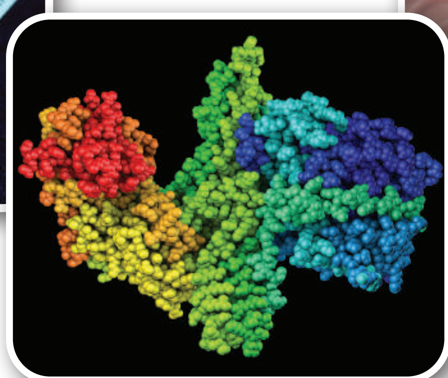
Core Knowledge® SCIENCE

Reading About Science

Science Literacy Teacher Guide

Measuring

Collecting and displaying data



Modeling

Engineering, designing, and testing

Reading About Science

Science Literacy Teacher Guide

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Reading About Science

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Core Knowledge Science™ 3

GRADE 3

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 Grade 3 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.

Sources:

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

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

National Governors Association Center for Best Practices, Council of Chief State School Officers. 2010. *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects*. National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C.

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

NOS1. Scientific Investigations Use a Variety of Methods

- Science methods are determined by questions.
- Science investigations use a variety of methods, tools, and techniques.

NOS2. Scientific Knowledge Is Based on Empirical Evidence

- Science findings are based on recognizing patterns.
- Scientists use tools and technologies to make accurate measurements and observations.

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

- Science explanations can change based on new evidence.

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

- Science theories are based on a body of evidence and many tests.
- Science explanations describe the mechanisms for natural events.

NOS5. Science Is a Way of Knowing

- Science is both a body of knowledge and processes that add new knowledge.
- Science is a way of knowing that is used by many people.

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

- Science assumes consistent patterns in natural systems.
- Basic laws of nature are the same everywhere in the universe.

NOS7. Science Is a Human Endeavor

- Men and women from all cultures and backgrounds choose careers as scientists and engineers.
- Most scientists and engineers work in teams.
- Science affects everyday life; Creativity and imagination are important to science.

NOS8. Science Addresses Questions About the Natural and Material World

- Science findings are limited to what can be answered with empirical evidence.

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 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions about what would happen if a variable is changed.
- Identify scientific (testable) and non-scientific (non-testable) questions.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Use prior knowledge to describe problems that can be solved.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

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 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Identify limitations of models.
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Develop and/or use models to describe and/or predict phenomena.
- Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

SEP3. Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions. Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Evaluate appropriate methods and/or tools for collecting data.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Make predictions about what would happen if a variable changes.
- Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.

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 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.

- When possible and feasible, digital tools should be used.
- Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- Analyze data to refine a problem statement or the design of a proposed object, tool, or process.
- Use data to evaluate and refine design solutions.

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 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.
- Organize simple data sets to reveal patterns that suggest relationships.
- Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
- Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.

SEP6. Constructing Explanations (science) and Designing Solutions (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 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.
- Apply scientific ideas to solve design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

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 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Compare and refine arguments based on an evaluation of the evidence presented.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
- Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.

- Construct and/or support an argument with evidence, data, and/or a model.
- Use data to evaluate claims about cause and effect.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

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 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Crosscutting Concepts

CCC1. Patterns

Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. In grades 3–5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. Patterns of change can be used to make predictions. Patterns can be used as evidence to support an explanation.

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—Mechanism and Explanation

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. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts. In grades 3–5, students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions. Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause-and=effect relationship.

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 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. In grades 3–5, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume. Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

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

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.

In grades 3–5, students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions. A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions.

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—Flows, Cycles, and Conservation

Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. In grades 3–5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change. Matter is made of particles. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Energy can be transferred in various ways and between objects.

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

The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. In grades 3–5, students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions. Different materials have different substructures, which can sometimes be observed. Substructures have shapes and parts that serve 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. 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)

For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study. In grades 3–5, students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change. Change is measured in terms of differences over time and may occur at different rates. Some systems appear stable, but over long periods of time will eventually 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.

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 - Specify criteria and constraints that a possible solution to a simple problem must meet.

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 - Research and explore multiple possible solutions.

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 - Improve a solution based on results of simple tests, including failure points.

Science, Technology, Society, and the Environment

STSE1. Interdependence of Science, Engineering, and Technology

- Science and technology support each other; Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.

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

- People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.

Common Core State Standards for English and Language Arts

Reading Standards for Informational Text

Key Ideas and Details:

- **CCSS.ELA-LITERACY.RI.3.1:** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- **CCSS.ELA-LITERACY.RI.3.2:** Determine the main idea of a text; recount the key details and explain how they support the main idea.
- **CCSS.ELA-LITERACY.RI.3.3:** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Craft and Structure:

- **CCSS.ELA-LITERACY.RI.3.4:** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a *grade 3 topic or subject area*.
- **CCSS.ELA-LITERACY.RI.3.5:** Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently.
- **CCSS.ELA-LITERACY.RI.3.6:** Distinguish their own point of view from that of the author of a text.

Integration of Knowledge and Ideas:

- **CCSS.ELA-LITERACY.RI.3.7:** Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- **CCSS.ELA-LITERACY.RI.3.8:** Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence).
- **CCSS.ELA-LITERACY.RI.3.9:** Compare and contrast the most important points and key details presented in two texts on the same topic.

Range of Reading and Level of Text Complexity:

- **CCSS.ELA-LITERACY.RI.3.10:** By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2–3 text complexity band independently and proficiently.

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.

Features

Using the Student Book

Online Resources

The *Reading About Science* Student Reader includes twenty chapters and a student Glossary that provides definitions to Core Vocabulary words. Engaging text, photographs, and diagrams encourage students to draw upon their own experiences and the world around them to understand scientific concepts. 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.

Explore, then read: In the core units of the CKSci program, lessons are sequenced to provide active engagement before reading. First, students explore phenomena through hands-on investigations or teacher demonstrations, accompanied by active questioning and analysis; then, students study the informational text provided in the Student Readers, including the Science Literacy series.

CK Science Literacy Student Readers extend, clarify, and confirm what students have learned in their investigations. The text helps students develop a sense of the language of science while images, diagrams, charts, and graphs deepen conceptual understanding. Use of the CK Science Literacy Student Readers supports the Science and Engineering Practice "Obtaining, Evaluating, and Communicating Information" as described in *A Framework for K–12 Science Education*.

Independent reading or group read-aloud: While the text in the Student Readers is written for independent reading, we encourage group read-aloud and engagement with the text. The Teacher Guide provides Guided Reading Supports to prompt discussion, clarify misconceptions, and promote understanding in relation to the Lesson Questions.

The intent of the Grades 3–5 CK Science Literacy lessons is to build students' understanding and knowledge of science concepts, as well as of associated practices and skills, using text 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 96–119. 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—Is It Science? (AP 1)

Lesson 2—Science Words (AP 2)

Lesson 3—Using Science Tools (AP 3)

Lesson 4—Variables (AP 4)

Lesson 5—Types of Models (AP 5)

Lesson 6—Think About Testing (AP 6)

Lesson 7—Data Picture (AP 7)

Lesson 8—Describing, Estimating, and Measuring (AP 8)

Lesson 9—Evidence and Explanations (AP 9)

Lesson 10—Fact or Opinion? (AP 10)

Lesson 11—Endangered Species Library Activity (AP 11)

Lesson 12—Peppered Moths Survival (AP 12)

Lesson 13—Cause and Effect (AP 13)

Lesson 14—Drawing to Scale (AP 14)

Lesson 15—A System: Open or Closed? (AP 15)

Lesson 16—Cycles (AP 16)

Lesson 17—Magnifying with a Hand Lens (AP 17)

Lesson 18—A Small but Dynamic System (AP 18)

Lesson 19—What a Design Must Have (AP 19)

Lesson 20—Science or Technology (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 8

- rulers, measuring tape, scale, beakers, thermometers, clock or stopwatches
- small cups of water
- various objects such as pencils, water bottles, markers, glue, lukewarm water
- hand weight

Lesson 9

- scissors

Lesson 10

- scissors

Lesson 11

- reference books and other research materials
- newspapers

Lesson 12

- pattern blocks, counters, math cubes, buttons, candies, or other materials to create simple patterns
- computers or tablets for each student or pair of students

Lesson 13

- reference books and other research materials

Lesson 17

- small objects such as rocks, fossils, and feathers
- hand lenses

Pacing

The Core Knowledge Science Literacy Student Reader 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 to facilitate 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. Is It Science?	Physical, life, and earth science	**11.** Spotting Evidence	Life science, habitats, survival
2. Testing a Hypothesis	Physical, life, and earth science	**12.** Patterns as Evidence	Life science, habitats, survival
3. Science Tools	Physical science, forces	**13.** Cause-and-Effect Detectives	Life science, habitats, survival
4. Sneaker Testing	Physical science, forces	**14.** Maria's Model	Life science, habitats, survival
5. Many a Model	Physical science, forces	**15.** Open and Closed Systems	Physical and earth science, weather and climate
6. Nailed It!.	Physical science, forces	**16.** Water: One Matter Cycle	Physical and earth science, weather and climate
7. How Much Data?	Life science, traits and variation	**17.** A Closer Look!	Life Science, traits and variation
8. About to Exactly	Life science, traits and variation	**18.** Dynamic!	Earth science, weather and climate
9. Relationships	Physical and earth science, weather and climate	**19.** Wants, Needs, and Limits	Earth science, hazards, engineering
10. Believing Versus Knowing	Life science	**20.** Science or Technology? Both!	Earth science, hazards, engineering

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

Is It Science?

At a Glance

Lesson Question

What makes a process science?

Learning Objective

✓ Describe science as both a process for collecting knowledge and a collection of verified knowledge.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Science involves a process of collecting data using scientific methods, verifying the data, and drawing conclusions based on the data.

NGSS and CCSS References

NOS1. Scientific Investigations Use a Variety of Methods: Science methods are determined by questions. Science investigations use a variety of methods, tools, and techniques. (Also **NOS5** and **NOS7**)

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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.

data **observation**

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.

conservation **dialogue** **fishery** **hearing** **stakeholders**

Instructional Resources

Student Reader

Ch. 1

Student Reader, Chapter 1
"Is It Science?"

Activity Page

AP 1

Activity Page
Is It Science? (AP 1)

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

Ask students to share their observations, experience, and knowledge of what science means to them. They may tell about the experiments they have done or heard about.

Show a video to explore the question of what science is. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What makes a process science?

2. Read and discuss: "Is It Science?"

Student Reader

Ch. 1

Prepare to read together, or have students read independently, Chapter 1 "Is It Science?" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 2

- What is the topic of the meeting? (*fishing for haddock in the Gulf of Maine*)
- Why do you think so many people attended the meeting and are interested in this topic? (*There are many people who are involved in fishing for haddock, including people who fish for haddock, people who sell haddock, and people who buy haddock.*)

  SUPPORT—Discuss the Words to Know.

  Fishery: Ask students to describe a fishery they know or can imagine and why it is important. A fishery is a place where fish may be raised or are caught and processed for sale. The study of fisheries is important to make sure fish are healthy and survive in an ecosystem or for food.

Ask students to share if they know what *stakeholder* means and give an example. (*A stakeholder is someone who can benefit or be harmed by an issue. If school is closed because of weather, the stakeholders are the teachers, staff, and students and their families.*)

Page 3

- What is Mr. D'Almeida's experience with haddock fishing? (*He is an experienced fisher and comes from a long line of people who fish.*)
- What caused the meeting? (*There is a plan to cut the amount of haddock people can harvest, and people are upset.*)
- What makes Mr. D'Almeida a stakeholder in this discussion about fishing for haddock? (*He has a lot of experience, and his job depends on being able to fish and sell his fish.*)

Page 4

- Is Dr. Cho a stakeholder? (Yes. *As a senior scientist at the Marine Fisheries Service, Dr. Cho is responsible for making sure the fish population is healthy.*)
- How does Mr. D'Almeida use science when he adjusts his nets to catch different kinds of fish? (*He has analyzed how big his nets must be to catch big fish and allow small fish to get out of the net.*)
- How is Mr. D'Almeida's interest different from Dr. Cho's? (*Mr. D'Almeida is concerned with catching a lot of fish to sell. Dr. Cho is concerned with the health of the fish population.*) Point out that Dr. Cho's concern with the health of the fish is also in the fishers' interest, because it protects their way to earn a living.

Page 5

- How has Dr. Cho used science to study the fish population? (*The observer collected data about what types of fish were caught, where the fish were caught, and many other things and analyzed the data using mathematical techniques.*)
- How might Mr. D'Almeida use scientific observations? (*Mr. D'Almeida counts how many fish are caught and weighs them to figure out how much money he might make. He looks for ways to catch more fish.*)

Page 6

- What concerns does Dr. Cho raise about the haddock population? (*Over time, the average size of the haddock is smaller, and they are being overfished. If that continues, there will be smaller and fewer fish.*)
- Why is quantitative data effective? (*You can compare quantities or sizes instead of just thinking something has changed.*)

CHALLENGE—Challenge students to think of other examples of using scientific methods to identify potential problems, such as ways in which populations of wildlife are increasing or decreasing.

Know the Standards

NOS5. Science Is a Way of Knowing

Students compare two ways of knowing about a fish population in this lesson, one that is experiential and one that is scientific.

Page 7

- Why is sharing data and communicating essential? (*If you don't tell other people what you have observed, they cannot verify it or learn from it.*)
- What are some other solutions to the problems with the haddock population that Dr. Cho presented? (*The people who fish could catch other fish or find other work until the haddock population is restored.*)

3. Check for understanding.

Activity Page

AP 1

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Science involves observation, collecting and analyzing data, and communicating results.

What details from the chapter support the main idea? (*Dr. Cho used scientific methods to observe, collect quantitative data, analyze data, and communicate results.*)

Distribute Activity Page 1, and go over the instructions with students. They should read the two statements in each row and decide which is based on scientific evidence that can be observed and quantified.

See the Answer Key for sample or correct answers.

Know the Standards

NOS1. Scientific Investigations Use a Variety of Methods

In this lesson, students experience the variety of methods a scientist used to come to the conclusion that a population of fish had changed, including questioning, observing, collecting data, quantifying data, and communicating results.

LESSON 2

Testing a Hypothesis

At a Glance

Lesson Question

What do testing and evidence have to do with the laws of nature?

Learning Objectives

✓ Define *theory*.

✓ Cite examples of a theory and a natural law.

✓ Describe elements of a scientific test.

✓ Explain the reasoning behind testing a theory.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Testing ideas about how nature works helps us figure out things that are always true.

NGSS and CCSS References

NOS4. Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena: Science theories are based on a body of evidence and many tests; Science explanations describe the mechanisms for natural events. (Also **NOS6** and **NOS8**)

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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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experiment **hypothesis** **investigation** **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.

evidence **laws of nature** **loamy** **test**

Instructional Resources

Student Reader

Ch. 2

Student Reader, Chapter 2
"Testing a Hypothesis"

Activity Page

AP 2

Activity Page
Science Words (AP 2)

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

Ask students to share a time when they were involved in a scientific experiment. Have them explain what they learned from the experiment and how they knew it was true.

Show a video to explore the meanings of scientific words. Some words and concepts may be difficult, but it is important to establish the idea that some words have specific scientific meanings. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What do testing and evidence have to do with the laws of nature?

2. Read and discuss: "Testing a Hypothesis."

Student Reader

Ch. 2

Prepare to read together, or have students read independently, Chapter 2 "Testing a Hypothesis." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 8

- What is the question about sunflowers that Rachel wants to find out? (*Is sandy or loamy soil better for growing sunflowers?*)

- Why should people care about Rachel's question? (*Sunflowers are used by humans in so many ways. It is important to know the best way to grow them. Also, what is learned about sunflowers also applies to lots of other plants.*)

  SUPPORT—Discuss the Words to Know.

Ask students what they think a *hypothesis* is, and guide them to recognize that a hypothesis is a guess based on knowledge and information. Ask them to make a hypothesis about what type of soil is better for sunflowers.

Then discuss the terms *observation, experiment,* and *test.*

Confirm that students understand that an *observation* is something they can see with their own eyes. An *experiment* requires a controlled experience to isolate the factor that makes a difference, and a *test* is a way of finding out if something works or not. Explain that in science each of these words has a specific meaning.

Page 9

- How will Rachel test which soil is better for growing sunflowers? (*She set up a test with the same amount of different soils, the same number of sunflower seeds planted in the same way, and the same amount of water.*)
- What are the elements of a scientific test? (*You have to make sure everything is the same except for one thing that is different to find out what works and what doesn't.*)
- Will this be a fair test of the soils? (*yes, because if they all receive the same amount of sun, the only variable will be the type of soil*)
- What is your hypothesis about what will happen? (*Possible answer: I would hypothesize that the sunflowers will grow the same in each soil type.*)

Page 10

At some point, observations and theories become accepted as natural laws. These are phenomena that can be observed and experienced consistently.

A scientific law is a statement that summarizes a collection of observations or results from experiments. A theory describes and explains why a natural phenomenon occurs. For example, the law of gravity states that every time you drop an apple, it will fall to the ground. The theory of gravity is the explanation as to why the apple falls to the ground. A law is description.

Know the Standards

NOS8. Science Addresses Questions About the Natural and Material World

In this lesson, students engage in an example to answer a question with empirical evidence that can be observed and experienced rather than just assumed.

Know the Science

For the purpose of simplification, the Student Reader chapter, mimicking a student report, suggests that the main difference between loamy and sandy soil is the rate at which water passes through them. Nutrients from organic matter that the soils contain, or lack thereof, would also be a factor.

A theory is an explanation.

