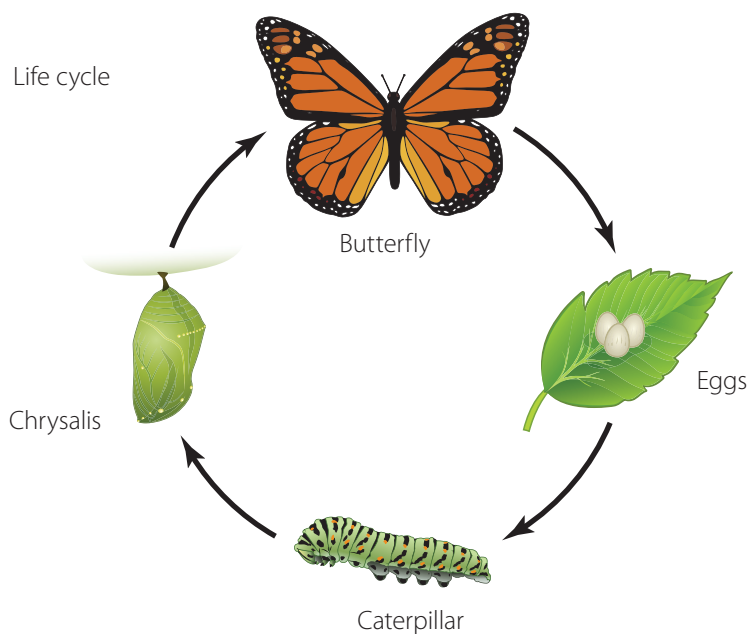
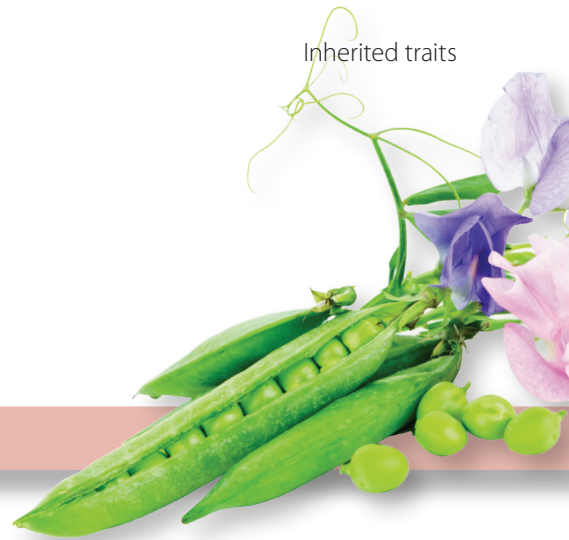


Life Cycles, Traits, and Variations

Teacher Guide

Inherited traits



Gregor Mendel

Variation and species



Life Cycles, Traits, and Variations

Teacher Guide



Creative Commons Licensing

This work is licensed under a
Creative Commons Attribution-NonCommercial-ShareAlike
4.0 International License.



You are free:

- to Share**—to copy, distribute, and transmit the work
- to Remix**—to adapt the work

Under the following conditions:

Attribution—You must attribute the work in the following manner:

This work is based on an original work of the Core Knowledge® Foundation (www.coreknowledge.org) made available through licensing under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. This does not in any way imply that the Core Knowledge Foundation endorses this work.

Noncommercial—You may not use this work for commercial purposes.

Share Alike—If you alter, transform, or build upon this work, you may distribute the resulting work only under the same or similar license to this one.

With the understanding that:

For any reuse or distribution, you must make clear to others the license terms of this work. The best way to do this is with a link to this web page:

<https://creativecommons.org/licenses/by-nc-sa/4.0/>

Copyright © 2019 Core Knowledge Foundation

www.coreknowledge.org

All Rights Reserved.

Core Knowledge®, Core Knowledge Curriculum Series™, Core Knowledge Science™, and CKSci™ are trademarks of the Core Knowledge Foundation.

Trademarks and trade names are shown in this book strictly for illustrative and educational purposes and are the property of their respective owners. References herein should not be regarded as affecting the validity of said trademarks and trade names.

ISBN: 978-1-68380-503-8

Life Cycles, Traits, and Variations

Table of Contents

Introduction	1
Building Science Knowledge	4
Using the Student Reader	7
Using the Teacher Guide	7
Materials and Equipment	12
Sample Pacing Guide	14
Part A	Organisms Have Life Cycles 17
Lesson 1	The Beginning of Life for a Plant ... 19
Lesson 2	Animals Have Life Cycles 26
Lesson 3	Plants Have Life Cycles 33
Lesson 4	Modeling a Life Cycle 39
Part B	Organisms Have Traits 47
Lesson 5	Noticing Different Traits 49
Lesson 6	Traits of Parents, Offspring, and Siblings 55
Lesson 7	Studying Family Traits 63
Lesson 8	Traits Vary Within Populations and Species 69
Part C	The Environment Affects Traits 77
Lesson 9	Investigating Plant Growth 78
Lesson 10	Environments and Traits 83
Lesson 11	Environments and Traits—Investigation Results 90
Part D	Advantages of Specific Variations 95
Lesson 12	Helpful Traits 96
Lesson 13	Traits, Survival, and Differing Environments 104
Lesson 14	Traits and Advantage 111
Unit Review	116
Teacher Resources	123
Activity Pages and Unit Assessment Masters	125
Answer Key and Unit Assessment Evaluation Guide	160
Appendices	166
A. Glossary	166
B. Classroom Safety for Activities and Demonstrations	168
C. Strategies for Acquiring Materials	170
D. Advance Preparation for Activities and Demonstrations	171
E. What to Do When Activities Don't Give Expected Results	172

