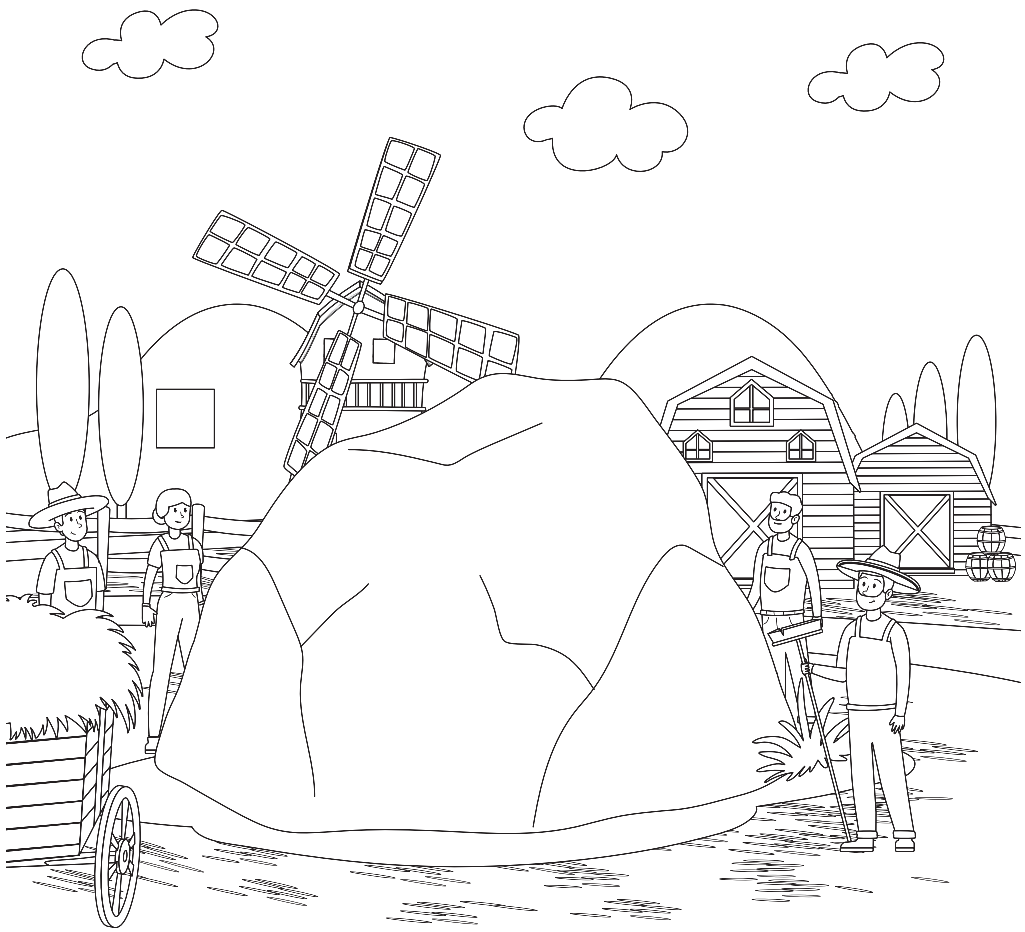


Name ______________________________ Date ____________________

Activity Page 3 Use with Lesson 3

What Do You Say?

Read about the big rock in the farm field. Then answer the questions. In your answers, use the terms <u>claim</u> and <u>evidence</u>.



A farm family finds a big rock in their field. A neighbor claims that it is a rock from outer space. The neighbor says, "Tourists will pay you to see the space rock!"

Soon, a scientist comes to investigate the rock. After testing it, she claims the rock is from Earth, not space. She says, "The scientific evidence shows that this rock is from Earth."

Is it OK for the farm family to claim the rock is from space anyway?

1. What would a scientist say?

____

____

2. What do you say?

____

____

Name ________________________________ Date ____________________

Activity Page 4 Use with Lesson 4

What's the Problem?

Think of a problem that can be solved by building something.

1. What is the problem you want to solve. Tell about people's needs or wants.

____

____

____

2. Think like the Roeblings. What could be built to solve the problem?

____

____

____

3. What would you do next to solve your problem?

____

____

____

Name ______________________________ Date ________________

Activity Page 5 Use with Lesson 5

Plan Your Own Model

Your school needs a new playground. Your job is to plan the best design.

1. Which kind of model will best show your plan? Check one. ☐ 3D ☐ 2D
2. What is the purpose of your model? What will it show?

____

____

____

3. What materials do you need to make your model?

____

____

____

4. How will your model be different from the real playground you want to build?

____

____

____

5. Draw a detail to show some part of your idea.

Name ________________________ Date ________________

Activity Page 6 Use with Lesson 6

Make Your Own Squishy Putty

Follow the directions to design your own squishy putty.

1. Measure ⅔ cup of cornstarch. Pour it in a bowl.
2. Measure ½ cup clear liquid dish soap. Pour it in the bowl.
3. Stir with a spoon.
4. Use your finger to put four drops of water in the bowl.
5. Decide what color you want your putty to be. Add one or two drops of food dye and stir.
6. Use your hands to mix and squeeze the materials.
7. Evaluate the mixture. Add more soap if it is crumbly. Add more cornstarch if it is too liquid.

Turn and talk. Check the ways you evaluated your putty.

☐ I thought about how well a solution solves a problem.

☐ I said which details about the solution were important to me.