- What are the laws of nature that Rachel is using? (*Sunflowers grow upward toward the sun. Sunflowers need water, air, and light. Water sinks through soil. Loamy soil holds more water than sandy soil, so it will provide the roots with more water.*)
- What is a natural scientific law? (*a description of what happens based on observation*)
- What is an example of a natural law? (*Gravity makes things fall to the ground and us stay on the ground. Plants grow up toward the sun.*)
- Why are the assumptions that Rachel is using laws of nature? (*By observation, we know that all plants grow upward toward the sun and that without light, air, or water, they will not grow. Water always sinks down.*)

Page 11

- What variable was different in the experiment? (*Only the type of soil was different.*)
- What is a theory? (*A theory is an explanation of how and why something happens based on observation, experience, and repeated experiments.*)
- What is an example of a theory based on scientific knowledge? (*Climate change is happening because of changes in the atmosphere. Germs cause diseases.*)

Page 12

- What did the results show? (*More sunflower seeds sprouted and grew taller in the loamy soil.*)
- Why is it important to test theories? (*Sometimes more information can cause a theory to change, and you have to make sure it still is a good explanation of why something is happening.*)

Page 13

- What questions are still unanswered about growing sunflowers? (*Would another type of soil or fertilizer help sunflowers grow? How much water is best? What would you need to do to grow sunflowers if you only had sandy soil?*)
- Do you think someone else would get the same results if they repeated the same experiment? (*yes, as long as the test and variables are the same*)
- What do testing and evidence have to do with the laws of nature? (*Once you understand the laws of nature, you can test and find evidence of how to use the laws of nature to the best advantage.*)

3. Check for understanding.

Activity Page

AP 2

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Scientific tests and experiments can confirm or reject hypotheses and help establish theories.

Distribute Activity Page 2, and go over instructions with students. Have students match each definition to the word that is most closely related and define any two other science words of their choosing.

See the Answer Key for sample or correct answers.

LESSON 3

Science Tools

At a Glance

Lesson Question

What kinds of tools collect scientific evidence?

Learning Objectives

✓ Recognize and describe the functions of a ruler, measuring tape, calipers, flask and graduated cylinder, mass balance, spring scale, hand lens, microscope, telescope, thermometer, and hot plate.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- optional video

Main Science Idea

Many devices help with making observations and measurements in science.

NGSS and CCSS References

NOS2. Scientific Knowledge Is Based on Empirical Evidence: Science findings are based on recognizing patterns; Scientists use tools and technologies to make accurate measurements and observations. (Also **NOS3**)

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

3 MD A. Solve problems involving measurement and estimation of liquid volumes and masses of objects.

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

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balance **caliper** **flask** **graduated cylinder** **spring scale**

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.

hand lens **microscope** **telescope**

Instructional Resources

Student Reader

Ch. 3

Student Reader, Chapter 3
"Science Tools"

Activity Page

AP 3

Activity Page
Using Science Tools (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.

Online Resources

Ask students about how they measure different things, such as time, length, weight, and temperature. Discuss different types of tools they use. Relate using informal tools or nonstandard units, such as arm length, to using precision tools.

Show a video to explore which measuring tools are best for a task. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What kinds of tools collect scientific evidence?

2. Read and discuss: "Science Tools."

Student Reader

Ch. 3

Prepare to read together, or have students read independently, Chapter 3 "Science Tools." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 14

- Why would you need to measure anything in a science investigation? (*to collect data so you can compare and analyze the length, growth, weight, or temperature of objects and draw conclusions*)
- What are calipers? (*a tool with jaws that can measure objects with odd shapes*)

  SUPPORT—Discuss Words to Know.

Ask students what types of things a caliper would be good for measuring, such as rocks or how wide a hole in the wall is.

Discuss other tools students use to measure width, length, temperature, weight, amount, and time. They may think of measuring tapes and cups, medicine droppers, rulers, and thermometers.

Page 15

- What is the difference between a meterstick and a measuring tape? (*A meterstick is solid, and a measuring tape is flexible.*)
- Could you use either one to measure your height or the length of the door? (*yes*)
- When would it be easier to use a measuring tape? (*when the thing you want to measure is not straight and solid*)

Page 16

- What is a flask? (*It's a container that holds and measures liquids.*)
- What is the difference between a flask and a graduated cylinder? (*Both measure liquids, but a graduated cylinder is usually marked for more precise measurements.*)
- What is a cylinder? (*a solid round figure with straight parallel sides*)

Page 17

- What do balances and spring scales measure? (*the weight or mass of something*)
- Discuss different types of scales with which students are familiar and how they compare to balances and spring scales. (*Possible answer: Grocery store scales used for measuring produce are like spring scales. A doctor's office scale is like a mass balance scale.*)
- Why is it important to know how much something weighs in science? (*You might need to know if an animal or plant has gained or lost weight to tell if it is growing or is failing.*)

Page 18

- How is a microscope different from a hand lens? (*It has much greater magnification so you can see much smaller things.*)

Know the Standards

NOS2. Scientific Knowledge Is Based on Empirical Evidence

Science findings are based on recognizing patterns; Scientists use tools and technologies to make accurate measurements and observations.

In this lesson, students recognize that scientists use different tools to make useful measurements and observations.

Know the Science

Mass is the amount of material in an object. Weight is the result of the effect of gravity on an object's mass. Students experientially observe mass by sensing the weight of objects that they handle. At this grade level, the concepts can be discussed interchangeably. The distinction becomes more understandable in later grades when students have had further discussions about gravity and how it differs in proximity to other celestial bodies beyond Earth.

- How is a hand lens different from having eyeglasses or contact lenses? (*Eyeglasses correct people's vision if their eyes are not able to see as well when they look at objects either very close or far away. A hand lens helps people see small details more clearly when they are trying to make observations.*)
- How is a microscope different from a telescope? (*A microscope helps you see very tiny things. A telescope helps you see things that are far away.*)

  CHALLENGE—Ask students what the words *telescope* and *microscope* have in common. Explain that the root word *scope* means "to look." Challenge them to find other words with the root word *scope,* and discuss what these words have in common.

Page 19

- What do thermometers measure? (*how hot or cold something is*)
- Why would you measure temperature in science? (*to control variables to make sure the temperature is the same or to measure changes in temperature*)
- How is a lab hot plate different from a stove or microwave? (*It usually has just one heating element and is used for precise scientific measurements, not for heating food.*)

3. Check for understanding.

Activity Page

AP 3

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Many devices help with making observations and measurements in science.

Collect a number of science tools, such as a hand lens, ruler, thermometer, balance, microscope, and calipers. Allow students time to explore the tools.

Have students choose the best tool for each task. When students are done, discuss the uses of each of the tools, and sort them by their different uses.

Distribute Activity Page 3 to students, and go over the expectations. Expand the exercise by asking students to write an additional use for two of the tools.

See the Answer Key for sample or correct answers.

LESSON 4

Sneaker Testing

At a Glance

Lesson Question

How and why are variables changed and controlled in tests?

Learning Objectives

✓ Identify controls and variables in provided test scenarios.

✓ Express how changing a variable during a test supports the ability to find an answer to a question.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

In a scientific test, changing a variable and looking for different outcomes can help answer a question. But only one variable at a time should be studied.

NGSS and CCSS References

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. Ask questions about what would happen if a variable were changed.

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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

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control **variable**

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.

experiment **investigation** **prototype** **technology**

Instructional Resources

Student Reader

Ch. 4

Student Reader, Chapter 4
"Sneaker Testing"

Activity Page

AP 4

Activity Page
Variables (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.

Online Resources

Ask students what they know about sneakers and what they like about sneakers. They may like the colors, special features like lights in the sole, the quality of the glue, or the type of laces or closures.

Show a video that demonstrates how sneakers are made so that students know how involved it is to make a sneaker and how many variables there are. Discuss what variable could make a sneaker appealing or unappealing, for example, how heavy the shoe is, the color, or any other variable.

Next, show a video that explains what variables in a scientific test are. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How and why are variables changed and controlled in tests?

2. Read and discuss: "Sneaker Testing."

Student Reader

Ch. 4

Prepare to read together, or have students read independently, Chapter 4 "Sneaker Testing." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 20

- What kinds of things make certain sneakers more popular than other sneakers? (*Sample answers: color brand, flexibility, comfort*)
- Why would Cedric and Elijah dream of becoming basketball sneaker designers? (*Possible answer: They like sneakers and think that they could make a lot of money if they created a better sneaker.*)

  SUPPORT—Discuss Words to Know.

Ask students what *technology* is. Explain that technology is whenever anyone applies scientific knowledge for practical purposes to solve problems. There are computer technologies, but there are also communication technologies with cell phones and the internet, electrical technologies such as electric cars, and energy technologies such as solar panels. There are also mechanical, medical, and transportation technologies. Have students suggest different technological devices they use themselves. (*cell phone, GPS device, digital thermometer, smart watch, electric scooter*)

Page 21

- What are the different main parts of a sneaker? (*upper, outsole, insole, midsole*)
- What would make one sneaker better than another? (*One outsole is more grippy and durable. One insole is more comfortable and formfitting. One midsole has more cushioning.*)

Page 22

- What problem have Cedric and Elijah identified? (*The midsole absorbs force but does not give an extra bounce.*)
- What technologies are they considering to help solve the problem? (*different foams that bounce back, coiled springs made of metal, and leaf springs made of plastic*)
- Why do they think these technologies would help them sell more shoes than other sellers? (*They would provide more bounce than other sneakers.*)

Page 23

- What are the controls Cedric and Elijah want to use in the test? (*a midsole with a bubble full of air and a midsole with spongy foam*)
- What is the *dependent* variable, the thing they want to test? (*the amount of bounce*)

Know the Standards

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

Students recognize in this lesson that some basic laws of nature are the same everywhere in the universe.

SEP1. Asking Questions

In this lesson, students experience asking questions to identify and clarify issues for engineering better sneakers.

- Why is it important to only test one independent variable at a time? (*so you can identify what one thing changed and how it affected the results*)

Page 24

- How did Cedric and Elijah test the five midsoles? (*They mounted a meterstick on the wall, dropped a metal ball on each one, and measured how high it bounced.*)
- What is the *dependent* variable in this test? What are they trying to measure? (*how high the ball bounces when it hits each midsole*)
- What is the *independent* variable in this test? (*the different types of midsoles*)

  CHALLENGE—Challenge students to design a scientific test with a control, a dependent variable, and independent variables to test the quality or favorability of one type of object over another. Have them share their test ideas with the class.

Page 25

- Why were Cedric and Elijah excited? (*Their midsole designs were bouncier than those of the shoes on the market.*)
- Why did they test each sole fifty times and calculate the average? (*to make sure that it was a pattern, not a mistake*)
- What could happen if they dropped the ball on each midsole only one time? (*It could miss, or it could hit at an odd angle that would affect the results.*)

3. Check for understanding.

Activity Page

AP 4

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Controlling variables and testing one at a time can help answer questions and solve problems.

What details from the chapter support the main idea? (*There is an example of a test of sneaker midsoles with a dependent variable* (*how much bounce*), *controls* (*existing sneakers*), *and independent variables* (*three types of midsoles.*)

Have students complete the activity page individually and then together discuss each test and determine which factors are the dependent and independent variables.

See the Answer Key for sample or correct answers.

LESSON 5

Many a Model

At a Glance

Lesson Question

What range of objects and processes can be represented with models?

Learning Objectives

✓ Describe how a model helps with understanding something too large to be seen.

✓ Describe how a model helps with understanding something too small to be seen.

✓ Describe how a model can represent a process.

✓ Describe how a model can simulate an event.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

A model is a representation of an object, idea, or process. Models can help us understand things that are too large or too small to be seen. Models can also help us understand processes.

NGSS and CCSS References

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. (Also **RI.3.1**, **RI.3.2**, and **RI.3.4**)

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.

model **scale** **visualize**

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.

atom **electron** **neutron** **particle** **proton**

Instructional Resources

Student Reader

Ch. 5

Student Reader, Chapter 5
"Many a Model"

Activity Page

AP 5

Activity Page
Types of Models (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.

Online Resources

Ask students what they think of when they hear the word *model*. Some may think of model rockets, model cars, dolls, or fashion models.

Show a video about what scientific models are. After the video, discuss what types of models students have used, built, or played with. Then show a simple video of making a model of the solar system. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What range of objects and processes can be represented with models?

2. Read and discuss: "Many a Model."

Student Reader

Ch. 5

Prepare to read together, or have students read independently, Chapter 5 "Many a Model." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 26

- What toys do you know of that are models of something big?
  (*Sample answers: model cars, dolls, stuffed animals, board games like Life, computer game simulations, treasure maps*)

- What are some models you know of that allow you to visualize something very big? (*Sample answers: toy cars, building models, maps*)
- How do people develop models for things they can't see? (*They use measurements and other information to create a miniature version.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *model*. Distinguish between a model and a prototype that is used to test the functionality and performance of a product. Explain that a model helps you visualize an idea.

Relate the word *visualize* to the word *vision*, and explain that it comes from a word meaning "to see." Make a class list of all the words with *vis-* that have to do with sight. (*visual, vision, visor, visionary*)

Page 27

- What is the purpose of the Griffith Observatory's solar system model? (*to show how far the planets in the solar system are from one another*)
- How does this model compare to other models of the solar system? (*It doesn't show the size, shape, or color of the planets.*)
- What would make a model incorrect? (*If a measurement is wrong or new information is discovered, a model will be incorrect.*)

Page 28

Ask students:

- What models have you seen of things too small or hard to see with the naked eye? (*Sample answers: a large model of an insect, a snowflake, a drop of water, the human eye*)
- What is the advantage of making models of things you cannot see? (*A model can help you understand what something is made of.*)

  EXTEND—It is beyond grade level to assess students on the concept of atoms or the notion that they are made up of even smaller particles. However, you might spark interest while discussing the diagram on the page by sharing that if you represent the nucleus, the center part, of an atom with an object the size of an egg, the farthest electrons orbiting the nucleus would be about a mile and a half away. Even though all matter is made up of atoms, the atoms themselves are mostly empty space.

Know the Standards

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

In this lesson, students recognize that measuring is a way of collecting and verifying data, which can provide evidence to confirm or challenge hypotheses.

SEP2. Developing and Using Models

In this lesson, students explore different types of scientific models, including models of objects that are large and small and models that represent events and processes.

Page 29

- How can models lead to new discoveries in science? (*A model that shows how something works or fits together can change people's ideas. A model of an atom helps people understand what everything is made of.*)

  SUPPORT—To compare models, ask students how they know about dinosaurs. They may have seen pictures or had toy hard plastic or plush dinosaurs. Discuss what children learn from toys, such as stuffed animals, about real animals. For example, young children can learn that some animals have four legs, some have wings, and some have six or eight legs. Talk about how people developed models for dinosaurs so that students recognize that model toys are based on discoveries and measurements of dinosaur remains.

Page 30

- How can a model be useful for understanding a process or event? (*It can show how something happened.*)
- How is a model of a process different from the model of the solar system or atoms on the previous pages? (*It involves several steps and shows how something happened.*)

  CHALLENGE—Challenge students to create a model of something very large or very small or a process model. Have them share their models with the class.

Page 31

- What types of process models have you seen? (*weather path models, the growth of a plant or animal, how something is made*)
- How can process models help predict the future? (*An accurate model can show the path of a hurricane so you know what will happen. A process model can help visualize what will happen to surroundings if a tree is planted.*)

  SUPPORT—Discuss the word *scale*. Some may think scale has only to do with weight scales. Explain that drawing something to *scale* is drawing it with the actual measurements. Sometimes models are built to scale, for example, a dinosaur model in a museum can dramatically show how large the dinosaur actually was. But a model can also have the same proportions but be made much smaller or much larger than the actual thing.

3. Check for understanding.

Activity Page

AP 5

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. People who work in all science, technology, engineering, and mathematics fields use different kinds of models for different purposes.

What details from the chapter support the main idea? (*There are examples of models of large and small things and models of a process and event.*)

Have students complete Activity Page 3, and then together discuss the models that interest them the most.

See the Answer Key for sample or correct answers.

LESSON 6

Nailed It!

At a Glance

Lesson Question

What is a fair test?

Learning Objectives

- ✓ Order provided steps for a sample investigation.
- ✓ Identify controls and variables in a sample investigation.
- ✓ Characterize multiple trials as a best practice for testing.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

A fair test is an attempt to answer a scientific question by controlling all variables except one and conducting several trials to make sure the result can be verified.

NGSS and CCSS References

SEP3. Planning and Carrying Out Investigations: Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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

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Core Vocabulary and Language of Instruction

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constraint **criteria** **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.

control **experiment** **trial** **unbiased** **variable**

Instructional Resources

Student Reader

Ch. 6

Student Reader, Chapter 6
"Nailed It!"

Activity Page

AP 6

Activity Page
Think About Testing (AP 6)

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

Ask students what they think of when they hear the word *fair.* They may say *fair* is following the rules. Fair is the opposite of cheating or trying to take advantage of a situation. Then ask them what the word *test* means to them. Lead them to recognize that a test is a way to figure out the quality or reliability of something.

Show a video about what a fair test is. After the video, discuss why it is important to conduct fair tests to get reliable results. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What is a fair test?

2. Read and discuss: "Nailed It!"

Student Reader

Ch. 6

Prepare to read together, or have students read independently, Chapter 6 "Nailed It!" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 32

- What does the Griffin Tool Company want to know about its hammers? (*Is the head strong enough to drive nails? Is the hammer too heavy? Is the hammer comfortable to hold? Is it durable?*)

- What would happen if the company did not test its hammers? (*They could be too heavy, break easily, or not work, and then no one would buy them.*)
- Why would they test each hammer with five different people and fifteen times? (*to make sure that not just one person can use the hammer and that it works every time*)

  SUPPORT—Discuss Words to Know.