Life Cycles, Traits, and Variations

Teacher Guide

Core Knowledge Science™ 3

UNIT 2

Introduction

ABOUT THIS UNIT

The Big Idea

This unit focuses on the scientific concepts that organisms grow and change through predictable cycles and possess varied traits.

This unit first examines the life cycles of various plants and animals. Students investigate how life cycles of various organisms differ and what they have in common: the pattern of birth, growth, reproduction, and death.

The focus then shifts to how organisms can be described by their traits and the visible evidence that traits are inherited. Students learn how the environment can affect traits. For example, the size of a plant will be tall or short depending on how much water it gets or the amount of sunlight it receives. Students also learn that some traits can help an individual to survive and reproduce. Other traits can reduce an individual's chances to survive and reproduce. For example, in an area marked by steady, powerful winds, individuals in a bird population that have the trait of big, strong wings may survive and reproduce in greater numbers than individuals in that population that have small, weak wings.

Note to Teachers and Curriculum Planners

This unit introduces Grade 3 students to real-world examples and fundamental concepts that will be explored in greater depth in later grades. Students will learn about the observable stages of life, some of the factors that affect traits, and how traits affect survival. The following are preliminary considerations for planning and instruction relative to this unit:

- Organisms go through changes during their life, which forms a pattern known as a *life cycle*. In this unit, students develop and use models of life cycles to recognize patterns and establish that there are causal directions to the life cycle of all organisms.
- A trait is a characteristic belonging to something. The similarities and differences in traits shared between offspring, parents, and siblings form patterns. Students will organize and interpret data to describe patterns among individuals and families. The unit does not include the genetic mechanisms of inheritance or the prediction of traits.
- In this unit, students will use evidence to support explanations about cause-and-effect relationships between an organism's traits, the environmental conditions that affect its life cycle, and the connection between variations of a trait and the ability to survive, mate, and reproduce.

Note to Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, in particular, students benefit from not just reading about concepts and ideas, but from hands-on experiences. Following the release of the Next Generation Science Standards (NGSS), the Core Knowledge Foundation used this opportunity to update and enhance the science portion of the *2010 Core Knowledge Sequence*. The result of this effort is the revised *2019 Core Knowledge Science Sequence*.

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

Online Resources



To download the *2019 Core Knowledge Science Sequence*, use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit, aligned to the *2019 Core Knowledge Science Sequence*, and informed by NGSS, embodies Core Knowledge's vision of best practices in science instruction and knowledge-based schooling, such as:

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

To see how you can continue to use your current Core Knowledge materials with the 2019 CKSci curriculum, please see below an example of how this unit compares to the *2010 Core Knowledge Sequence*.

Examples of content retained from the <i>2010 Core Knowledge Sequence</i>	Examples of Core Knowledge content in this CKSci unit
Cycles in Nature (Grade 2) <ul style="list-style-type: none">• The life cycle: birth, growth, reproduction, death• Reproduction in plants and animals:<ul style="list-style-type: none">– For example, from egg to egg, from frog to frog Introduction to Classification of Animals (Grade 3) <ul style="list-style-type: none">• Different classes of vertebrates and their defining characteristics:<ul style="list-style-type: none">– Fish, amphibians, reptiles, birds, mammals	Organisms Have Life Cycles <ul style="list-style-type: none">• Different organisms have different life cycles, but all life cycles share common stages:<ul style="list-style-type: none">– Birth, growth, reproduction, death Organisms Have Traits <ul style="list-style-type: none">• Traits: characteristics of living things, including structures, functions, and behaviors• Population: a group of organisms that are similar and live in the same area• Variation: differences among a trait in a population
For a complete look at how CKSci relates to the <i>2010 Sequence</i> , please refer to the full Correlation Charts available for download using the Online Resources Guide for this unit: www.coreknowledge.org/cksci-online-resources	

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

This unit, *Life Cycles, Traits, and Variations*, has been informed by the following Grade 3 Performance Expectations for the NGSS topic *Inheritance and Variation of Traits: Life Cycles and Traits*. Students who demonstrate understanding can:

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

3-LS4-2 Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Online Resources



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

www.coreknowledge.org/cksci-online-resources

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

Sources:

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

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

What Students Should Already Know

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

LS1.B: Growth and Development of Organisms

Grades K–2

- Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change.
- Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.

LS3.A: Inheritance of Traits

Grades K–2

- Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind.

LS3.B: Variation of Traits

Grades K–2

- Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.

LS4.B: Natural Selection

Grades K–2

- Some kinds of plants and animals that once lived on Earth (e.g., dinosaurs) are no longer found anywhere, although others now living (e.g., lizards) resemble them in some ways.