☐ I explained which details were not important to me.

Name ________________________________ Date ____________________

Using Weather Data

Read the scene. Then use the data in the table to answer the questions.

Carter lives in Chicago, where there is a beach next to a big lake. His family wants to meet at the beach one fall evening. Which day should have the best weather for a picnic? Use the data in the table to decide.

Weather Forecast for Chicago, October 1–7							
	SUN.	**MON.**	**TUES.**	**WED.**	**THUR.**	**FRI.**	**SAT.**
Air Temperature in Degrees Fahrenheit	73	77	80	78	72	66	63
Clouds	Mostly sunny	Sunny	Sunny	Mostly cloudy	Partly cloudy	Partly cloudy	Partly cloudy

1. Analyze the temperature data. Which day will be the warmest?

   ____

2. Analyze the cloud data. Which days will have the most sun?

   ____

3. Interpret all the weather data together. Which day will be the best for a picnic? Explain how you decided.

   ____

   ____

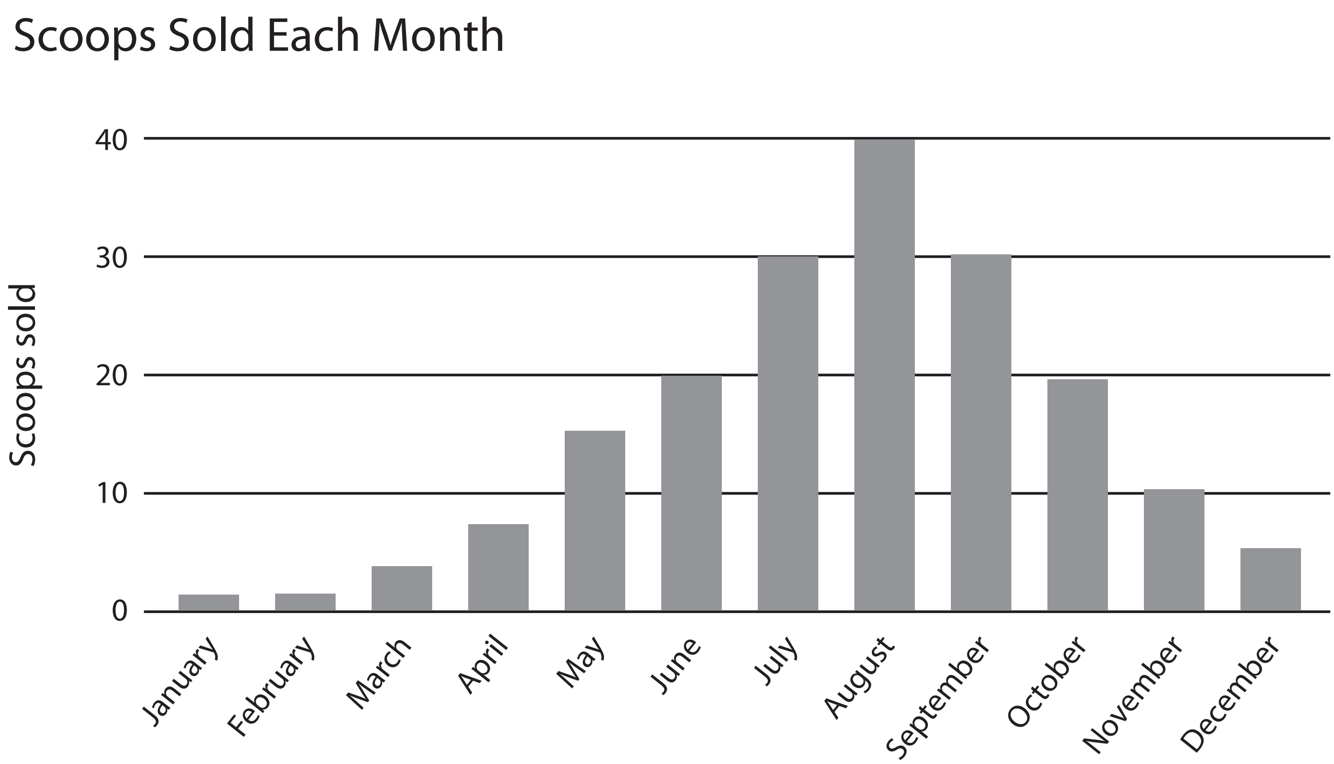
   ____

Name ______________________ Date ______________

Activity Page 8 Use with Lesson 8

Ice Cream Sales

Uncle Ernie needs Rose's help at his ice cream stand. He tells Rose that he needs to know which month the most ice cream is sold and why that might be. Use the data Rose collected to help her uncle!