Discuss the word *criteria*. Explain that *criteria* are the things that need to be included or satisfied in a test. Ask what the criteria are for testing hammers. (*It must be strong, comfortable, and not break, and a number of people can use it.*) Discuss what the criteria would be for a toy car that they might want to buy. For example, it must be safe, have wheels, and not break.

Page 33

- What is the advantage of Phil Fried's hammers over those of the Griffin Tool Company? (*They are custom-made, look like works of art, and have high-quality materials.*)
- What are the disadvantages of Phil Fried's hammers compared to those of the Griffin Tool Company? (*They cost much more. People complain that the handles break and the heads are too heavy.*)
- How are the criteria of the Griffin Tool Company different from those of Phil Fried? (*The Griffin Tool Company wants to make hammers that work well, are easy to use, and appeal to the most customers. Phil Fried wants them to be works of art.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *constraint*. Explain that *constraints* are things that limit or restrict something. What are Phil Fried's constraints? (*He is the only tester and cannot afford to do many tests.*)

Page 34

- Whose hammer will probably be more profitable? (*Phil Fried's hammers are more expensive. The hammers from the Griffin Tool Company will probably be more profitable because they work better and will last longer.*)
- Why would you buy one hammer over the other? (*I would buy a hammer from the Griffin Tool Company to use, and I would buy one of Phil Fried's hammers to show off.*)

Page 35

- What are the different ways that the Griffin Tool Company tests its hammers? (*The company tests with different types of nails and different types of swings.*)
- What are the advantages of having many types of tests? (*The company can find out if the hammer is too heavy for average people and if it will work with a variety of nails.*)

Know the Standards

SEP3. Planning and Carrying Out Investigations

In this lesson, students consider examples in order to explore the elements of a fair test in planning and carrying out an investigation.

Page 36

- Why is it helpful to have "blind" tests? (*You won't be influenced by any information, such as color or brand.*)
- How would you conduct a blind taste test of different brands of cereal? (*I would put a small amount of different cereals in different cups. I would blindfold the testers and have them taste each cereal to see which one they liked the best.*)

  CHALLENGE—Challenge students to develop procedures for a blind fair test. Have them establish criteria and conduct the test. Then have them share the results with the class, explaining what their controls and variables were and why the test was fair.

Page 37

- A test like this one involves comparing the performance of a new solution to the performance of an old solution. In the clothespin test, which type of clothespin is the control, and which type is the variable? (*The control is the older version of the clothespin. The new clothespin is the variable.*)
- What are some *criteria* in the clothespin test? (*The shirts will dry and stay on the clothesline.*)
- Why is it important that the shirts are the same weight and are hung in the same way? (*so the only difference between the two parts being compared is the clothespin*)
- How would the testers know if one clothespin was better than the other? (*if one shirt stayed on the line and the other fell off or if one shirt was clean and the clothespin stained the other shirt*)

3. Check for understanding.

Activity Page

AP 6

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A fair test is an attempt to answer a scientific question by controlling all variables except one and conducting several trials to make sure the result can be verified.

What details from the chapter support the main idea? (*There are examples of how to conduct fair tests for hammers and clothespins.*)

Have students complete Activity Page 6, and then together discuss the questions and answers.

See the Answer Key for sample or correct answers.

LESSON 7

How Much Data?

At a Glance

Lesson Question

How does the amount of data and how we collect it affect what we can learn from it?

Learning Objectives

- ✓ Relate a larger data set to a more reliable answer to a question.
- ✓ Characterize conclusions from data revealed for multiple trials as increasingly more reliable.
- ✓ Associate careful measurement with more helpful information.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

More data, and data collected carefully, provide better information in science.

NGSS and CCSS References

SEP4. Analyzing and Interpreting Data: Scientific investigations produce data that must be analyzed in order to derive meaning.

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

3.MD.B.3. Represent and interpret data.

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

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data **reliable** **sample**

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.

infer **population** **trial** **variable**

Instructional Resources

Student Reader

Ch. 7

Student Reader, Chapter 7
"How Much Data?"

Activity Page

AP 7

Activity Page
Data Picture (AP 7)

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

Ask students what they think of when they hear the word *data*. Guide the discussion so that students understand that data are the facts and statistics collected to provide evidence. People gather data by observing, questioning, counting, and measuring. Data help people prove that something is true or not true.

Show a simple video about collecting, representing, and analyzing data. After the video, discuss how much more understanding people have when they have data that support what they say. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How do the amount of data and how we collect it affect what we can learn from it?

2. Read and discuss: "How Much Data?"

Student Reader

Ch. 7

Prepare to read together, or have students read independently, Chapter 7 "How Much Data?" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 38

- What is a katydid? (*a cricket or grasshopper type of insect that can jump*)
- How many katydids are being counted in this first collection of data? (*ten*)
- Why might it be important to have data about a population of animals or plants? (*to see if a population is growing or dying out*)

  SUPPORT—Discuss Words to Know.

Discuss the word *sample*. Ask what it means if they get to try a sample of a new food. Guide them to understand that a sample is a part of a thing that may or may not represent a whole thing or group.

Page 39

- What problems could arise from counting just a small sample of katydids? (*The sample may not represent the whole group, and any conclusions may be wrong.*)
- Why do people rely on samples to gather data? (*You can't count every single thing, so you get an idea of how many by counting a sample.*)
- Why might data from a bigger sample be the same or more reliable than a small sample? (*It could be the same, but getting a bigger sample would help support the data. It could also be different because you didn't collect enough of one thing or another in the small sample.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *reliable*. Explain that *reliable* is related to the word *rely*. Talk about what it means to rely on someone or something to develop the idea that if something is reliable, you can trust it.

Page 40

- What types of data could be used to help figure out what is wrong with the onions? (*Count how many plants are sick. Observe how many have floppy, brownish leaves. Count onion flies or other insects that might make the plants sick.*)
- What techniques could be used to collect these data? (*Observe and then record each day for several days how many plants are sick and how many flies are seen.*)

Page 41

- Why is it important to know how big the onion flies are? (*Students need to cover the plants with mesh that is the right size to keep the flies out so they will not lay their eggs on the onions. Mesh that is too small will make the plants too hot. Mesh that is too big will allow the flies to get in.*)
- How did the students gather data on the size of the onion flies? (*They caught some flies and measured them. Then they could select mesh that was the right size to keep them away from the plants.*)

Know the Standards

SEP4. Analyzing and Interpreting Data

In this lesson, students explore how collecting data from small and large samples compares to learn that larger sample sizes provide more reliable data than smaller sample sizes.

Page 42

- How did the students collect data about how long it takes for a pupa to change into a butterfly? (*They set up a tank with a caterpillar and some plants and then observed when the pupa forms, drew a picture each day, and noted any changes.*)
- Why might the students have gotten different results? (*There were different types of caterpillars; the conditions were different.*)
- Was the trial worthwhile? (*Yes. We observed the life cycle of a butterfly. Not all butterflies have the same time spans for the pupa stage.*)

Page 43

- What did the students learn about the length of the pupa stage of the example spark butterfly? (*The average length was ten days but never shorter than six days or longer than fourteen days.*)
- What conclusions can you draw about collecting data from different sample sizes. (*You can collect data from a small sample, but it may not be reliable. Collecting data at various times with larger samples will make your data more reliable. Science knowledge is always growing.*)
- What could go wrong if your sample is not reliable? (*When someone else collects data, it could be different. You could also make conclusions and decisions that are not right and result in poor choices.*)

3. Check for understanding.

Activity Page

AP 7

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. More data are more reliable than data from a small sample size.

Distribute Activity Page 7 to students, and go over the expectations. After students respond individually, discuss the questions and answers as a class.

See the Answer Key for sample or correct answers.

Know the Science

This lesson and the Student Reader chapter greatly simplify statistical analysis to first introduce students to the generalizations that more data are better and carefully collected data are better. In the “real science world,” even when comparing two huge data sets to determine which has the larger average, just calculating average value for the two and comparing them is not sufficient to determine if there is a significant difference between the two data sets. Standard deviations and other statistical parameters must be calculated to ensure that the variability within each of the two data sets is not so large that it makes comparison of their average values an unacceptable way to determine the statistical significance of the resultant comparison. From an early age, people need to be wary of statistics so that they are not willing to accept any number someone with an agenda provides, no matter what the size of their sample.

LESSON 8

About to Exactly

At a Glance

Lesson Question

What's the difference between describing, measuring, and estimating?

Learning Objectives

✓ Describe and contrast quantities through estimation.

✓ Quantify by measurement.

✓ Differentiate reliable measurement from imprecise quantification.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- small-group activity

Main Science Idea

Size and quantities of things can be loosely described or estimated, or they can be counted or measured precisely.

NGSS and CCSS References

SEP5. Using Mathematics and Computational Thinking: Mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks, such as recognizing, expressing, and applying quantitative relationships.

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.

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

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describe **estimate** **measure**

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.

quantity/quantify **temperature** **time** **volume** **weight**

Instructional Resources

Student Reader

Ch. 8

Student Reader, Chapter 8
"About to Exactly"

Activity Page

AP 8

Activity Page
Describing, Estimating, and Measuring (AP 8)

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project images/video for whole-class viewing
- rulers, measuring tape, scale, beakers, thermometers, clock or stopwatches
- small cups of water
- various objects such as pencils, water bottles, markers, glue, lukewarm water
- hand weight

Advance Preparation:

- Gather materials and set up stations for AP 8.

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Project an image of animals by a watering hole. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**). Ask students to notice all the different things they see in the image. Guide students so they begin describing the things they see using mathematical descriptions of size and quantity. For example, they can describe the size of some things, how many things they see, what the temperature is, and the size of the plants and animals.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What's the difference between describing, measuring, and estimating?

2. Read and discuss: "About to Exactly."

Student Reader

Ch. 8

Prepare to read together, or have students read independently, Chapter 8 "About to Exactly" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Pages 44–45

- Ask students to point out the different objects and the way they are described. Have them share what the description is saying; i.e., is this object big, small, etc.? Challenge students to come up with other ways to describe the object.
- Have students look around the room. Can their descriptions describe other objects? Which ones? If not, can they come up with new descriptions? Are these descriptions exact or not exact? (*not exact*)
- Guide students to think about why descriptions like these are used. Show students a ruler and/or measuring tape. Why would people use inexact statements to describe objects instead of using these tools? (*Sometimes it is hard to measure things, so you use descriptions like this. It's faster and easier.*)

Page 46

- What does it mean to estimate something? (*Estimate means to carefully guess how much or how many*). What tools do you need to estimate? (*You don't need tools; you use your five senses*).
- Tell students that in order to estimate, you need to be able to compare something to a measurement that you already know. Practice estimating things in the classroom by comparing them to a known measurement. What are some measurements we know and can use in our classroom? (*We know our heights and that the room temperature is usually 70 degrees Fahrenheit.*)
- Practice estimating height by sharing your height with students. Ask a student to stand next to you. Ask students to estimate their own height by standing next to you. Estimate temperature by reminding students that room temperature is about 70 degrees Fahrenheit. Next, ask students to estimate the quantity of something, like the number of desks in the room.

Page 47

- Continue practicing estimating. Ask students to identify something they know the weight of. Examples may be a cat or dog, their own weight, or a hand weight that you pass around. Estimate volume by asking them to describe how much water is in their water bottles or in a cup of water. Last, ask students to describe time by estimating something like the length of the school day or the length of their favorite TV show.
- Ask students to reflect on the pros and cons of using estimates and descriptions. (*Students may discuss how estimating and describing are easier to do because you don't need tools and you don't need to be exact. Some cons are that you may not be accurate and that your descriptions may not be clear to someone else.*)

Page 48

- What does it mean to measure something? (*Measuring uses tools to find an exact number.*)
- What is the difference between estimating and measuring? (*When you estimate something, you don't use tools or exact numbers. When you measure something, you use tools and exact numbers.*)
- Why do we use tools when we measure something? (*Tools give us exact measurements.*)

Page 49

- What are some tools we can use to measure . . .
    - Height? (*We can use a tape measure or ruler.)*
    - Temperature? *(We can use a thermometer to measure temperature.)*
    - Weight? *(We can use a scale to measure weight.)*
    - Volume? *(We can use measuring cups, beakers, or graduated cylinders to measure volume.)*
    - Time? *(We can use a stopwatch or clock to measure time).*

Demonstrate the uses of a selection of instruments. Hold up an object such as a folder, book, or bag. Demonstrate using the available tools to measure the height and weight. Then measure the temperature and volume of a cup of water using a measuring cup and thermometer. Last, ask students to time an activity using the stopwatch.

3. Check for understanding.

Activity Page

AP 8

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Size and quantities of things can be loosely described or estimated, or they can be counted or measured precisely.

Use the activity page to check for student understanding of the main idea and Core Vocabulary (describe, measure, estimate). Students will practice describing, estimating, and measuring the quantity and size of objects.

Have a station set up for each row/object in the table so students can describe, estimate, or measure. Students should rotate through the stations. Describe the activity page to students, telling them that they should choose objects that they can measure using the tools available.

Two objects are pre-chosen for students and filled into the activity page for them. For volume, students should use the cup with water. For time, students can estimate the time it takes for them to tie their shoe.

> **SUPPORT**—Help students by giving an example of each quantity and size in the table. Demonstrate how to use each of these tools to students. Remind students that the beaker should be placed flat on a table in order to get an accurate measurement.

See the Answer Key for sample or correct answers.

LESSON 9

Relationships

At a Glance

Lesson Question

What can observing relationships between objects or events teach us?

Learning Objectives

- ✓ Construct a relational explanation from provided observational evidence.
- ✓ Recognize a case in which observed evidence does not provide sufficient support for an explanation.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

When two things are related, it means there is some sort of connection between them. Close observation can help us figure out the nature of the relationship.

NGSS and CCSS References

SEP6. Constructing Explanations and Designing 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.

RI.3.8. Integration of Knowledge and Ideas: Describe the logical connection between particular sentences and paragraphs 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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cause **effect** **explanation** **relationship**

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evidence **observation**

Instructional Resources

Student Reader

Ch. 9

Student Reader, Chapter 9
"Relationships"

Activity Page

AP 9

Activity Page
Evidence and Explanations (AP 9)

Materials and Equipment

Collect or prepare the following items:

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

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Watch the video "My dad is a space alien." (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) What observations make them think the dad is an alien? Have students answer the question and describe why they think so. Tell them that in this lesson, they will be thinking about how they can use observations to support their answers to questions.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What can observing relationships between objects or events teach us?

2. Read and discuss: "Relationships."

Student Reader

Ch. 9

Prepare to read together, or have students read independently, Chapter 9 "Relationships." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 50

- Compare how we generally talk about relationships with the way scientists talk about relationships. (*We usually talk about people having relationships like being married or in the same family. Scientists talk about relationships between things and how these things are connected or change each other.*)

- What might it mean when scientists say that a relationship is between things and how the things change each other? (*It might mean that the things interact. If two things are related, when one thing changes, the other thing changes, too.*)

  SUPPORT—Give examples of the normal use and scientific use of the words *related* and *relationship* (e.g., siblings vs. how the more food you eat, the fuller you feel). Focus on how the normal use of the word *related* describes how people or things are connected by blood or an emotional connection. The scientific use of the word *relationship* describes how things change or impact each other.

Page 51

- Practice identifying relationships and how one thing impacts the other. Write the following pairs on the board. Have students describe these relationships.
  - age and height (*As age increases, height increases*.)
  - amount of studying for a test and grade (*As amount of studying increases, grade increases*.)
  - amount of food eaten and feeling full (*As amount of food eaten increases, the feeling of being full increases*.)

    As you go through these responses, emphasize that the main point is that these two things change *together.*

Page 52

- Work with students to come up with different examples of relationships that use the stem "As ________ increases, ________ decreases". (*Sample answer: As the amount I eat increases, my feeling of hunger decreases*.)
- Work with students to come up with a definition for the words *cause* and *effect*. (*A cause is WHY something happens. An effect is WHAT happened as a result of something else.*)
- Review the example relationships in the chapter so far, and write them on the board. Have students practice identifying the cause and the effect in these relationships. (*Possible answer: Cause more cooking time; Effect: jam temperature increases*.)

Page 53

- Why can't Ms. Sophos and Prentis explain the relationship between shoe size and number of words spelled correctly? (*They don't have enough evidence yet. They need to know more to figure it out*.)
- Ask students to define the word *explanation.* (*An explanation is the cause. It is the reason that something happened.*) In the example, what is the explanation for the changes? In other words, what caused the changes? (*Time and growing older caused more spelling words to be spelled correctly.*)

Page 54

- What is the explanation for the changes in the example on this page? (*We need to know more in order to figure out the cause/explanation*.)
- Why is the bulletin an important piece of information? (*It describes how the trees and deer are connected.*) Is this enough information to understand the relationship between height of tree saplings and wolves? (*Not yet. We don't know how wolves are connected yet.*)

Page 55

Ask students to identify the evidence that was missing when we looked at the graph. (*The deer eat tree saplings. As the number of deer increases, the sapling height decreases. Also, wolves eat deer.*)

- Have students pair-share an explanation for the relationship between sapling height and wolves. (*Deer eat tree saplings. Wolves scare or eat deer. If there are fewer deer, the trees aren't eaten and can grow taller.*)

3. Check for understanding.

Activity Page

AP 9

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. When two things are related, it means there is some sort of connection between them. Close observation can help us figure out the nature of the relationship.

Use Activity Page 9 to evaluate student understanding. Have students answer individually, and then discuss the questions and answers together.

See the Answer Key for sample or correct answers.

LESSON 10

Believing Versus Knowing

At a Glance

Lesson Question

What's the difference between fact and opinion?

Learning Objectives

✓ Define *fact*.

✓ Define *opinion*.

✓ Describe what a hunch is and explain its limitations.

✓ Differentiate provided facts and opinions.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- facts and opinions game

Main Science Idea

Facts are verifiable as true. Opinions or beliefs are what a person thinks or feels. Opinions and beliefs might not be true.

NGSS and CCSS References

SEP7. Engaging in Argument from Evidence: Argumentation is the process by which evidence-based conclusions and solutions are reached. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits

RI.3.4. Craft and Structure: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.

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.

fact **hunch** **opinion**

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.

fossil **paleontologist** **verify**

Instructional Resources

Student Reader

Ch. 10

Student Reader, Chapter 10
"Believing Versus Knowing"

Activity Page

AP 10

Activity Page
Fact or Opinion? (AP 10)

Materials and Equipment

Collect or prepare the following items:

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

Advance Preparation:

- Cut out cards for the Fact or Opinion? matching game. (optional)

The Core Lesson

1. Focus attention on the Lesson Question.

Engage students in a short discussion on fact and opinion. Read each statement aloud one at a time. After each statement, ask students to raise their hands if they think the statement is true.

Statements:

- Dogs need food and water to survive. (fact)
- Dogs are the best pets in the world. (opinion)
- Caterpillars turn into butterflies. (fact)
- Butterflies are the most beautiful creature I've ever seen. (opinion)

Tell students that the reason many people agreed with some statements is because the statements are facts. Not everyone agreed with some statements. Those are opinions. Today they will be thinking about these two ideas.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What's the difference between fact and opinion?

2. Read and discuss: "Believing Versus Knowing."

Student Reader

Ch. 10

Prepare to read together, or have students read independently, Chapter 10 "Believing Versus Knowing." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 56

- Define *opinion* in your own words, and give an example of an opinion. (*Sample answer: An opinion is something that you think or feel, and not everyone thinks the same way. An example is that I think spaghetti is the best dinner food.*)
- Define *fact* in your own words. Give some examples of facts that you know. (*Sample answer: A fact is something that has been proven. An example is that I was born on August 5.*)

Page 57

- What does it mean when it says that you cannot verify an opinion? (*It means that opinions aren't fact, so you can't prove them to be true or false.*)
- After the statement "For example, you might have a hunch that your little sister ate most of the jellybeans. Is this an opinion or fact?" have students pair-share their answer and defend their choice. (*It remains an opinion until it can be verified with evidence. Then it might turn out to be a fact!*)
- What's the difference between a hunch and an opinion? (*A hunch is a guess, or an idea you have about something. It's different from an opinion because you can verify it by looking for evidence.*)

Page 58

- After reading each paragraph aloud, ask students to reread the paragraph and differentiate facts, opinions, and hunches.
- Focus on the last paragraph. Ask students to defend their responses. (*Since the text uses the term "idea," students should state that this is a belief or hunch. It is a hunch because it is based on evidence and, with more evidence, can be verified.*) Ask students to describe what was needed in order to try to verify this idea. (*They needed more evidence.*)

Page 59

- After reading each paragraph aloud, ask students to reread the paragraph and identify any facts, opinions, or hunches.
- What other kinds of fossils do you think scientists use to learn more about the past? (*dinosaurs, plants, other animals, eggs*)

Know the Standards

SEP7. Engaging in Argument from Evidence

In science, students engage in argumentation as a process for reaching agreements about explanations and solutions. They use reasoning and arguments based on evidence, making it essential that students are able to identify the best explanation for phenomena. Being able to differentiate between fact, opinion, and hunches is a necessary foundation to engaging in arguments.

- Paleontologists study dinosaurs and other prehistoric creatures. What are some facts they might know, some beliefs they might have, and some hunches? *(They know that dinosaurs lived millions of years ago. A belief they might have is that dinosaurs and the past are very interesting. It used to be a hunch that dinosaurs were related to birds. Evidence has changed that to a scientifically accepted fact.)*

Page 60–61

- Before reading the following pages, review the definitions for *fact*, *verify*, *opinion*, and *hunch*. (*Facts can be verified. Opinions are feelings or beliefs about something. Verify means to use evidence to tell whether something is true or false. Hunches are based on feelings or beliefs but can be verified.*)
- Tell students that the author of this chapter has identified each of the highlighted sentences as facts, opinions, or hunches. As you read each statement, have students defend the author's choice for each claim. (*Students should describe how facts can be verified, opinions are beliefs or preferences that don't involve verification, and hunches are feelings or beliefs that can be verified.*)

3. Check for understanding.

Activity Page

AP 10

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Facts are verifiable as true. Opinions or beliefs are what a person thinks or feels. Opinions and beliefs might not be verifiably true.

Use the Activity Page 10 game to reinforce and assess student understanding of facts and opinions.

Cut out each of the game cards. Assign students to pairs, with a set of game cards for each pair. They should shuffle the cards and deal five cards face down to each person. The remaining cards go in a stack face down.

Turn over the top card of the stack. The first student must play either a card that matches the topic (e.g., dinosaurs, cats) or a card that matches the type (fact or opinion). If the student plays a card incorrectly or is unable to play a card, they must draw a card from the stack and return the incorrectly played card to their hand.

The first student to get rid of all of their cards wins.

See the Answer Key for sample or correct answers.

LESSON 11

Spotting Evidence

At a Glance

Lesson Question

How can we spot good evidence in things we read about science?

Learning Objectives

✓ Appraise sample text passages for inclusion of factual evidence as a strength.

✓ Differentiate stronger from weaker text passages based on the inclusion of relevant versus irrelevant information.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- research practice

Main Science Idea

When we read about science topics, we should look for facts that matter to the topic. Opinions, or even facts that are true but not related to the topic, are red flags that should make us consider whether or not what we are reading is good information.

NGSS and CCSS References

SEP8. Obtaining, Evaluating, and Communicating Information: Scientists and engineers must be able to clearly communicate their ideas. Critiquing and communicating ideas is a critical activity in science. To do so, scientists and engineers must be able to evaluate the merit and validity of claims, methods, and designs.

RI.3.2. Key Ideas and Details: Determine the main idea of a text; recount the key details and explain how they support the main idea.

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

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evidence **relevant**

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.

fact **irrelevant** **opinion**

Instructional Resources

Student Reader

Ch. 11

Student Reader, Chapter 11
"Spotting Evidence"

Activity Page

AP 11

Activity Page
Endangered Species Library Activity (AP 11)

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
- newspapers

Advance Preparation:

Partner with a school librarian to prepare a collection of books or student web resources about various endangered animals. Students will search for facts and opinions in these resources to complete the activity page and participate in a small-group exercise.

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Display images of newspaper headlines. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Read the headlines aloud to students. Ask for student volunteers to talk about what they think about the different headlines. Which headlines do they think are backed by science data? Why? What makes a newspaper headline and the article trustworthy?

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How can we spot good evidence in things we read about science?

2. Read and discuss: "Spotting Evidence."

Student Reader

Ch. 11

Prepare to read together, or have students read independently, Chapter 11 "Spotting Evidence." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 62

- Tell students that when you learn more about something before a presentation or writing a paper, this is called doing research. Ask if anyone has ever done research before. Refer to CK Science *Habitats and Change* activities in which they may have conducted research, specifically "Suited for Survival" (Lesson 6), "How Do Beavers Change the Environment?" (Lesson 7) and "Local Environmental Project" (Lesson 12).
    - Ask students to describe their research. Where did they get their information? How did they know they were using good evidence? (*They might share websites or textbooks that they read and that the facts were true or that the facts showed up in a few different trustworthy places and so were accurate*).
    - Why might it be important to do research before making a presentation? (*Students may say that it is important to learn more about something and not just make things up.*)

Page 63

- Review the main idea from Lesson 10: Facts are verifiable as true. Opinions or beliefs are what a person thinks or feels. Opinions and beliefs might not be true. Discuss the meaning of *verifiable* and how that can help distinguish between facts, opinions, and hunches.
- Ask students to think about what they should look for in a text to know if it uses good evidence. (*I think I will look for information that is factual and does not include beliefs or hunches.*)
- Create a T-chart on the board with the headings "Good Evidence" and "Not Good Evidence". Ask students to help you complete the chart with tally marks to indicate the type of evidence in the passage, or if they are reading on their own, they should complete charts of their own. Review as a class.

Page 64

- Create another T-chart on the board for this passage for students to contribute to and review.
- Have students turn to a neighbor and think about the prompt on the bottom of page 62: "Think about which one you would choose and why. Do you think that both of them will help you with your presentation?" Encourage students to use the T-chart as data to defend their claim. (*We think that the second passage should be used the most. It has fewer opinions and has more facts in it.*)

Page 65

- Discuss as a class if the last sentence on page 64 about the bear named M34 is relevant or not. Accept all answers, but guide students to remember that the statement must focus on the topic.
- Give a few examples of relevant vs. nonrelevant statements. Have students identify which is relevant and which is nonrelvant. For example,
    - Topic: The giraffe and its adaptations
    - Relevant: The long neck of the giraffe allows it to reach leaves on very tall trees.
    - Not relevant: The savannah, where the giraffe lives, can be very hot.
    - Topic: How can plants survive in the desert?
    - Relevant statement: Cactus can go long periods of time with no water.
    - Not relevant statement: Some cactus parts can be used as medicine.

Page 66–67

- Again, work with students to create T-charts for both passages, with one side labeled "Relevant" and the other "Not Relevant". Ask students to defend their reasoning for their choices.
- Ask students to silently think about and decide which passage they would choose. Once they have decided, tell students who would use Passage 1 to stand in one corner of the room, students who would use Passage 2 to stand in another corner, and students who would use both Passages 1 and 2 to stand in yet another corner. Tell them they will be asked to defend their answers. After allowing time for groups to discuss, have students share and debate the merits of all ideas. (*Encourage students to discuss all ideas and give evidence for their claims before revealing that Passage 1 includes more relevant statements.*)

3. Check for understanding.

Activity Page

AP 11

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. When we read about science topics, we should look for facts that matter to the topic. Opinions, or even facts that are true but not related to the topic, are red flags that should make us consider whether or not what we are reading is good information.

In this activity, place students in small groups of three or four (depending on class size) with the goal of researching and writing about an endangered animal that interests them and why this animal is endangered. Distribute Activity Page 11, and go over expectations with students before providing them with library resources.

As students present, ask the class for their help in making sure the presentation uses facts and all the statements are relevant to the topic. Challenge students to identify irrelevant information and non-fact-based statements. Practice using positive criticism and identifying ways to improve (again, focusing on facts and relevancy).

Online Resources

Please refer to the Online Resources Guide for suggested research sites. **www.coreknowledge.org/cksci-online-resources**

See the Answer Key for sample or correct answers.

LESSON 12

Patterns as Evidence

At a Glance

Lesson Question

How can patterns be used as evidence to support explanations?

Learning Objectives

✓ Detect a pattern in data.

✓ Use the pattern to form and articulate an explanation.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- class game

Main Science Idea

Some patterns can help us describe how predictable things happen. They can also help us figure out and explain why things happen.

NGSS and CCSS References

CCC1. Patterns: The existence of patterns naturally suggests an underlying cause for the pattern. Patterns are also helpful when interpreting data, which may supply valuable evidence in support of an explanation or a particular solution to a problem.

RI.3.3. Key Ideas and Details: Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

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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evidence **explanation** **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.

data **observation** **process** **question**

Instructional Resources

Student Reader

Ch. 12

Student Reader, Chapter 12
"Patterns as Evidence"

Activity Page

AP 12

Activity Page
Peppered Moths Survival
(AP 12)

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project images/video for whole-class viewing
- pattern blocks, counters, math cubes, buttons, candies, or other materials to create simple patterns
- computers or tablets for each student or pair of students

Advance Preparation:

- Practice playing the Peppered Moth Game.

THE CORE LESSON

1. Focus attention on the Lesson Question.

Project or draw a simple pattern on the board, such as red circle, blue circle, red circle, blue circle, red circle. Ask students to determine what comes next and to describe why they think this.

Draw increasingly difficult patterns by incorporating repetition of different shapes or layouts.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How can patterns be used as evidence to support explanations?

2. Read and discuss: "Patterns as Evidence."

Student Reader

Ch. 12

Prepare to read together, or have students read independently, Chapter 12 "Patterns as Evidence." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 68

- Ask students to describe what a pattern is, using their own words. (*something that happens over and over again*) Why are patterns important? (*They help us explain our observations*.)
- Using the snowflake pattern as an example, review the process scientists used:
    - Ask a Question: What question are they trying to answer? (*How are snowflakes formed?*)
    - Observe and Gather Data: What do they observe? (*They looked at many snowflakes*.)
    - Find Patterns: Is there a pattern in the data? (*They saw that every snowflake has six sides*.)
    - Make Explanations: What explanation did they come up with based on their observations? (*Water forms a six-sided crystal when it freezes*.)

Page 69

- Before reading the text, ask students to talk about what they have noticed when looking at clouds. Write their responses on the board. Tell them that they were making observations, just like scientists make observations.
- After lots of observations, scientists noticed patterns in the clouds. What were those patterns? (*1*) *Clouds come in just a few shapes, 2*) *different cloud types form at different heights, and 3*) *sometimes events happen together in a pattern, like rain, thunder, and lightning happen with cumulonimbus clouds*.) Remind students that these observations and patterns are evidence.

Page 70

- Ask students to define the word *precipitation*. (*liquid and solid water that falls from the sky*) What do you think scientists were trying to find out about precipitation? (*Students may think of some variation of: How are the different types of precipitation formed?*)
- Ask students to identify the patterns between the types of precipitation. (*Rain is always liquid at the surface, and snow is always solid/frozen at the surface. Snow is always below 32ºD at the surface, and rain is always above 32ºF at the surface*.)

Page 71

- After reading the explanations, ask students if they agree with the explanation based on the evidence. Was it similar to their own explanation? (*Yes, I agree with this explanation, and it is based on the evidence. It was similar to my own explanation*.)
- Remind students that as they were walking through the process, they were being scientists by thinking about patterns and coming up with explanations. Point out that we wouldn't be able to come up with explanations without first asking questions, gathering evidence (observations), and looking for patterns.

Know the Standards

CCC1. Patterns

Patterns are the bridge between explorations and the scientific explanations that describe *why* things happen the way they do. In grade 3, students should be working toward identifying similarities and differences in their observations to discern patterns. Students use these patterns to connect the scientific explanation to their evidence.

- Why is looking for patterns so important? Would we be able to come up with explanations without looking for patterns? (*Looking for patterns is important because we have to organize the data in a way that makes sense. Patterns help us see the important parts of the data that help us come up with an explanation. Patterns connect the data to the explanation.*)

Page 72

- After looking at the image, ask students what scientific question they have. (*I notice a figure eight. I wonder why the sun looks like that. My question is "What causes the sun to make a figure eight in the sky?"*)

Online Resources

SUPPORT—Analemmas can be a difficult and abstract concept for students to understand. For those that want more information, a video can be helpful. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Encourage students by telling them that the lesson is on patterns and acting like a scientist, not on the cause of analemmas.

- As the class reads, list the evidence on the board. Make and add to a list of patterns as you read the page. As you find a pattern, ask students if that is enough to come up with an explanation (*No!*)

Page 73

- Look at the picture of the sun at noon on the summer and winter solstices. Where do you think the sun would be in the fall and spring equinoxes? (*I think the sun would be somewhere in the middle of the solstices.*) Point at the different dates on the diagram on page 72, naming December 21 as the winter solstice, June 20 as the summer solstice, March 20 and September 23 as the spring and fall equinoxes.

ALERT—Although this section of the chapter talks about the sun's different positions in the sky, remind students that the sun is not moving—instead Earth is orbiting the sun.

3. Check for understanding.

Activity Page

AP 12

Online Resources

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Some patterns can help us describe how predictable things happen.

Engage students in playing a game that simulates changes in a moth population. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Students play as a bird and must click on the moths to "eat" them in both the light- and dark-colored forest. At the end of the game, students will see if they caught more camouflaged moths or non-camouflaged moths.

Distribute Activity Page 12, and go over expectations with students. Once students have gathered data and organized it into a chart, give them an additional piece of evidence. During the Industrial Revolution, trees became darkened by soot. Using all pieces of evidence, students should identify patterns and use these patterns to develop explanations.

See the Answer Key for sample or correct answers.

LESSON 13

Cause-and-Effect Detectives

At a Glance

Lesson Question

How can you do a test to isolate the cause of something?

Learning Objectives

✓ Summarize a process devised to determine the cause of an event or outcome.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

If you have a hunch about what causes something to happen, you can test the cause and effect to see if one thing really causes the other.

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.3.10. 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

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cause **control** **effect** **fair 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.

claim **compare** **isolate**

Instructional Resources

Student Reader

Ch. 13

Student Reader, Chapter 13
"Cause-and-Effect Detectives"

Activity Page

AP 13

Activity Page
Cause and Effect (AP 13)

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

Advance Preparation:

- Cut sentence strips.
- Find local TV or radio advertisements to share with students.

THE CORE LESSON

1. Focus attention on the Lesson Question.

Online Resources

Project the cause-and-effect images. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Have students volunteer ideas on what they think is happening in the scene. Guide them to identify that the boy is crying and that it might be because he fell off his bike and that the ice cream is melting because it is hot outside. Tell them that today, they will be thinking about how sometimes one thing makes other things happen. We call this cause and effect.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How can you do a test to isolate the cause of something?