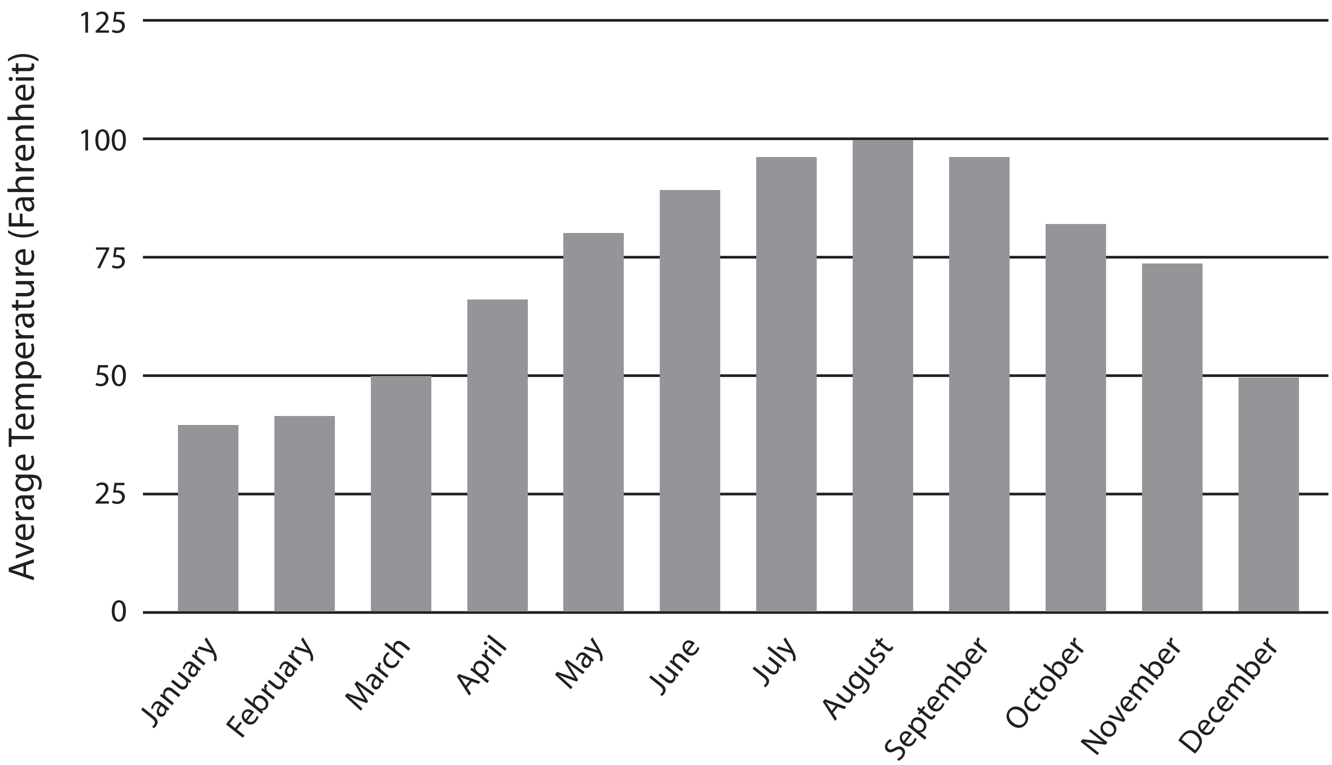


What would you tell Uncle Ernie?

Name ______________________ Date ______________

Activity Page 8 (*continued*) Use with Lesson 8

Average Temperature Each Month



1. **What pattern do you see?**

____

____

2. **What trend(s) do you see? (Remember: a trend describes how the graph changes.)**

____

____

3. **What can you claim from the graph?**

____

____

4. **What would you tell Uncle Ernie?**

____

____

Name ______________________________ Date ____________________

Activity Page 9 Use with Lesson 9

Designing a Solution

Your teacher wants a new way to keep the pencils and markers on their desk apart. Design a way to keep the pencils and markers apart. You can only use materials in the classroom.

While you are designing your solution, think about the following:

- **What materials will your solution use?**
- **How will the materials be used?**

My Pencil and Marker Separator

The Problem: How to keep pencils and markers apart
Identify a criterion. (A criterion is a feature the design must have.)
Draw your design.

Name ______________________________ Date ____________________

Activity Page 10 Use with Lesson 10

Claims, Evidence, and Reasoning

Use one of the sentence starters below to write a claim.

A. The greatest sports player of all time is ______________________________.

B. The best movie is ______________________________.

C. The best musical artist (song or group) is ______________________________.

D. The best sport is ______________________________.

Write down at least three pieces of evidence to support your claim:

1.

2.

3.

Reasoning: Why did you use this evidence? Why is this evidence important?

Name ______________________________ Date ________________

Activity Page 11 Use with Lesson 11

Growing Gummies

Follow along with your teacher's directions as you complete this investigation.

Question				
Guess	I think the gummy bear in water will ______________________________, because ______________________________.			
Prediction	If ______________________________, then ______________________________.			
Results: Write or draw what you see.	**Bear 1: No Water**		**Bear 2: Water**	
	Before	**After**	**Before**	**After**
Claim				

Name ________________________________ Date ____________________

Activity Page 12 Use with Lesson 12

Patterns in Your School

Find five different types of pattern somewhere in the classroom. Write or draw what each pattern is and why it is important in the design of the object. The first one is an example.

Pattern	Two Examples	Why It's Important in the Design
circles	**rollers on bottom of teacher chair, wheels on book cart**	**easier to move things**
____________________	desktop and tabletop	____________________
four legs	my chair and ______________	____________________
____________________	______________ and chair cushion	easy to sit on
____________________	____________________	so we can see the teacher
rounded shape	______________ and cups	____________________

Name ________________________ Date ________________

Activity Page 13 Use with Lesson 13

Theories

Put an X next to the sentences that you think apply to scientific theories.

	A. Theories include observations.
	B. Theories use facts and evidence.
	C. A theory never changes.
	D. Theories are explanations that are supported by evidence.
	E. Theories are just good guesses that scientists have.
	F. You should never try to change a theory

In your own words, write what a theory is.