2. Read and discuss: "Cause-and-Effect Detectives."

Student Reader

Ch. 13

Prepare to read together, or have students read independently, Chapter 13 "Cause-and-Effect Detectives." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 74

- The girl and boy have different claims about what is causing something to happen. What is the girl's claim? What is the boy's claim? (*The girl says that pruning makes the plant grow bigger. The boy claims that it might not be pruning that makes the plant grow bigger.*)
- What reasons does the boy give for his claim? What reason does the girl have? (*He says that the plant might grow bigger because the plant might have more nutrients or be farther apart from other plants. She says that when she cut the plant, it grew back bigger and had more leaves.*)

- What do you think they should do next to solve this argument? (*Accept all answers. Students may suggest that they plant new plants and cut some and make sure they have nutrients and space to grow.*)

Page 75

- Focus attention on the question written on the bag, "How would you prove that pruning the basil is what causes it to grow differently?" Ask students to turn to a neighbor and brainstorm an answer. Write ideas on the board. (*Accept all ideas. Students may suggest testing by growing new plants*)
- After reading the page, make a chart to identify the things that will be the same and the one thing that is going to be different in the test.
- What is the one thing that will be different? Why is this important? (*The only thing that will be different is pruning. This is important because if the plant becomes bushier, we will know that it is the pruning that caused the change, not the other things.*)

Page 76

- Review the definitions for *cause* and *effect*. Ask students to think back to the basil plant and pruning story. Practice identifying the cause and effect in that situation.
- Now focus on the term *fair test*. What does it mean to be fair? Ask students what they think *fair test* means? How can a scientific test be fair? (*Fair means that you aren't cheating or playing favorites. A scientific test can be fair by making sure that you are only testing one thing to make sure it's the cause.*)
- Focus on the word *isolate*. Review the definition of the term. (*put something alone*) Why is isolating the cause part of doing a fair test? (*When you are doing a test, you need to make sure that your test shows that only one thing is the cause of something.*)

Page 77

- Review page 75 and the chart you just created. Have students pair-share and identify the control and describe their thoughts. (*No pruning. This is the one that stayed the same. No changes were made to it.*)
- Look at the images on the page. Compare the control with the test plants. Write a sentence stating the cause and effect of pruning on basil plants. (*Pruning basil plants causes them to grow bushier.*)

Page 78

- Support students in writing a cause-and-effect sentence. Identify the hunch or idea that is described in the text. Then write the sentence. (*We think that animals eating the plants causes them to grow more spines*)
- Work together to describe a fair test to find out the cause. Support students by making a chart to identify the things that will be the same and the one thing that is expected to be different in the test.
- Based on the fair test, what is the control? (*the plant not eaten by animals*)

Page 79

- Again, practice writing a cause-and-effect sentence and describing a fair test. What could cause the butterflies to look different? Discuss the many differences between spring and summer. (*We think that the length of day in spring can cause the map butterflies to look different.*)

3. Check for understanding.

Activity Page

AP 13

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. If you have a hunch about what causes something to happen, you can test the cause and effect to see if one thing really causes the other.

Assess student learning and understanding of Core Vocabulary (*cause, effect, control,* and *fair test*) through this activity.

Distribute Activity Page 13, and go over the expectations. Have students work individually, then reconvene as a class to discuss their responses.

See the Answer Key for sample or correct answers.

LESSON 14

Maria's Model

At a Glance

Lesson Question

What are scale models, and how are they useful?

Learning Objectives

- ✓ Redraw a provided diagram at 1:4 and 1:10 scales.
- ✓ Categorize similarities and differences between a scale model and the real object, system, or event that it represents.
- ✓ Describe a case in which a scale model would be useful.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- scale drawing exercise

Main Science Idea

Scale models are useful tools for teaching and learning. They can help us figure out solutions and explain concepts and processes to others.

NGSS and CCSS References

SCCC3. 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. Scale, proportion, and quantity are essential considerations when deciding how to model a phenomenon.

RI.3.1: Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

3MD.B.4. Represent and interpret data. (Also **3.G.A.2**)

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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scale 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.

elevation **hatchlings** **incubate** **predators** **vulnerable**

Instructional Resources

Student Reader

Ch. 14

Student Reader, Chapter 14
"Maria's Model"

Activity Page

AP 14

Activity Page
Drawing to Scale (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

Ask students what they think of when they think of a *scale model*. Some may think of building or playing with model cars, trains, or airplane toys.

Present a video showing the building of a scale model. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, discuss what types of models students have used, built, or played with. Then reinforce the idea that the scale model is just like the real thing, only smaller. Show a video of different scales of trains or cars so students can see how different scale models have the same proportions but different sizes. A G scale train is 1:22.5, an O scale train is 1:48, an HO scale train is 1:87, an N scale train is 1:160, and a Z scale train is 1:200.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What are scale models, and how are they useful?

2. Read and discuss: "Maria's Model."

Student Reader

Ch. 14

Prepare to read together, or have students read independently, Chapter 14 "Maria's Model." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 80

- What types of toys do you know of that are scale models? (*model cars, model planes, kitchen sets, dollhouses, train sets*)
- What is a scale model? (*a smaller or larger version of a real thing*)
- What concern does Maria have? (*She is concerned that human activities are harming loggerhead turtles.*)

  SUPPORT—Discuss Words to Know.

Discuss the term *scale model*, which is a smaller or larger version of a real thing that has the same proportions as the real thing. Introduce the words *dimension* and *proportion*. Explain that a dimension is the measurement, or the length, height, or width, of an object. The *proportion* is one size in comparison to another. Provide examples such as a book that is twice as tall as it is wide. Explain that a scale model has the same proportion as the real thing, although it is smaller or larger.

Page 81

- Why is Maria assembling a scale model? (*to show how coastal development and other human activities are affecting loggerhead sea turtles*)
- What are the advantages of a scale model as opposed to visiting the beach? (*The model can be moved, and it can be used to demonstrate to lots of different people what is happening. The model allows Maria to explain the problem regardless of the weather or time of year without endangering the turtles with crowds of people.*)
- What if Maria built her model to a scale that was too big or too small? (*It might be too big to move from place to place or too small for people to see the detail.*)

Page 82

- What does the scale 1:36 mean? (*If the real thing is 36 feet tall, it is 1 foot tall in the model.*)
- What is the difference between a scientific scale model and a toy? (*Scientific scale models have all the same details and dimensions as the real thing so the thing can be carefully studied.*)

Page 83

- Why does Maria include details about the upper part of the beach? (*She wants people to see how close the turtles are to the beach and what threats they might encounter.*)
- What are some other ways Maria could make her point? (*She could show photographs, present data about the decline of the turtle population, create a slideshow or video, or just talk about it.*)
- Why might the scale model be an effective way to describe the threats to the turtles? (*People can see how close the threats are and understand why Maria is concerned.*)

Know the Standards

SCCC3. Scale, Proportion, and Quantity

In this lesson, students explore how scale models can be used to show and explain scientific phenomena.

Online Resources

SUPPORT—Ask students what they know about turtles. Show a video about sea turtles. Discuss the hazards the hatchlings have in getting to the water. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Page 84

- What hazards do baby loggerhead sea turtles face? (*They must travel a long way from the nest to the ocean and could be stuck in obstacles, get eaten by predators, get too much sun, or get smashed by vehicles. In the nest, the eggs could be eaten or smashed.*)
- How is a map like and different from the type of scale model that Maria built? (*It is drawn to scale, but it is flat and not three-dimensional.*)

  CHALLENGE—Challenge students to build or share a scale model with the class and explain its scale.

Page 85

- What different types of scale models are you aware of? (*Possible answers: maps, dioramas, movie props, building models, battle plans, floor plans*)
- How could you use a scale model to explain how a new building will affect an environment? (*You could make a model of an existing area next to a model of the same area with the new building and look for issues.*)

  SUPPORT—For support with comparing scales, discuss why a scale model that is 1:10 would be bigger than a scale model that is 1:100 of the same thing. Reinforce the idea that a 1:10 model is 10 times smaller than the real thing and that the 1:100 scale model is 100 times smaller than the real thing.

3. Check for understanding.

Activity Page

AP 14

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Scale models are useful tools for teaching and learning. They can help us figure out solutions and explain concepts and processes to others.

What details from the chapter support the main idea? (*Maria's 1:36 scale model helped her show how the loggerhead turtles were being threatened.*)

Distribute Activity Page 14, and go over expectations with students. The math concepts of ratios and proportions are beyond the grade level. However, making 1:4 and 1:10 scale drawings on the grid is a concrete exercise that utilizes simple counting. Coach students through what 1:4 scale means. It means something shown as 4 units in the big version will appear as 1 unit in the smaller version. A scale of 1:10 means something shown as 10 units in the big version will appear as only 1 unit in the smaller version.

See the Answer Key for sample or correct answers.

LESSON 15

Open and Closed Systems

At a Glance

Lesson Question

What are open and closed systems?

Learning Objectives

✓ Describe characteristics of a closed system.

✓ Determine what makes provided examples open systems.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Open systems allow both energy and matter to move across their boundaries. Closed systems only allow for the movement of energy across their boundaries.

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.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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system

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energy **functioning** **interact** **matter**

Instructional Resources

Student Reader

Ch. 15

Student Reader, Chapter 15
"Open and Closed Systems"

Activity Page

AP 15

Activity Page
A System: Open or Closed?
(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

Ask students what they think of when they think of a *system*. Some may think of a plumbing system or a system of roads and bridges.

Present a video showing the parts of a weather system. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, make a class list of the parts of the weather system: sun, water, wind, pressure, landforms, air, atmosphere. Talk about how these different parts work together or interact to create different types of weather patterns.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What are open and closed systems?

2. Read and discuss: "Open and Closed Systems."

Student Reader

Ch. 15

Prepare to read together, or have students read independently, Chapter 15 "Open and Closed Systems." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 86

- What is a system? (*a set of things that work together*)
- What are some examples of systems that you know? (*Possible answers: the digestive system, the circulatory system, information system, highway system, air traffic system*)

- What type of system is a cell phone part of? (*information system to receive information, communication system to talk to others, gaming system to play games*)

  SUPPORT—Discuss the word *system,* a set of connected parts that form a whole thing that does a job. Guide students to realize that systems are all around us. People identify systems so they can study the parts to learn how they work together to understand more about the world.

Page 87

- What is an open system? (*a system that interacts with other systems*)
- What is a closed system? (*a system in which matter does not enter or leave*)
- Can Earth be both an open and a closed system? (*It can be considered closed when you define the system as a single planet. It can be considered open when you think of it as part of the solar system.*)
- What is the difference between an open and a closed system? (*A closed system is one in which matter does not enter or leave the system. In an open system, matter and energy can flow in and out.*)

Page 88

- Why is an insulated container a closed system? (*When closed, matter does not move in and out of it even though heat energy slowly escapes.*)
- Why is ocean water an open system? (*Matter and energy move in and out of it, interacting with other systems.*)
- Is a weather system an open or closed system, and why? (*an open system because air and water move in and out of it*)

Page 89

- Can an object be both an open and closed system? (*Yes, it could be closed for matter but open for energy.*)
- Why does it matter whether a system you are studying is open or closed? (*If you are studying a closed system, you only need to study the parts in the closed system. If you are studying an open system, you need to consider how the system interacts with other systems.*)

Online Resources

SUPPORT—Watch a video about salt marshes. Then discuss the different parts of a salt marsh system, including birds, grasses, salt water, fish, and peat. Discuss the importance of understanding the open system of a salt marsh. If something becomes damaged, it can affect all the other systems, including plants, animals, and flood protection.

Page 90

- Why is a hurricane an open system worth studying? (*The wind and water of a hurricane move in and out of the hurricane system and interact with other systems, sometimes causing great damage to other systems, such as an electrical system or a highway system.*)

Know the Standards

CCC4. Systems and System Models

In this lesson, students explore examples of open and closed systems.

- Is a closed system better than an open system? (*No system is better or worse than another. The defined system identifies the parts that are being studied.*)

  CHALLENGE—Challenge students to identify an open system and a closed system and describe their conclusions to the class.

Page 91

- Why is a fertilized egg an open system? (*Oxygen moves in, and carbon dioxide moves out, which allows the chick to grow until it is big enough to break out of the shell.*)
- Why is a sewing machine a closed system? (*The only thing that goes in and out of the system is energy. No matter enters or leaves the system.*)
- How would you know that what you thought was a closed system was really an open system? which is something that is made up of (*if the state of matter changed, if the food in a container rotted, or if the system was affected by other elements*)

3. Check for understanding.

Activity Page

AP 15

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A system of parts that work together can be closed or open. If matter or energy can get in or out of the system, it is open. If matter or energy cannot get in or out, the system is closed. A system can be closed to matter but open to energy.

What details from the chapter support the main idea? (*There are many examples of open and closed systems.*)

Have students complete Activity Page 15, and then together discuss their responses.

See the Answer Key for sample or correct answers.

LESSON 16

Water: One Matter Cycle

At a Glance

Lesson Question

What is a cycle?

Learning Objectives

✓ Define a cycle as a repeating process.

✓ Describe familiar cycles in terms of what happens to objects/matter in the systems.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Matter moves around on Earth. Water is one example of a type of matter that moves around in a big and complex cycle. A cycle is a repeating process.

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. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs.

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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cycle **matter**

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.

atmosphere	**biosphere**	**hydrogen**	**molecule**
oxygen	**tides**	**transpiration**	

Instructional Resources

Student Reader

Ch. 16

Student Reader, Chapter 16
"Water: One Matter Cycle"

Activity Page

AP 16

Activity Page
Cycles (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

Ask students what they think of when they think of a *cycle*. Some may think of a bicycle or a tricycle.

Present a video explaining the water cycle. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, talk about the weather. Have students explain whether the water cycle they are experiencing is in the stage of evaporation, transpiration, condensation, or precipitation.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What is a cycle?

2. Read and discuss: "Water: One Matter Cycle."

Student Reader

Ch. 16

Prepare to read together, or have students read independently, Chapter 16 "Water: One Matter Cycle." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 92

- What is a water molecule? (*two atoms of hydrogen and one atom of oxygen*)
- What is a cycle? (*something that goes round and round*)

- What are the different states of matter that water can take? (*liquid, gas, and solid*)

  SUPPORT—Discuss Words to Know.

Discuss the word *cycle,* which is a repeating process or series of steps. Guide students to realize that cycles are patterns that are all around us. They help us understand and predict what will happen next.

Page 93

- What are some examples of liquid water? (*rainwater, lake water, ocean water, drinking water, bathwater*)
- What state of matter is water in during evaporation? (*gas*)
- Could evaporation occur if water did not change its state of matter from liquid to gas? (*no, because it would not be able to get into the atmosphere*)

Page 94

- What form of matter is water in when it is snow, hail, or ice? (*solid*)
- How would the water cycle be affected if water could not change its state of matter to ice? (*Precipitation would only occur as rain, and there would be no snow or ice.*)
- In which state of matter could a water molecule stay for the longest time? (*solid state in a glacier in a very cold place on Earth*)

  CHALLENGE—Challenge students to research glaciers and explain where they occur on Earth and how long they have existed.

Page 95

- What is the biosphere? (*all living organisms on Earth, including all plants and animals*)
- How is water part of the biosphere? (*Animals drink water to live. Plants need water to grow and live. Water makes up most of an organism's body.*)
- Explain the water cycle. (*Water evaporates as a gas from oceans and transpires from living things into the atmosphere. Then it condenses in clouds and then falls to Earth in precipitation as a liquid or solid.*)

  SUPPORT—Explain that the human body consists of 60 percent water. It is a vital part of every cell, including blood cells in the circulatory system. It regulates body temperature, lubricates joints, forms saliva, and helps to flush waste. Talk about how much water to drink each day to keep your body healthy. Then discuss how their own bodies represent a cycle of drinking, processing, and eliminating water in order to live.

Page 96

- Explain the predator-prey cycle. (*The population of prey like mice or rabbits is controlled by its predators like cats or coyotes. If the population of prey goes up or down, so does the population of predators.*)

Know the Standards

CCC5. Energy and Matter—Flows, Cycles, and Conservation

In this lesson, students explore examples of different types of cycles in their lives.

- What other cycles have students observed in nature? (*In the spring, some birds build nests and lay eggs. The baby birds grow and then migrate for the winter but return in the spring. Many plants, including trees, seem to die at certain times of year and then sprout new leaves and then flowers in the spring and summer.*)
- How does identifying and studying cycles help us understand the world? (*If you have studied a cycle, you know what to expect. You also know if something is not right if the cycle is interrupted. Then you can find out what caused the cycle to stop repeating.*)

Page 97

- How would the electricity cycle be different in a home without air conditioning? (*The cycle would show that more electricity was used in the winter when the days were shorter and less in the summer.*)
- What are some cycles in your life? (*Possible answer: On school days, I wake up, brush my teeth, have breakfast, go to school, have lunch, come home, have dinner, do my homework, brush my teeth, and go to bed.*)
- What is your cycle of energy during the day? (*Sample answer: I have the most energy in the morning, get sleepy after lunch, feel energetic when I get home, and then get very sleepy at night.*)

3. Check for understanding.

Activity Page

AP 16

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Matter moves around on Earth. Water is one example of a type of matter that moves around in a big and complex cycle. A cycle is a repeating process.

What details from the chapter support the main idea? (*There are several examples of cycles, including the water cycle, the cycle of tides, and the life cycles of plants and animals.*)

Have students complete Activity Page 16, and then together discuss the cycles they chose to represent.

See the Answer Key for sample or correct answers.

LESSON 17

A Closer Look!

At a Glance

Lesson Question

What do the structures in objects look like with closer and closer examination?

Learning Objectives

- ✓ Relate visible structures to their functions in living and nonliving examples.
- ✓ Associate images of substructures that are not normally visible with the visible structures that contain them.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

A structure is something that is built or arranged in a way that enables it to serve a particular purpose. Each structure is made up of smaller structures with characteristics that make the structures work the way they do.

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.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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function **structure**

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characteristic **insulation** **particles**

Instructional Resources

Student Reader

Ch. 17

Student Reader, Chapter 17
"A Closer Look!"

Activity Page

AP 17

Activity Page
Magnifying with a Hand Lens (AP 17)

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project images/video for whole-class viewing
- small objects such as rocks, fossils, and feathers
- hand lenses

The Core Lesson

1. Focus attention on the Lesson Question.

Online Resources

Ask students what they think of when they think of a *feather*. Some may think of birds. Others may think of painting with a feathered stroke.

Present a video about bird feathers. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, talk about the different kinds of feathers and the different function for each feather. Reinforce the idea that by looking closer, they can distinguish different kinds of feathers and their different functions.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What do the structures in objects look like with closer and closer examination?

2. Read and discuss: "A Closer Look!"

Student Reader

Ch. 17

Prepare to read together, or have students read independently, Chapter 17 "A Closer Look!" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 98

- What is the difference between flight feathers and down feathers? (*Flight feathers are on the wings, are long and firm, and move air around like the blades of a fan. Down feathers are shorter and softer.*)

- What is the function of each type of feather? (*Flight feathers help birds fly. Down feathers keep the bird warm.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *structure,* which is something that is built or arranged in a way to serve a purpose. Make a class list of familiar human-made structures, such as buildings, bridges, and sculptures. Then discuss living structures, such as the human hand, a leaf, and an acorn. Help students conclude that a structure is an organization of parts that serves a particular purpose or function. Expand the concept of structure to a sentence or a story.

Next, discuss the word *function* by identifying the function or purpose of each living and nonliving structure students suggested.

Page 99

- What are the smaller structures of a feather? (*There is a shaft that holds the feather strands, and there are barbs that branch off.*)
- What are the smaller structures of air? (*molecules of oxygen, carbon dioxide, nitrogen, water vapor, and other elements*)

Page 100

- What structures do fish have that help them swim? (*winglike fins, with thicker front edges and thinner rear edges*)
- If sharks had feathers, how would that affect their ability to swim? (*They would be much slower and might get waterlogged and heavy.*)
- Which are faster, birds or fish? (*Different birds and fish are fast; others are slow. Most fish are faster in water than most birds. Both have structures that enable them to move in their environments.*)

Page 101

- What are a shark's dermal denticles? (*millions of tiny, sharp skin structures*)
- What is the function of dermal denticles? (*They protect the shark and help sharks glide through water.*)
- Does every structure have a purpose? (*probably, even if we don't know what it is*)

Online Resources

SUPPORT—Show a video about different kinds of wood, or bring in examples of different types of softwood and hardwood. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Have students compare the structures and characteristic properties of the trees, including the leaves, bark, different grains, the heaviness, knots, and resistance to rot. Then discuss the functions of the different structures of wood. Acorns are seeds, bark protects the tree, and leaves help the tree capture energy from the sun. Woodworkers also use different woods for different purposes. Some types of wood are best for framing, some for making airplanes, and some for building furniture.

Know the Standards

CCC6. Structure and Function

In this lesson, students explore different structures and their functions, such as bird feathers, shark skin, and parts of different plants.

- How is a plane like a bird? (*It has two curved wings and a tail.*)
- Why would people use the structure of a shark's dermal denticles to design planes? (*If it helps sharks swim faster, it could help planes fly faster.*)
- What other structures in plants and animals have influenced things people make? (*flippers for swimming, sponges like sea sponges, down insulation, silk thread, hook-and-loop closures, hummingbird-like helicopters*)

Pages 102–103

- How did lily pads help paint makers? (*They studied how bumps on the leaves repelled water and kept the leaves clean. Then they made paint that repelled water in the same way.*)
- What are examples of structures you depend on in the room? (*The building has room for me, my chair will support me, and the day will be organized to help me learn.*)
- Describe the structure of an apple and the function of each main part. (*It has an outer skin that protects it from rotting. Its flesh protects the seeds, and the seeds allow it to reproduce.*)

3. Check for understanding.

Activity Page

AP 17

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. A structure is something that is built or arranged in a way that enables it to serve a particular purpose. Each structure is made up of smaller structures with characteristics that make the structures work the way they do.

What details from the chapter support the main idea? (*There are several examples of the structures and substructures of different things.*)

Distribute Activity Page 17, and make available an assortment of objects, such as rocks, fossils, and feathers, for students to examine. Have students complete the activity page, and then together discuss what advantage using a hand lens gives to understanding the object.

See the Answer Key for sample or correct answers.

LESSON 18

Dynamic!

At a Glance

Lesson Question

What does *dynamic* mean?

Learning Objectives

✓ Describe systems that are in a constant state of change.

✓ Explain factors that cause changes in examples of dynamic systems.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Dynamic means "constantly changing."

NGSS and CCSS References

CCC7. Stability and Change: For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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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.

cycle **dynamic** **stability** **system**

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.

atmosphere **climate** **extreme**

Instructional Resources

Student Reader

Ch. 18

Student Reader, Chapter 18
"Dynamic!"

Activity Page

AP 18

Activity Page
A Small but Dynamic System (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.

Online Resources

Ask students to hold completely still for thirty seconds. When time is up, ask them to describe what changed in that time. Some may say the clock continued to move, their hearts continued to beat, their eyes blinked, or the wind continued to blow.

Present a video about weather. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, talk about the different ways weather can change quickly and slowly.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What does *dynamic* mean?

2. Read and discuss: "Dynamic!"

Student Reader

Ch. 18

Prepare to read together, or have students read independently, Chapter 18 "Dynamic!" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 104

- How is your body a system? (*It has different parts that work together.*)
- How can your body change quickly? (*If you fall and scrape your knee, that is a quick change.*)
- How does your body change slowly? (*by growing*)

  SUPPORT—Discuss Words to Know.

Discuss the word *system,* different parts that work together. Identify different systems in the immediate environment, such as the heating system or lighting system. Reinforce the idea that small things like clocks are systems and big things like buildings are systems.

Page 105

- What are the parts of a forest system? (*soil, trees, animals, air, and water*)
- How can a forest change quickly? (*if there is a forest fire or flood*)
- How does a forest change slowly? (*Trees grow, and in the fall some trees drop their leaves. Erosion wears away rocks and soil and changes the path of water.*)
- Is there anything in a forest that never changes? (*No, but some things change faster than other things.*)

SUPPORT—Discuss Words to Know.

Discuss the word *dynamic,* which refers to constant change. Ask students to identify examples of dynamic systems, such as the landscape around a building that is constantly changing by growing and being cut back.

Page 106

- How is Earth's *climate* a dynamic system? (*It is made up of parts like the sun's energy, land surfaces, and atmosphere that constantly change and affect each other.*)
- How is Earth's *weather* a dynamic system? (*Weather conditions in a particular area on Earth may change several times during the day from sunny to stormy or from hot to cold.*)
- Which are faster, climate or weather changes? (*Weather changes happen frequently. Weather patterns may last only a few days until they change. Climate changes happen very slowly over long periods of time.*)

Page 107

- What is a cycle? (*something that repeats regularly as in a circle, a repeating process*)
- What is an example of changes that happen in a cycle? (*the life cycle of a plant or animal, seasonal changes that happen every year, rainbows appearing after a storm, animals migrating*)

Online Resources

SUPPORT—Show a video about El Niño. Make a list of the different parts of the weather system that work together to cause weather changes (e.g., water, temperature, wind). Discuss why this is a cycle. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Page 108

- How are glaciers evidence of long-term climate changes? (*Glaciers take a long time to form if Earth's temperature is cold and a long time to melt if the temperature warms up.*)
- What cycles does the tilt of Earth cause? (*seasons and longer and shorter amounts of sunlight throughout a year*)
- What slow changes can occur as the result of long-term climate change? (*rising water levels as glaciers melt, areas turning into rainforests or deserts*)

Know the Standards

CCC7. Stability and Change

In this lesson, students explore different dynamic systems, including forest and climate systems that are in a constant state of change.

Online Resources

CHALLENGE—Show a video about how Earth's tilt affects seasons and climate. Challenge students to create a model to explain how the tilt changes the amount of direct sunlight on different parts of Earth. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Page 109

- Why are climate changes dynamic? (*because although the changes slow, climate is constantly changing*)
- Is climate change a cyclical change? (*not always, because it cannot be predicted*)
- What extreme changes can occur as the result of long-term climate change? (*unusually high or low temperatures, rain, tornadoes, hurricanes, flooding*)

  SUPPORT—Discuss Words to Know.

Discuss the word *stability*. Reinforce that being stable means that something is steady and predicable. Cyclical changes represent stability because they are reliable.

3. Check for understanding.

Activity Page

AP 18

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. *Dynamic* means "constantly changing."

What details from the chapter support the main idea? (*Both quick changes like a flood and slow changes like seasonal changes are dynamic. They are part of ongoing processes.*)

Have students complete Activity Page 18 individually, and then together discuss what makes a terrarium a dynamic system.

See the Answer Key for sample or correct answers.

LESSON 19

Wants, Needs, and Limits

At a Glance

Lesson Question

What are criteria and constraints?

Learning Objectives

✓ Identify criteria in a provided problem/solution scenario.

✓ Express criteria for a hypothetical solution.

✓ Identify constraints in a provided problem/solution scenario.

Instructional Activities

- reading
- class discussion
- vocabulary exploration
- scenario evaluation

Main Science Idea

To solve a problem, we must identify everything that the solution needs to do. These are criteria. Some things limit our ability to solve a problem. These are constraints.

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.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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

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constraint **criteria** **evaluate**

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.

limit **problem** **solution**

Instructional Resources

Student Reader

Ch. 19

Student Reader, Chapter 19
"Wants, Needs, and Limits"

Activity Page

AP 19

Activity Page
What a Design Must Have
(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

Discuss student experience when electricity has been disrupted at home or at school. Some may talk about lighting candles to find their way in the dark, not being able to watch TV, going to bed early, or going out to eat.

Present a video about what to do if the power goes out. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) After the video, talk briefly about the different precautions people can take to stay safe during power outages.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: What are criteria and constraints?

2. Read and discuss: "Wants, Needs, and Limits."

Student Reader

Ch. 19

Prepare to read together, or have students read independently, Chapter 19 "Wants, Needs, and Limits." When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 110

- How do windshield wipers solve a problem? (*They allow drivers to see the road when it rains.*)
- What are some other solutions for driving while it is raining? (*Possible answers: holding a rag or squeegee to clear the windshield, not driving, slowing down*)

- How would you evaluate the solutions? (*A rag would be really hard and uncomfortable. It would be dangerous and not practical. Not driving would not be an option if you really had to go somewhere.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *criteria,* which are the goals or conditions that a solution must meet. Talk about the criteria for solving the problem of driving when it's raining, such as keeping the windshield clear and not distracting the driver. Explain that the criteria are things that the solution must do to really address a problem.

Page 111

- What experience do people in your area have with tornadoes, ice storms, or other hazards, such as floods, blizzards, wildfires, or earthquakes? (*Discuss students' personal experiences.*)
- Why is it important to be prepared for a hazard? (*If you don't know what to do, you could get really hurt.*)
- How do the solutions for weather hazards that affect your area compare to the criteria for tornadoes described on this page? (*We have tornado and fire drills so everyone knows where to go if there is a danger.*)

Page 112

- What are some constraints on solutions for preparing for a weather hazard like an ice storm? (*We need teams of people with equipment to cut down tree limbs that could cause problems before cold weather. People need to have light sources like battery-operated flashlights or candles in case the power goes out.*)
- How can constraints be overcome? (*If something is too expensive, you can have a fundraiser or ask for donated or used materials. If something will take too long, you can ask more people to help.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *constraint,* or limit. Talk about the types of constraints students have in their daily lives. Reinforce the idea that constraints limit the potential solutions and activities they can do.

Page 113

- What were the constraints for having an emergency radio? (*affordability, being lightweight, and having a sturdy crank*)
- What are some other solutions to keeping floodwater away from homes and businesses? (*pumps, solid doors and foundations, building on stilts, moving the building away from water sources*)

Online Resources

SUPPORT—Show a video about preparing for flooding. Make a list of different solutions, and discuss the constraints for each solution. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Know the Standards

ED.A. Defining and Delimiting Engineering Problems, ED.B. Developing Possible Solutions, ED.C. Optimizing Design Solutions In this lesson, students are presented with different potential weather hazards, identify criteria and constraints for staying safe, and propose possible solutions.

Page 114

- What problem do tumbleweeds present? (*They can catch fire in dry weather and cause damage. They can block roads and houses.*)
- What is a criterion for solving the tumbleweed problem? (*Tumbleweeds cannot be able to blow around, especially during the dry season.*)
- What are the constraints for your solution? (*We need someone to make a plan and groups of people to agree to collect the tumbleweeds. We need a safe way to burn or mulch them.*)

  CHALLENGE—Challenge students to identify a problem in the local area. Have them identify the problem and the criteria for solving the problem. Then have them come up with a solution and identify the constraints for the solution.

Page 115

- What problem do icy bridges represent? (*Bridges freeze faster than pavement, and salt does not work well in melting ice and keeping bridges safe in freezing weather.*)
- What is a criterion for solving the problem? (*making bridges safe for drivers in freezing weather*)
- What types of solutions can you think of to solve this problem? (*heated strips or tiles to melt ice*)
- What are the constraints for your solution? (*cost, effectiveness, power source availability*)

3. Check for understanding.

Activity Page

AP 19

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. To solve a problem, we must identify everything that the solution needs to do. These are criteria. Some things limit our ability to solve a problem. These are constraints.

What details from the chapter support the main idea? (*Both quick changes like a flood and slow changes like seasonal changes are dynamic because they represent constant change.*)

Distribute Activity Page 19, and go over instructions with students. Have students complete the activity page individually, and then together discuss their solutions and the criteria and constraints they identified.

See the Answer Key for sample or correct answers.

LESSON 20

Science or Technology? Both!

At a Glance

Lesson Question

How do science and technology influence each other?

Learning Objectives

- ✓ Differentiate examples of science and technology.
- ✓ Explain the relationship in a provided instance wherein science stimulated a change in technology.
- ✓ Explain the relationship in a provided instance wherein technology stimulated an advancement in science.

Instructional Activities

- reading
- class discussion
- vocabulary exploration

Main Science Idea

Science is a process of studying. Technology is the use of knowledge. We use science knowledge to develop technology. We use technology to help with science activities. Science and technology support each other.

NGSS and CCSS References

STSE1. Interdependence of Science, Engineering, and Technology: Science and technology support each other; Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. (Also **STSE2**)

RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (Also **RI.3.2** and **RI.3.4**)

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

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science **technology**

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.

meteorologist **radar** **weather satellite**

Instructional Resources

Student Reader

Ch. 20

Student Reader, Chapter 20
"Science or Technology? Both!"

Activity Page

AP 20

Activity Page
Science or Technology (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

Discuss student experience with cell phones. Some may explain that cell phones can be used to call someone, find information, provide directions, and set alarms. Talk about how life would be different without cell phones.

Present a video about technologies used for weather forecasting. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**) Talk about what life was like before technologies like satellites and radar existed and if students think weather forecasts have improved because of these technologies.

Pose a question for everyone to keep in the back of their minds as the class moves forward to read the chapter: How do science and technology influence each other?

2. Read and discuss: "Science or Technology? Both!"

Student Reader

Ch. 20

Prepare to read together, or have students read independently, Chapter 20 "Science or Technology? Both!" When reading aloud together as a class, instruct students to follow along. Pause for discussion using prompts and questions such as the following:

Page 116

- What was the potential weather that was coming where Sara lived? (*a blizzard*)
- Why is it important to know what the weather will be? (*You can be prepared for hot, cold, windy, or rainy weather so you can dress for it and change your plans if you need to.*)
- How do you learn about the weather each day? (*Sample answer: I look outside, or my parents tell me.*)

Page 117

- How are science and technology different? (*Science is learning about and understanding the world. Technology is making things that use scientific knowledge.*)
- How can science lead to new technology? (*Sample answer: If people learn about weather patterns, they can build technology that helps them gather and keep track of weather patterns around the world to help predict the weather.*)
- How can technology lead to greater scientific understanding? (*Sample answer: If people build a more powerful telescope, they can gather more scientific knowledge about the solar system and universe.*)

  SUPPORT—Discuss Words to Know.

Discuss the word *technology,* which is the practical application of scientific knowledge. Make a class list of common technology tools that students use frequently, like a zipper, pencil, or key. Reinforce that just about everything made by humans is technology and that technology does not have to mean computer technology or involve electricity or wave energy.