____

____

____

____

____

____

Explain a theory you read about.

____

____

____

____

____

____

____

Name ______________________________ Date ____________________

Activity Page 14 Use with Lesson 14

Half, Quarter, Whole

Write or draw something that is half of something whole. Then, draw what a quarter of the whole thing would look like. Finally, draw the whole.

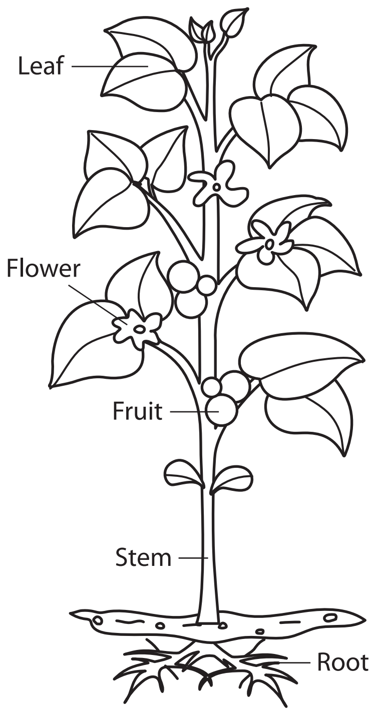
Half	Quarter	Whole

Name ______________________ Date ______________

Activity Page 15 Use with Lesson 15

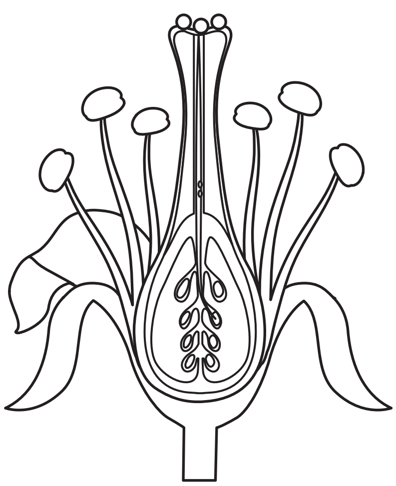
Learning from Models

Use these diagrams to help you complete the items on the following page.

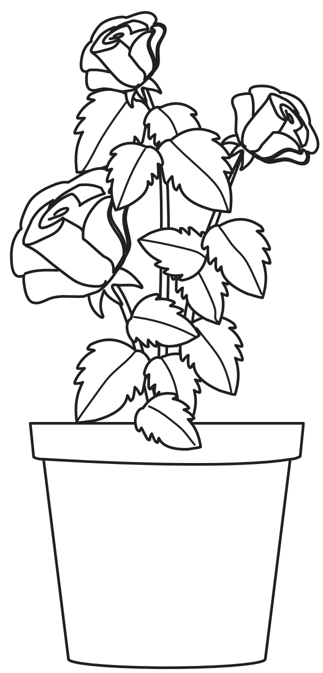


Diagram

Terrarium



Cross section



Object

Name ______________________________ Date ______________

Activity Page 15 (*continued*) Use with Lesson 15

Word Bank

Complete each sentence about what you can learn from different types of models. Use the words and phrases in the word bank. Each word or phrase can be used once.

terrarium	**learn how things live and grow**
diagram	**explore the parts of something**
cross section	**how something works**
object	**see the inside of something**

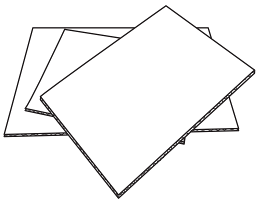
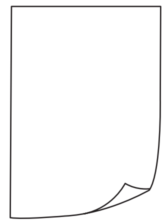
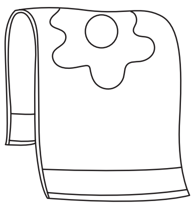
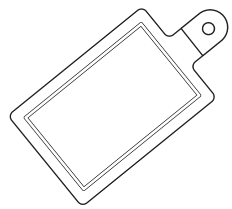
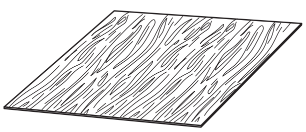
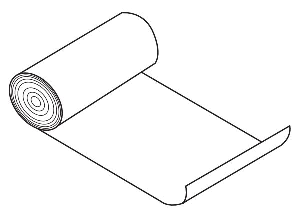
A drawing or ________________ shows the parts and ________________.
Look at a ________________ model or cutaway to ________________.
To touch and ________________ use a model of the ________________ itself.
If you want to ________________, use a living model called a ________________.

Name ______________________________ Date ____________________

Activity Page 16 Use with Lesson 16

Flexible and Rigid

Identify each item as flexible or rigid. Circle the best description.

cardboard 	**flexible** **or** **rigid**	**paper** 	**flexible** **or** **rigid**
cotton fabric 	**flexible** **or** **rigid**	**plastic cutting board** 	**flexible** **or** **rigid**
sheet of wood 	**flexible** **or** **rigid**	**aluminum foil** 	**flexible** **or** **rigid**

Write words to complete these examples. Fill in the blanks with things that belong to you.

My ____________________ is flexible because I can bend it.