Page 118

- How did the invention of the technology of the lightning rod depend on scientific understanding? (*Franklin would never have invented the lightning rod if he hadn't understood that lightning was electricity and could start fires if it struck a house unless it was directed to the ground.*)
- Is science or technology more important? (*They are both important because they are interdependent. When we learn more about science, we can invent new technologies. When we invent a new technology, we can learn more about science.*)

Page 119

- What technologies were created as a result of our understanding of Doppler radar? (*Doppler radar on cell phones and TV weather programs*)
- What scientific understanding was the Doppler radar based on? (*People had to understand how waves can transmit signals.*)

Page 120

- What do weather satellites do? (*They orbit Earth and send data about clouds, precipitation, and weather back to Earth.*)
- What science did the invention of weather satellites rely on? (*rockets and how they could be launched and orbit Earth*)

- Is gathering weather data from satellites better or worse than collecting data from ships? (*Satellite data is much easier to collect. It is better because you can gather it from a greater area.*)

Online Resources

SUPPORT—Show a video about recording the weather. Explain that keeping weather records is a scientific effort to understand weather patterns so that we know if the weather is getting hotter or colder or more or less humid. (See the Online Resources Guide for links to recommended resources. **www.coreknowledge.org/cksci-online-resources**)

Page 121

- How did Doppler radar help scientists learn about tornadoes? (*The radar helped people see that at the beginning of a tornado, the raindrops move in a certain pattern. Then when they see this pattern, they can tell if a tornado is possible.*)
- How do weather balloons help meteorologists learn about weather? (*They collect data about air pressure, temperature, and humidity from the lowest layers of the atmosphere.*)
- Does scientific understanding always come before technological advances? (*No, sometimes technology advances science.*)

3. Check for understanding.

Activity Page

AP 20

Main Science Idea: Reiterate the main idea of the chapter in plain and simple terms. Science is a process of studying. Technology is the use of knowledge. We use science knowledge to develop technology. We use technology to help with science activities. Science and technology support each other.

What details from the chapter support the main idea? (*All of the examples of weather concepts and technology explain how science and technology are interdependent.*)

Distribute Activity Page 20. Have students complete the activity page, and then together discuss how and why they identified the examples that they chose.

See the Answer Key for sample or correct answers.

GRADE 3

Teacher Resources

Activity Pages

Name ______________________________ Date ____________________

Activity Page 1 Use with Lesson 1

Is It Science?

Circle the scientific statement based on scientific observation in each row.

	A	B
1	Beagles are the cutest dogs.	Beagles shed all year long.
2	People will have good luck if they find a cricket in the house.	Crickets have hind legs for jumping.
3	Male cardinals have bright red feathers.	Male cardinals are the most beautiful birds.
4	The female honeybee dies after stinging.	All people are naturally afraid of bees.
5	Sharks are dangerous.	Shark populations dropped by 70 percent in the last fifty years.
6	Metal's ability to have a shiny polish makes it pretty.	Metal can be made into strong tools.
7	Snow is frozen precipitation.	Snow makes winter more fun.
8	The appearance of the moon changes in a monthly cycle.	The full moon makes the night sky look scary.
9	In North America, the prettiest animals migrate in the winter.	In North America, many types of animals migrate to the south in winter.
10	Energy from the sun heats Earth.	Sunny days are better than rainy days.

Name ________________________________ Date ____________________

Science Words

Match each science word to its best definition.

A	B
1. an explanation that explains how and why something happens that can be verified by repeating experiments	a. hypothesis
2. starting with a reasoned guess and controlling variables to produce new knowledge	b. test
3. a process of gathering information and analyzing it to gain a better understanding of something	c. experiment
4. trying something out before applying it widely	d. investigation
5. facts or information that tell whether something is true	e. true
6. a statement that is real because it is based on facts	f. evidence
7. something that predictably happens, which scientists have found to be always true after many experiments	g. natural law

Write two more science words and their definitions.

Word: ____________ Definition: ______________________________________

____

Word: ____________ Definition: ______________________________________

____

Name ______________________ Date ______________

Activity Page 3 Use with Lesson 3

Using Science Tools

Match the best tool for each task.

A	B
1. making sure the space between rows in a garden is the same	a. thermometer
2. looking at the surface of the moon	b. calipers
3. figuring how big a huge tree trunk is	c. meterstick
4. measuring a small amount of liquid	d. tape measure
5. learning if the rocks you collected weigh the same as a metal weight	e. flask
6. looking closely at grains of sand	f. graduated cylinder
7. looking for germs in a drop of water	g. balance
8. increasing the temperature of a liquid	h. spring scale
9. determining the widest dimension of an irregularly shaped rock	i. hand lens
10. comparing the temperature in two different spaces	j. microscope
11. containing liquids to be mixed together for an experiment	k. telescope
12. figuring how much something weighs	l. hot plate

Name ________________________________ Date ____________________

Activity Page 4 Use with Lesson 4

Variables

Imagine you are the scientist conducting these experiments.

- Circle the factor in each test that is a variable that you control.
- Draw a box around the factor in each test that stays the same in every trial.
- Underline the factor in each test that is a variable that changes because of another variable that you changed.

Test	Circle, box, and underline one factor in each row.		
1. Which paper towel is most absorbent?	cup of water	amount of water in a drip pan	the type of paper towels
2. Which paper airplane goes the farthest?	measured space	different paper airplane models	amount of force to throw the airplanes
3. Which type of fruit stays fresh the longest?	temperature and light of the fruit bowl environment	type of fruit	days fruit remains fresh
4. What sound best gets a dog's attention?	the speed of the dog's reaction	the sound the dog hears	the dog
5. Which paper color gets warmer in the sun?	amount of sunlight	temperature of the paper	paper color

Name ______________________________ Date ______________

Activity Page 5 Use with Lesson 5

Types of Models

For each item below, identify what type of model it is using the choices provided.

A. model of something big
B. model of something too small to see
C. model of an event
D. model of a process

	1. road map
	2. insect model
	3. plastic building model
	4. recipe for making bread
	5. hurricane path model
	6. model of a human eye
	7. steps of a science lab
	8. model rocket
	9. what happened during a flood
	10. relief map of the ocean bottom

Which model from the chapter do you think is the most interesting? Tell why you think so.

____

____

____

____

____

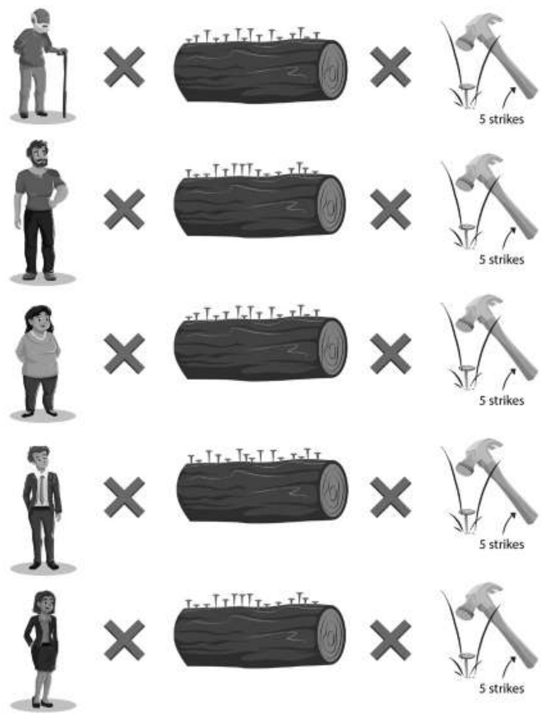
____

Name ______________________________ Date ________________

Activity Page 6 Use with Lesson 6

Think About Testing

Match the questions with their correct answers. Write your own answer for the remaining question.



1. Why should five people testing a hammer be different in size, gender, and strength?	**A.** so the hammer's performance can be trusted because of its design and not because of the skill or strength of the person using it
2. Why should five people take turns swinging the same hammer in a fair test?	**B.** Write your answer:
3. Why do the five testers each hit fifteen nails?	**C.** so the ease or difficulty of driving each size of nail in is the same for all the testers
4. Why are the fifteen nails that each tester hits of three different sizes?	**D.** so the hammer's performance can be compared many times in case testers have lucky or unlucky swings that affect how well they drive the nails in
5. Why do the five testers each hit nails into the same kind of wood.	**E.** so the hammer's performance can be compared for tasks of varying difficulty

Name ______________________________ Date ____________________

Activity Page 7 Use with Lesson 7

Data Picture

Answer the questions.

Suppose you wanted to know what most students' favorite lunch is.

Place a 1 beside the way to find out the most reliable answer.

Place a 2 beside to next best way to find out.

Place a 3 beside the least reliable way to find an answer.

____________ Ask three friends, and choose the answer that agrees most with what you like.

____________ Ask each teacher in the school to survey their students, and then collect and combine the responses for all the classes.

____________ Have every student in your class write their favorite lunch on a piece of chart paper.

What makes your choice the best way?

____

____

____

Suppose you want to know how long it takes spinach to sprout in a garden. Circle the method that will help you determine the most reliable answer.

Plant a new row of spinach seeds every day until sprouts appear. Count the rows you needed to plant.

Plant one row of seeds, and water it the same amount every other day. Count the days until sprouts appear.

Plant one row of seeds, and water it the same amount every other day. Count the days until sprouts appear. Repeat the process two more times, and choose the middle number of your three trials.

Give a row of spinach seeds more water each day until sprouts appear. Keep track of the amount of water as you increase it each day.

What makes your answer the most reliable one?

____

____

____

Describing, Estimating, and Measuring

Practice describing the size and quantities of objects by estimating and measuring.

Choose an object in the room. First, use your senses to estimate its size and weight without tools. Next, choose a tool to measure it. Complete the table with the information.

	Object	Description	Estimate	Measurement
Height				
Temperature	water in cup			
Quantity				
Weight				
Volume	water in cup			
Time		time to tie my shoe		

Name ______________________ Date ______________

Activity Page 9 Use with Lesson 9

Evidence and Explanations

Circle the correct words to complete the sentences about things that are related.

Example 1: You eat a bowl of cereal every morning for breakfast. Nine days after you first open the box, it is now one-quarter full of cereal.

As time increases / decreases, the amount of cereal in the box increases / decreases.

Example 2: The sound of birds singing outside your home quiets at sunset.

As daylight increases / decreases, the activity of the birds increases / decreases

Example 3: You water three tomato plants every day. Plant A gets one cup of water per day. Plant B gets half a gallon of water per day. Plant C gets one gallon of water per day. After 10 days, Plant A is 18 inches tall, Plant B is 24 inches tall, and Plant C is 36 inches tall.

As amount of water increases / decreases, the plant height increases / decreases.

Example 4: The sound of birds singing outside your home gets louder at sunrise.

As daylight increases / decreases, the activity of the birds increases / decreases

Name ______________________________ Date ____________________

Activity Page 10 Use with Lesson 10

Fact or Opinion?

Let's play! Use the cards to practice identifying facts or opinions.

The Rules:

- This is a two-player game.
- Shuffle the cards, and deal five cards face down to each person. The remaining cards go in a stack face down.
- Turn over the top card of the stack. The first player must play either a card that matches the topic (e.g., dinosaurs, cats) or a card that matches the type (fact or opinion). If the player plays a card incorrectly or is unable to play a card, they must draw a card from the stack and return the incorrectly played card to their hand.
- The first person to get rid of all of their cards wins.

DINOSAURS Dinosaurs are the most interesting thing to study.	**DINOSAURS** Dinosaur fossils have been found on all seven continents.	**SCIENTISTS** Paleontologists study fossils.
SCIENTISTS Scientists are hard workers.	**LIFE CYCLES** It is hard to be a young organism.	**LIFE CYCLES** All plants and animals go through life cycles.
FISH A shark is a type of fish.	**FISH** Fish are ugly.	**BIRTHDAY** A birthday indicates how many trips that person has taken around the sun.

Name ______________________________ Date ____________________

Activity Page 10 (*continued*) Use with Lesson 10

BIRTHDAY June birthdays are the most fun.	**FLOWERS** Flowers help the plant reproduce.	**FLOWERS** Red flowers are the prettiest.
WATER CYCLE Precipitation falls from clouds.	**WATER CYCLE** Dark clouds are scary.	**FRUIT** Fruit helps the plant disperse seeds.
FRUIT Oranges taste delicious.	**FACES** Eyebrows keep dirt from getting in our eyes.	**FACES** Eyebrows are our most important facial feature.
SPACE The same side of the moon always faces Earth.	**SPACE** Mars has a lot of craters.	**GEOLOGY** Geology studies the physical features and history of Earth.
BIRTHDAY June birthdays are the most fun.	**FLOWERS** Flowers help the plant reproduce.	**FLOWERS** Red flowers are the prettiest.

Name ______________________ Date ______________

Activity Page 10 (*continued*) Use with Lesson 10

GEOLOGY Earth's inner core is thicker than its crust.	**SPORTS** Basketball is played with a ball.	**SPORTS** Soccer is the best sport.
NEEDS OF LIFE A basic need of life is food.	**NEEDS OF LIFE** All shelters should be the color green.	**ANIMALS** Giraffes are the tallest land animal.
ANIMALS Giraffes should be given special houses.	**EATING** Mouths are part of the digestive system.	**EATING** Avocado toast is the most filling breakfast.
GEOLOGY Earth's inner core is thicker than its crust.	**SPORTS** Basketball is played with a ball.	**SPORTS** Soccer is the best sport.
NEEDS OF LIFE A basic need of life is food.	**NEEDS OF LIFE** All shelters should be the color green.	**ANIMALS** Giraffes are the tallest land animal.

Name ______________________________ Date ____________________

Activity Page 11 Use with Lesson 11

Endangered Species Library Activity

Many animals are endangered, which means they are at risk of becoming extinct. What are some examples of endangered animal types, and how did their survival become threatened?

Your steps:

1. **Choose an endangered animal from the list provided by your teacher. It includes animals listed by the US Fish and Wildlife Service.**
2. **Read about the animal. Remember to look for facts on *why* the animal is on the endangered species list. In the table below, write three facts, two opinions, and two details of information that are not relevant. Be sure to write them in random order on the rows provided.**
3. **Share your information with a classmate. Don't tell them which statements are facts, which are opinions, and which are not relevant! Their job is to review the information and use the checkboxes to show if they are facts, opinions, or not relevant.**

Name of animal: ______________________________

Information	Fact, Opinion, or Not Relevant?
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant
	☐ Fact ☐ Opinion ☐ Not Relevant

Name ______________________________ Date ____________________

Activity Page 12 Use with Lesson 12

Peppered Moths Survival

The Industrial Revolution was the time in history when people switched from doing things by hand and with the help of animals to using machines for many tasks. During the Industrial Revolution, it seemed that all the light peppered moths disappeared.

In this game, you will become a bird in the times of the Industrial Revolution and "eat" as many peppered moths as you can.

Your Question: What happened to the light peppered moths?

Your Observations:

____

____

	Which color was easier to see?	**Light-Colored Moths Left**	**Dark-Colored Moths Left**
Light Forest			
Dark Forest			

Patterns:

____

____

____

____

Explanation:

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____

Name ______________________________ Date ____________________

Activity Page 13 Use with Lesson 13

Cause and Effect

Look at the pictures of European map butterflies on page 79 of the *Reading About Science* Student Reader. Suppose you have 100 European map butterfly eggs divided evenly into two enclosed glass insect habitats. How could you investigate what causes the difference in colors between those that hatch in the spring and those that hatch in the summer?

1. Write a few sentences telling what you think causes the butterflies to hatch in different colors at different times of year. Use the word *relationship* in one of your sentences.

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2. What factors could you control and make different for the two sets of eggs to test your ideas?

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3. How would you keep track of the different causes you introduce in your investigation?

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4. How would you look for the effects produced by your investigation?

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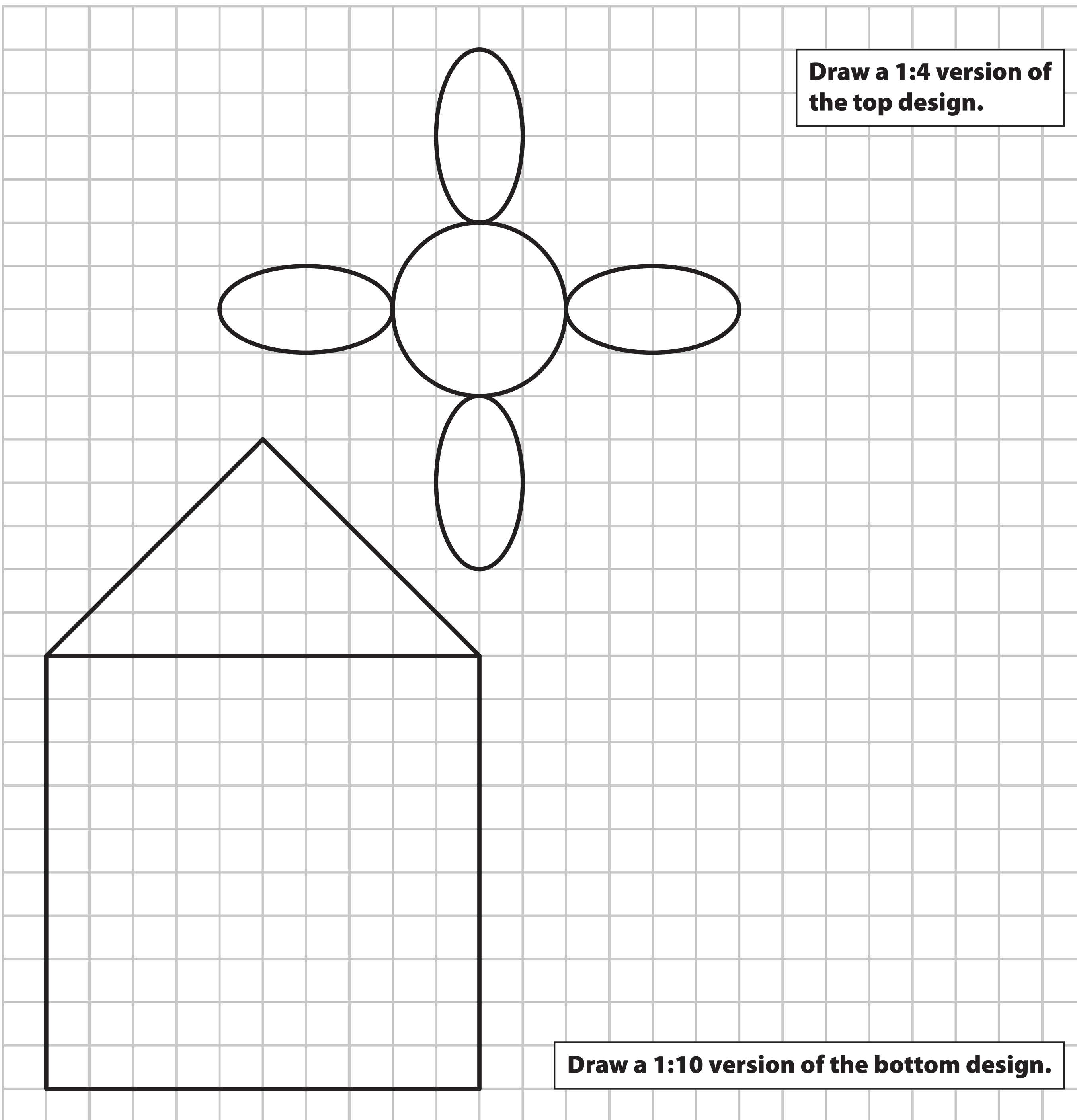
Name ______________________________ Date ____________________

Activity Page 14 Use with Lesson 14

Drawing to Scale

In a scale drawing 1:4 means, on a grid like this, that one square in the smaller version equals four squares in the bigger version.