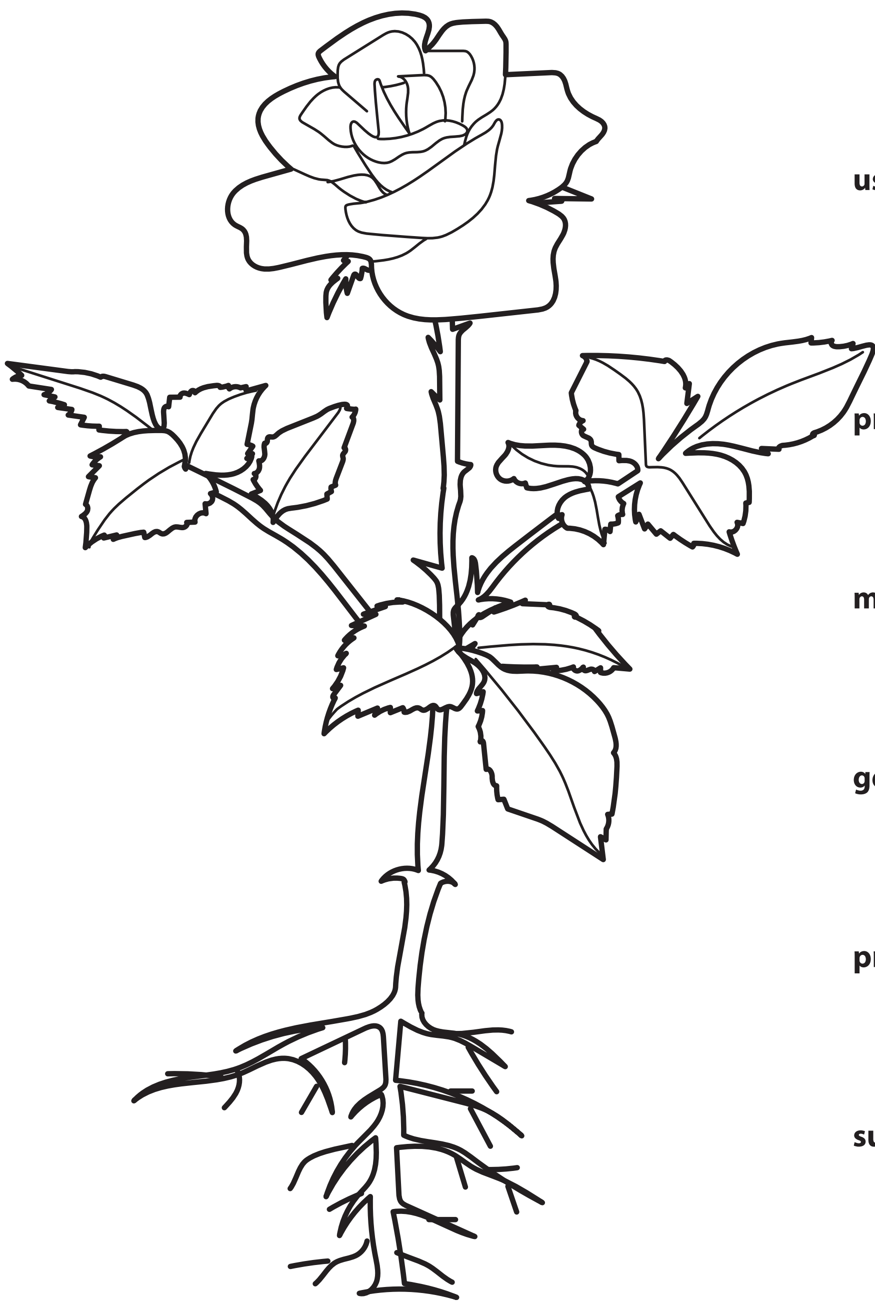
My ____________________ is rigid because I cannot bend it.

Name ____________________________ Date ____________________

Activity Page 17 Use with Lesson 17

Structures and Functions

Match each structure to its function.



use sunlight to make energy

provide pollen to make new plants

move water through the plant

get water from the soil

protect a plant from being eaten

support the leaves

Name ________________________________ Date ____________________

Activity Page 18 Use with Lesson 18

Are You Able to Label the Fable?

Create the best rhyming label for this fable.

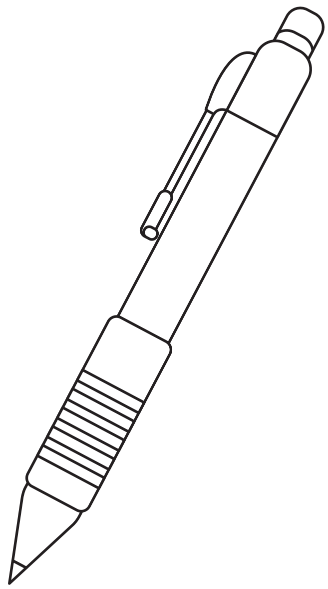
Farmer Fox uses a cable to lift hay into his barn. The rope hangs from a wooden arm at the highest place of the roof, called the gable. He pulls on one end of the cable, and the other end pulls the hay bales up. When Farmer Fox hears a cracking sound from above, he fears that his system is about to stop working as usual.

"Oh no," says Farmer Fox. "I have an ______________ ______________ ______________."

Name ______________________________ Date ____________________

Best Test

A company makes a new kind of pen.



The company says the pen has the following features:

- **It is easy to hold.**
- **It can write upside down.**
- **It can write on any surface.**
- **It can be erased.**
- **It is in your favorite color.**
- **It can write in different colors.**

You have to test the pen. Write which feature you would test. Then tell how you would test the feature.