A scale of 1:10 means that ten squares in the bigger version equal one square in the smaller version.



Name ______________________________ Date ____________________

Activity Page 15 Use with Lesson 15

A System: Open or Closed?

A terrarium can be made in a jar with a lid. Inside are plants, rocks, air, and wet soil. You don't need to water the plants. They take in water from the soil. Moisture moves from the plants' leaves into the air in the jar. The water vapor condenses on the inside of the glass and drips back into the soil.

Explain why the terrarium is a **closed system**. Add labels, arrows, and captions to the picture.

How is the terrarium an **open system** for energy though? Use the word *sunlight* in your answer.

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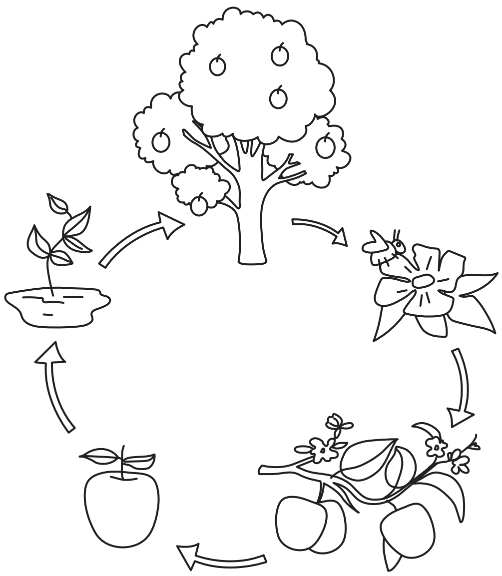
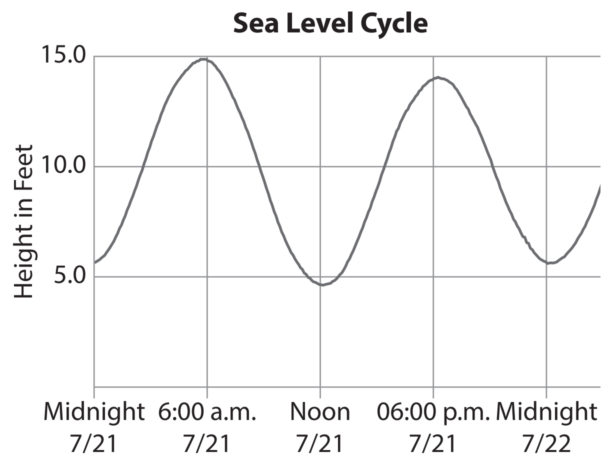
Name ______________________________ Date ____________________

Activity Page 16 Use with Lesson 16

Cycles

A cycle is a pattern that repeats over and over again. Here are two models of cycles. One is a picture diagram. The other is a graph.





Now think of another cycle that you have observed. It can be something in nature or any part of the routine of your life. Write your idea here:

____

____

Draw a diagram or graph to show how your cycle happens. Add labels and arrows to help explain it.

Name ______________________________ Date ____________________

Activity Page 17 Use with Lesson 17

Magnifying with a Hand Lens

- Look at the objects provided by your teacher. Draw two of them.
- Examine the objects more closely with a hand lens. Draw a detail that you could observe from your closer look.

With Eyes Only	With Lens

Describe something you were able to learn about each object by looking at a magnified view of it.

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Name ________________________________ Date ____________________

Activity Page 18 Use with Lesson 18

A Small but Dynamic System

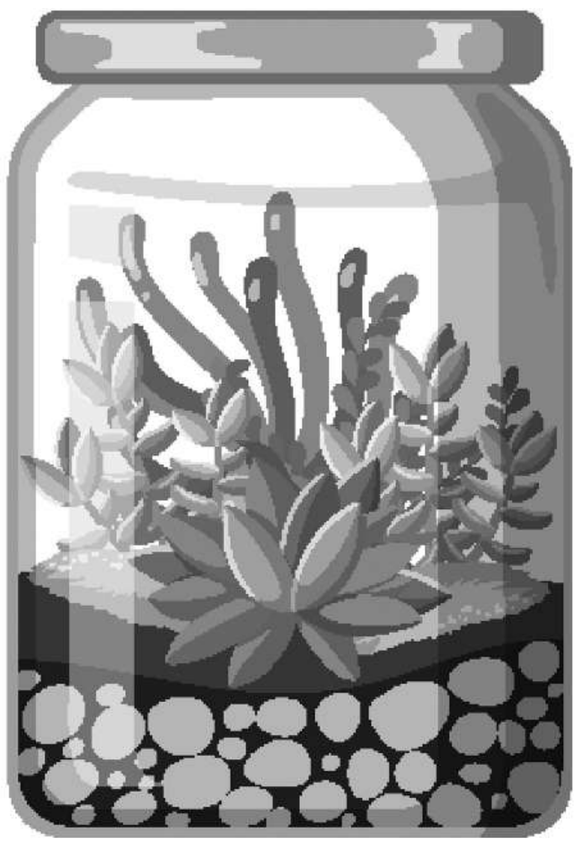
You probably remember that a terrarium in a jar is an example of a system. It is a closed system for matter. No new matter goes into or out of the jar. But the terrarium is an open system for energy. Sunlight goes into the jar. And heat can transfer in and out. The inside of the jar can get warmer or cooler.

The terrarium system is dynamic. What does that mean?

____

____

Add labels and captions to the picture to explain what makes the terrarium a dynamic system.



Name ________________________________ Date ____________________

Activity Page 19 Use with Lesson 19

What a Design Must Have

Clutter from toys can be a problem! What's the solution?

Suppose you are designing a way to organize and store toys in kids' bedrooms.

Write three things that your design for a toy storage solution must be able to do. These are criteria.	Write three things that your design for a toy storage solution cannot do. These are constraints.
1.	1.
2.	2.
3.	3.

Now draw and label your design.

Name ______________________________ Date ____________________

Activity Page 20 Use with Lesson 20

Science or Technology

You can find examples of both science and technology everywhere! Look at this recipe for baking bread. Find two examples of science and two examples of technology.

Draw lines and add captions to describe the examples that you identify.

Answer Key: *Reading 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.

Is It Science? (AP 1)
(page 96)

1, B; 2, B; 3, A; 4, A; 5, B; 6, B; 7, A; 8, A;

9, B; 10, A

Science Words (AP 2)
(page 97)

1, a; 2, c; 3, d; 4, b; 5, f; 6, e; 7, g

Look for words and definitions that students saw during the lessons.

Using Science Tools (AP 3)
(page 98)

1, c; 2, k; 3, d; 4, f; 5, g; 6, i; 7, j; 8, l; 9, b; 10, a; 11, e; 12, h

Variables (AP 4)
(page 99)

Test 1: cup of water, amount of water in a drip pan, the type of paper towels

Test 2: measured space, different paper airplane models, amount of force to throw the airplanes

Test 3: temperature and light of the fruit bowl environment, type of fruit, days fruit remains fresh

Test 4: the speed of the dog's reaction, the sound the dog hears, the dog

Test 5: amount of sunlight, temperature of the paper, paper color

Types of Models (AP 5)
(page 100)

1, A; 2, B; 3, A; 4, D; 5, C; 6, B; 7, D; 8, A; 9, C; 10, A

Look for responses that name and accurately describe a model from the chapter.

Think About Testing (AP 6)
(page 101)

1, A; 2, D; 3, B Look for answers that describe the importance of multiple trials; 4,E; 5, C

Data Picture (Ap 7)
(page 102)

3; 1; 2 This option gets the most data from the students of the entire school.

Plant one row of seeds, and water it the same amount every other day. Count the days until sprouts appear. Repeat the process two more times, and choose the middle number of your three trials.

This method uses multiple trials and a control.

Describing, Estimating, and Measuring (AP 8)
(page 103)

All answers should include an object in the room and a description. Estimates should not be made with tools, but measurements use tools. Both look at size and weight.

Evidence and Explanations (AP 9)
(page 104)

Example 1: increases, decreases; Example 2: decreases, decreases; Example 3: increases, increases; Example 4: increases, increases

Fact or Opinion? (AP 10)
(pages 105–107)

As students play the game, check to be sure they are identifying each card as either a fact or an opinion.

Endangered Species Library Activity (AP 11)
(page 108)

Make sure students are accurately marking if the information is fact, opinion, or not relevant to how the animal became threatened.

Peppered Moths Survival (AP 12)
(page 109)

Look for observations that describe what they experienced. Look for patterns such as the following: In the light forest, more dark moths were eaten because they were easier to see. In the dark forest, more light moths were eaten because they were easier to see. Look for explanations such as the following:

During the Industrial Revolution, tree trunks became dark. The population of the light peppered moths decreased because they were easier to see against the dark tree trunks and were eaten more. Dark-colored moths blended into the dark tree trunks and were not eaten as much.

Cause and Effect (AP 13)
(page 110)

Look for responses that describe a relationship between the color of the butterfly and the season. Responses should include controlled variables, such as type and number of variables, and one variable that changes, such as the season. Responses should describe recording tools such as charts and tables.

Drawing to Scale (AP 14)
(page 111)

Student drawings can be either bigger or smaller than the original image, but it should be at a 1:4 scale, with one square in the smaller version equaling four squares in the bigger version.

A System: Open or Closed? (AP 15)
(page 112)

Closed system responses should explain that the energy and materials are continually transferred between the components within the system. Arrows, labels, and captions should indicate that matter is staying within the system and nothing new is being added or removed. Student responses for an open system should indicate that sunlight energy is added to the system.

Cycles (AP 16)
(page 113)

Student responses should describe a cycle they have experienced, such as seasons, morning/night, or school on weekdays. Drawings should illustrate the cycle.

Magnifying with a Hand Lens (AP 17)
(page 114)

Drawings of objects seen with eyes only should have less detail than drawings of objects observed with a hand lens.

A Small but Dynamic System (AP 18)
(page 115)

The terrarium is dynamic because it constantly changes over time. Labels and captions should show energy and materials changing and affecting each other.

What a Design Must Have (AP 19)
(page 116)

Look for criteria that are things the storage solution must do in order to be successful, such as size of storage, number of compartments, etc. Look for constraints that limit the potential solutions, such as cost, type of material, and sturdiness.

Science or Technology (AP 20)
(page 117)

Science examples: 1, 2, 3, 4, 8; Technology examples: 5, 6, 7. Look for explanations that describe technology as tools or instruments used and explains how science displays an understanding of the world.

Appendix A

Glossary

Red 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 Reader. Vocabulary words are not intended for use in isolated drill or memorization.

A

atmosphere, n. the layer of gases that surrounds Earth

atom, n. the smallest particle of a chemical element that can exist independently

B

balance, n. a device used to determine the mass of an object

biosphere, n. all the living parts of Earth

C

caliper, n. a device used to measure the inside or outside dimension of a shape that is not easily measured by a ruler

cause, v. to make something happen (also n. the reason something occurs)

characteristic, n. a feature or quality that distinguishes something or someone

claim, n. a statement that is open to challenge

climate, n. the average weather conditions in a particular area over a long period

conservation, n. the preservation and careful management of the environment

constraint, n. a limitation on the designed solution to a problem

control, n. part of a test or experiment that is kept the same

criteria, n. conditions that a solution to a problem must meet for the solution to be considered successful

cycle, n. a series of events that repeat in the same order

D

data, n. factual information collected from observations

describe, v. to tell the characteristics of something

dialogue, n. a conversation between people

dynamic, adj. describing something that is continuously changing

E

effect, n. the outcome produced by a cause

electron, n. a subatomic particle with a negative electric charge

elevation, n. the height of a geographical location above a fixed reference point, often sea level

energy, n. the capacity to do work or cause change

estimate, v. to guess at a quantity without taking a precise measurement

evaluate, v. to form a judgment based on evidence

evidence, n. information that helps prove or disprove a conclusion

experiment, n. a scientific process used to test an idea or determine something

explanation, n. the stated reason for something or about how something happens

extreme, adj. the highest degree or most severe

F

fact, n. a thing that is proved to be true

fair test, n. a controlled investigation in which only one variable changes while all other factors remain constant

flask, n. a clear glass laboratory container for measuring and holding liquid

function, n. the way something works or its purpose

G

graduated cylinder, n. a narrow, round glass laboratory container for measuring liquid

H

hearing, n. a meeting in which decision makers collect information from stakeholders

hunch, n. an idea not yet proven with facts

hypothesis, n. a starting point for an investigation based on limited evidence

I

incubate, v. to maintain conditions for development

infer, v. to deduce information from evidence and reasoning rather than from explicit statements

insulation, n. a material used to prevent heat, electricity, or sound from escaping or entering

interact, v. to have an effect on each other

investigate, v. to systematically observe, examine, or study

investigation, n. an instance of investigating

irrelevant, adj. not connected with or relevant to something

isolate, v. to set apart from others

L

laws of nature, n. the natural certainties, such as physics, that describe the behavior of the universe

limit, n. a point or level beyond which something does not or may not extend or pass

M

matter, n. anything that has mass and takes up space

measure, v. to quantify by time, distance, volume, or mass

model, n. a representation of a thing or idea

molecule, n. a group of atoms bonded together

N

neutron, n. a subatomic particle with no net electric charge

O

observation, n. a noted detail

opinion, n. a belief about something that cannot be proven with factual evidence

P

paleontologist, n. a scientist who studies fossils

pattern, n. a reliable sample that enables predictability of characteristics or occurrences

population, n. all the inhabitants of a particular area

predator, n. an animal that naturally preys on others

problem, n. a situation regarded as needing to be changed

process, n. a series of actions or steps taken in order to achieve a particular end

proton, n. a subatomic particle with a positive electric charge

prototype, n. a preliminary version of a design from which other forms are developed

Q

quantify, v. to measure or express the amount of something

quantity, n. the amount or number of a thing

question, n. a sentence worded to elicit information

R

relationship, n. the way in which two or more things are connected

relevant, adj. providing evidence that matters

reliable, adj. able to be trusted

S

sample, n. a small part that helps show what the whole is like

scale, n. an instrument for weighing; *or* a range of comparisons

scale model, n. a physical model in which all parts are equally smaller or larger than the real thing they represent

science, n. a system of knowledge and investigation to determine the truth and physical laws governing phenomena

solution, n. the remedy to a problem

spring scale, n. a device used to determine the weight of an object

stability, n. the tendency of something to remain undisrupted

stakeholder, n. a person with an interest in or who is affected by something

structure, n. the pattern of organization of the materials that make something up

system, n. a set of parts that work together and affect each other

T

technology, n. the use of science in devices or processes to solve problems

temperature, n. the measure of thermal energy of a substance or object

test, n. to systematically observe outcomes from the manipulation of variables

theory, n. a set of ideas used to explain something

tides, n. the alternate rising and lowering of the sea level along a coastline

time, n. the continuing sequence of events and existence in irreversible succession from past, through present, to future

transpiration, n. the process in which plants give off water vapor through pores in their leaves

trial, n. a test of the performance, qualities, or suitability of something

U

unbiased, adj. showing no prejudice for or against something; impartial

V

variable, n. a factor in a test that is changed so the outcome of the change can be observed

verify, v. to make sure or demonstrate that something is true, accurate, or justified

visualize, v. to form a mental image of something

Appendix B

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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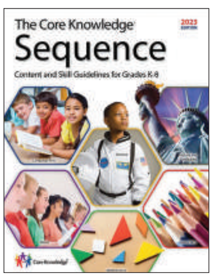
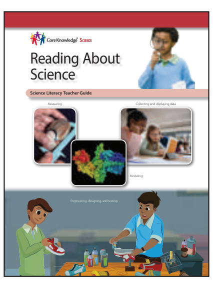


What is the Core Knowledge Sequence?

The *Core Knowledge Sequence* is a detailed guide to specific content and skills to be taught in Grades K–8 in language arts, history, geography, mathematics, science, computer science, and the fine arts. In the domain of computer science, the *Core Knowledge Sequence* outlines topics that build systematically grade by grade to support student learning progressions coherently over time.



For which grade levels is this book intended?

In general, the content and presentation are appropriate for students in the upper elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 3 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the **Core Knowledge SCIENCE** series, visit **www.coreknowledge.org**.

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