I would test if the pen ______________________________.

To test the feature of the pen, I would ______________________________

______________________________.

List the things you will need in order to test the feature.

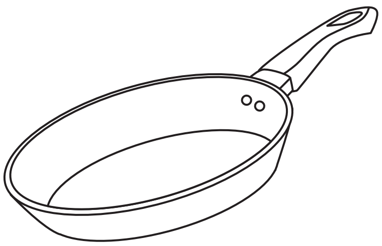
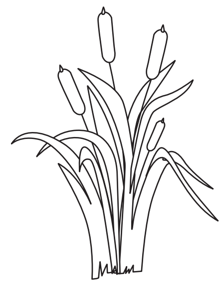
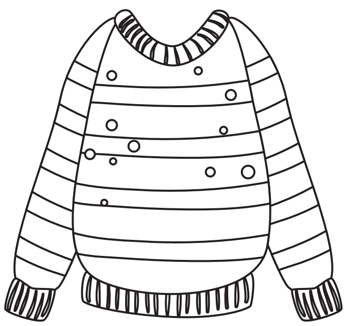
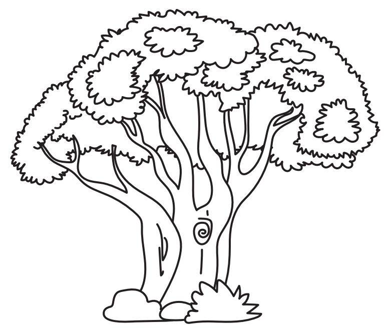
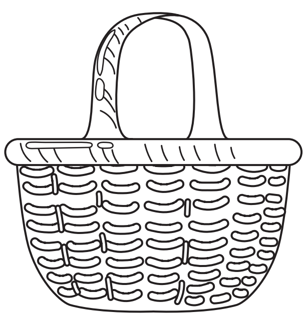
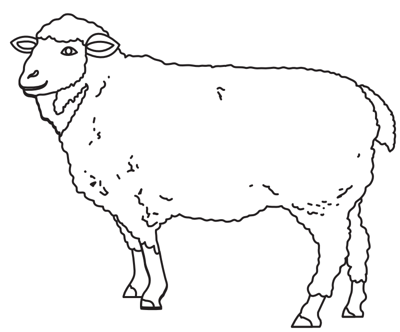
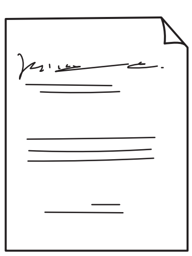
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Name ______________________________ Date ____________________

Activity Page 20 Use with Lesson 20

Raw Materials

Draw a line from each product to the raw or natural material it is made from.

Product	Natural Material
frying pan 	**grasses** 
wool sweater 	**tree** 
basket 	**sheep** 
paper 	**iron ore** 

Answer Key: *Learning About Science*

This answer key offers guidance to help you assess your students' understanding. Here, you will find descriptions of expectations, reasonable sample responses for open-ended items, and, where called for, singularly correct answers for each activity page of this grade level.

Work in Space! (AP 1) (page 176)

Look for responses that describe four things that a scientist does in space to investigate, such as spacewalk or grow plants.

Draw Your Own Comic About Nature (AP 2) (page 177)

Comics should show students as a character, and they should write about one thing in nature that repeats, such as seasons, day/night, or sunrise and sunset.

What Do You Say? (AP 3) (page 178)

Sample answers: A scientists would say it is not OK for the farm family to claim the rock is from space. The evidence shows that it is from Earth. I think it is not okay to say it is from space because the evidence confirms that it is from Earth.

What's the Problem? (AP 4) (page 179)

1, Look for responses that describe a problem that focuses on needs and wants. 2, Look for any solution that can be built. 3, Responses should indicate that there is a next step that can help solve the problem.

Plan Your Own Model (AP 5) (page 180)

1, 3D. 2, The purpose of the model should be to show a playground design. 3, Students should list a variety of materials for the model. 4, Responses should indicate that the model is smaller and made out of different materials. 5, The drawing should focus on one element of the design, drawn in detail.

Make Your Own Squishy Putty (AP 6) (page 181)

Make sure students talk about the different ways they can evaluate the putty.

Using Weather Data (AP 7) (page 182)

1, Tuesday; 2, Monday and Tuesday; 3, Tuesday because it is the warmest day and sunny.

Ice Cream Sales (AP 8) (pages 183–184)

Sample answer: The most ice cream is sold in August. 1, I see that more ice cream is sold in the summer months. Less is sold in the winter months. More ice cream is sold when it is hot, and less is sold when it is cold. 2, The graphs go from low to high then low again. 3, More ice cream is sold during the summer months when it is hot. 4, I would tell Uncle Earnie that the most ice cream is sold in August and the warmest month is August, too. I think people feel hottest in August and buy lots of ice cream to cool down.

Designing a Solution (AP 9) (page 185)

Look for a criterion that describes an essential feature, such as it lays flat, it is a rectangle, it has a divider, or it fits twenty pencils and twenty markers. Designs should show all the criteria.

Claims, Evidence, and Reasoning (AP 10) (page 186)

Students should make a claim for one sentence starter. Evidence must support their claim. Reasoning should describe why the evidence is important.

Growing Gummies (AP 11) (page 187)

Possible answers: Question: What will happen to gummy candies if they are put in water?; Guess: shrink, the water breaks them down; *or*, Prediction: If a gummy is placed in water, then it will get bigger than the gummy bear not placed in water; Results: Bear #1 Before – Normal gummy bear, After – normal gummy bear. Bear #2 Before – normal gummy bear, After – large and slimy gummy bear. Claim: If placed in water, gummy bears will swell up in size.

Patterns in Your School (AP 12) (page 188)

Row 1: Flat surface, keeps things from sliding off; Row 2: a desk, more stable; Row 3: soft, carpet; Row 4: rows, our desks or tables; Row 5: bowls, keeps items contained

Theories (AP 13) (page 189)

Look for X's next to A, B, and D. Sample answers: A theory is an explanation for something. It is based on lots of evidence. A theory I have read about is that gravity makes things fall down.

Half, Quarter, Whole (AP 14) (page 190)

Look for drawings of objects that can be divided into halves and quarters, and shown whole. Some objects may be pizzas, pies, or cakes.

Learning from Models (AP 15) (pages 191–192)

Completed sentences: A drawing or diagram shows the parts and how something works.

Look at a cross section model or cutaway to see the inside of something.

To touch and explore the parts of something, use a model of the object itself.

If you want to learn how things live and grow, use a living model called a terrarium.

Flexible and Rigid (AP 16) (pages 193)

cardboard, rigid; paper, flexible; cotton fabric, flexible; plastic cutting board, rigid; sheet of wood, rigid; aluminum foil, flexible. Look for responses that accurately identify items that are rigid or flexible.

Structures and Functions (AP 17) (page 194)

leaves, use sunlight to make energy; flower, provides pollen to make new plants; stem, moves water through the plant; roots, get water from the soil; thorns, protect a plant from being eaten; branches, support the leaves

Are You Able to Label the Fable? (AP 18) (page 195)

Look for fable labels that indicate that the system is unstable.

Best Test (AP 19) (page 196)

Student responses should choose one of the features. The test and list of things needed should describe a plan to test only that feature and no others.

Raw Materials (AP 20) (page 197)

frying pan, iron ore; wool sweater, sheep; basket, grasses; paper, tree

Appendix A

Glossary

Blue words and phrases are Core Vocabulary in the lessons, though the terms are not called out with color or bold treatment on the Student Book pages. **Boldface words and phrases** are additional vocabulary terms related to the lessons that you should model for students during instruction. Many of these also appear in the Student Book. Vocabulary words are not intended for use in isolated drill or memorization.

A

analyze, v. to examine, study, or look carefully to explain or describe

argument, n. a series of reasons, statements, or facts intended to support or establish a point of view

B

branches, n. a part of a plant that grows from the stem and holds the plant leaves

C

cause, n. the reason that something happens

certain, adj. known for sure

change, v. to become different; to make something different

claim, v. a statement that answers a question or poses a solution to a problem

criteria, n. the conditions that a solution must meet to be judged as successful

cross section, n. a cutting that allows you to see the inside structure of something

D

data, n. information that is observed or measured and recorded

design, v. to plan how to arrange or construct a solution

diagram, n. a picture that relates how something functions

E

ecosystem, n. all the living and nonliving things that interact in a given area

effect, n. a change that happens because of a cause

engineer, n. a person who uses science to design solutions to problems, especially by constructing tools or devices

engineering, n. a process used to develop a solution to a problem

equal, adj. the same quantity, amount, or number as another

evaluating, v. examining the details of something and determine the value or effectiveness of it

evaluation, n. the process of evaluating or the outcome of the process

evidence, n. a detail that supports a claim or helps prove an idea is true

explain, v. to describe the reason for an outcome or condition

F

flexible, adj. able to bend or twist easily

function, n. job; what an object is meant to do

G

glacier, n. a large area of thick ice made from layers of snow that have never melted

graph, n. a diagram that organizes and displays data in a way that reveals patterns and makes the data easier to understand

guess, n. an idea about something

H

half, adj. either of two parts that are equal

I

information, n. collected knowledge

interpret, v. to explain the meaning of something

L

life cycle, n. a series of stages in an organism's life

M

material, n. something that may be worked into a more finished form

matter, n. anything that has mass and takes up space

measure, v. to quantify by time, distance, volume, or mass

measurement, n. the quantity determined by measuring

meters, n. a measurement of length

model, n. a representation of something that can help people learn about the real thing

N

nature, n. places, wild plants, and wild animals that are not affected by humans

O

observation, n. a noted detail

observe, v. to watch something and notice details about it

P

pattern, n. a regular or repeated way in which something occurs

pollen, n. the powdery substance produced in the center of flowers

predict, v. to say that something is expected to happen

predictable, adj. expected because of a pattern or evidence

prediction, n. a statement that describes what might happen or what is expected to happen

problem, n. a condition that falls short of satisfying a want or a need

prototype, n. a preliminary version of a design from which other forms are developed

Q

quantity, n. the amount or number of a thing

quarter, adj. one of four equal parts of a whole thing

question, n. an expression for the purpose of inquiring or looking for a reason or explanation

R

raw material, n. natural unfinished material that come from nature

reasoning, n. a scientific mindset that connects claims and evidence

reliable, adj. able to be trusted

repeats, v. happens again

respectful, adj. being polite and thoughtful toward other people and things

rigid, adj. not able to bend

roots, n. the part of a plant that takes up water and minerals, typically underground

S

science, n. a system of knowledge and investigation to determine the truth and physical laws governing phenomena

scientific evidence, n. information that comes from science investigations

scientist, n. a person who investigates using scientific methodology

solution, n. a process, action, or device that fixes a problem

stability, n. the tendency of something to remain undisrupted

stable, adj. not changing, enduring

stem, n. the central part of a plant that provides support

structure, n. the way in which something is made and the parts it is made of

suspension, n. a something that is held over the top of something else

T

table, n. an arrangement of data in rows and columns for reference

technology, n. the use of science to solve problems

terrarium, n. a closed container with soil, plants, and air in it

test, v. to determine the performance or reliability of something

theory, n. a set of ideas used to explain something

three-dimensional, adj. has length, width, and height

trend, n. a general direction or tendency

triangle, n. a shape with three sides and three sides

two-dimensional, adj. has length and width but not depth

U

unstable, adj. changing or not enduring

V

vary, v. to change or differ

Safety

Classroom Safety: 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 the Science Literacy lessons make comparatively modest use of materials and hands-on science experiences. Some activities and demonstrations do 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:

- 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 foods, 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.

Internet Safety: Though online resources present many rich opportunities for student learning, unsupervised online activity for children is not advised. The U.S. Department of Justice provides the following guidelines, Keeping Children Safe Online:

- Discuss internet safety and develop an online safety plan.
- Supervise young children's use of the internet.
- Review games, apps, and social media sites.
- Adjust privacy settings and use parental controls. for online games, apps, social medial sites, and electronic devices.
- Tell children to avoid sharing personal information, photos, and videos online.
- Teach children about body safety and boundaries.
- Be alert to potential signs of abuse.
- Encourage children to tell a parent, guardian, or other trusted adult if anyone asks them to engage in sexual activity or other inappropriate behavior.
- Copy and distribute the Student Online Safety Contract, found on the next page. Prior to the start of the first lesson, do a read-along, and have students agree to the expectations for when they engage in computer and online activities.

Online Resources

For additional support concerning internet safety and online instruction, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we want students to be aware of the behavior expectations for engaging in online science activities. Please review the safety rules below with your student and sign this contract. If you have any questions, please feel free to contact me.

For important safety information about children, computers, and the internet, consider resources at these sites:

https://protectyoungeyes.com/

https://sharedhope.org/

https://www.justice.gov/coronavirus/keeping-children-safe-online

____

Teacher signature and date

_________________________ ______/______/______/

Parent or guardian signature and date

-- ______/______/______/

When doing online activities, I will do the following:

- Only do online activities with the supervision of an adult.
- Only visit websites and use apps that I am guided to by my teacher, parent, or trusted adult guardian.
- Never use my real name or reveal personal information if I communicate with others online.
- Tell a trusted adult right away if anyone online asks questions about my name, where I live, or where I go to school.
- Be careful around electronic devices and only plug them in or unplug them when an adult is supervising.

I understand and agree to the safety rules in this contract.

____

Student signature and date

_________________________ ______/______/______/

Print name

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science Literacy program are readily available and can be acquired through both retail and online stores. Some of the materials are reusable and are meant to be used repeatedly. This includes items such as plastic cups that can be safely used again. Often, these materials are durable and will last for more than one activity or even one school year. Other materials are classified as consumable and cannot be used more than once.

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 and technology can add up for an entire science program, even when the materials required for activities and demonstrations have been selected to be individually affordable. 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 in the teaching of science, as well as 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.

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flab / Alamy Stock Photo: 53
Francis Specker / Alamy Stock Photo: Cover C, 49
Geert Weggen / Alamy Stock Photo: 157
Geopix / Alamy Stock Photo: 17b
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Greatstock / Alamy Stock Photo: 164
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M&N / Alamy Stock Photo: 43b
Martin Parker / Alamy Stock Photo: 171a
Martin Smart / Alamy Stock Photo: 66b
Michael Gray / Alamy Stock Photo: 153, 154, 156, 158a–b
Mircea Costina / Alamy Stock Photo: 50a
Myrleen Pearson / Alamy Stock Photo: 65a
NASA: 18b
NASA / Dembinsky Photo Associates / Alamy Stock Photo: 18a
NASA Photo / Alamy Stock Photo: 17a, 21
NASA/Joel Kowsky: 19b
Nature Picture Library / Alamy Stock Photo: 33
Panther Media GmbH / Alamy Stock Photo: 51b, 171c
Penta Springs Limited / Alamy Stock Photo: 43a
Perry Mastrovito / Alamy Stock Photo: 173
Peter Wey / Alamy Stock Photo: 66a
PG Arphexad / Alamy Stock Photo: 132a
PhotosIndia.com LLC / Alamy Stock Photo: 138b
Pixel-shot / Alamy Stock Photo: 163
RGtimeline / Alamy Stock Photo: 116
Robbie Shone / Alamy Stock Photo: 20a
Robert Hoetink / Alamy Stock Photo: 67
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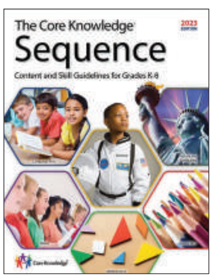

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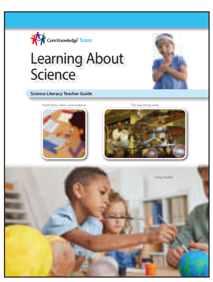

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