What Students Need to Learn

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

A. Organisms Have Life Cycles

LESSONS 1–4

- Describe the changes that you expect to see occur in a planted seed.
- Identify and describe each stage of the life cycle of an animal (such as a chicken or a mouse).
- Identify and describe each stage of the life cycle of an animal that goes through metamorphosis (such as a butterfly or a frog).
- Identify and describe each stage of the life cycle of a flowering plant.
- Identify and describe each stage of the life cycle of a fern.
- Develop a model to describe how organisms (plants and animals) go through different life cycles but that all life cycles share a common pattern.
- Describe the stages common to all life cycles.

B. Organisms Have Traits

LESSONS 5–8

- Describe an organism's physical traits.
- Compare and contrast the physical traits of multiple organisms.
- Analyze data to identify patterns in the traits of parents and offspring.
- Analyze data to describe variations among organisms of the same species, including within families.
- Compare and contrast the physical traits of multiple organisms (review from Lesson 5), specifically organisms from different species.
- Collect data and organize them in a table to reveal patterns of traits shared by parents and offspring.
- Create a graphical representation that shows variation of traits among siblings.
- Give examples of variation of traits within a population.
- Describe the relationship between populations and ecosystems.
- Tell that variation of traits can help certain individuals survive and reproduce.
- Define *species*.
- Create a graphical representation that shows variation of traits among individuals in a population.

- Describe examples that indicate that the environment can affect an organism's traits.
- Analyze and interpret evidence that demonstrates how the environment can affect an individual's traits.
- Use evidence to explain the cause-and-effect relationship between the amount of light a plant receives and its growth.
- Use evidence to explain the cause-and-effect relationship between the amount of food an animal eats and its growth.
- Use evidence to explain the cause-and-effect relationship between the environment and traits.

D. Advantages of Specific Variations

LESSONS 12–14

- Distinguish between traits that are helpful to an organism and traits that are not helpful.
- Compare advantageous and disadvantageous traits.
- Describe how changes in the environment may allow individuals with certain traits to survive and reproduce in greater numbers than individuals without those traits.
- Construct an explanation to show that, within a population, some individuals have traits that give them a greater advantage than others for survival and reproduction.

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.

USING THE STUDENT READER

Student Reader



The *Life Cycles, Traits, and Variations* Student Reader has seven chapters and a student Glossary providing 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. In addition to Core Vocabulary, the Student Readers include a feature called Word to Know, which provides background information to help students understand key terms, and may sometimes include additional informational boxes, such as Think About.

Explore, then read: In 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. The icon, shown at left, will signal Core Lesson segments that focus on Student Reader chapters.

CKSci 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 CKSci 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-alouds and engagement with the text. The Teacher Guide provides Guided Reading Supports to prompt discussion, clarify misconceptions, and promote understanding in relation to the Big Questions.

USING THE TEACHER GUIDE

Pacing

The *Life Cycles, Traits, and Variations* unit is one of four units in the Grade 3 CKSci series. To meet NGSS Performance Expectations we encourage teachers to complete all units during the school year. To be sure all NGSS Performance Expectations are met, each Core Lesson should be completed, and each requires thirty to forty-five minutes of instruction time. The time it takes to complete a lesson depends on class size and individual circumstances.

Within the Teacher Guide, the Core Lessons are divided into numbered segments, generally five or six, with approximate times listed per segment. The final segment is always a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this Unit Introduction, you will find a Sample Pacing Guide on page 14 and a blank Pacing Guide on pages 15–16, which you may use to plan how you might pace the lessons, as well as when to use the various other resources in this unit. We strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson. As a general rule, we recommend that you spend no more than twenty days teaching the *Life Cycles, Traits, and Variations* unit so that you have time to teach the other units in the Grade 3 CKSci series.

The Core Lessons

- Lesson time: Each Core Lesson constitutes one classroom session of up to forty-five minutes. Understanding that teachers may have less instructional time, we show a time range of thirty to forty-five minutes per lesson. Teachers may choose to conduct all Core Lesson segments, totaling forty-five minutes; may choose to conduct a subset of the lesson segments; or may choose to spend less time per segment.
- Lesson order: The lessons are coherently sequenced to build from one lesson to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

PART	LESSON	BIG QUESTION
A. Organisms Have Life Cycles (3-LS1-1)	1. The Beginning of Life for a Plant	How does a planted seed change?
	2. Animals Have Life Cycles	How do different types of animals change throughout their lives?
	3. Plants Have Life Cycles	How do different types of plants change over their lifetimes?
	4. Modeling a Life Cycle (three class sessions)	How can I model the common stages of a life cycle?
B. Organisms Have Traits (3-LS3-1)	5. Noticing Different Traits	What are examples of physical traits in plants and animals?
	6. Traits of Parents, Offspring, and Siblings	How are traits similar and different within families?
	7. Studying Family Traits	How do the traits of an individual compare to those of its parents and siblings?
	8. Traits Vary Within Populations and Species (two class sessions)	How do traits vary within groups of the same type of organism?
C. The Environment Affects Traits (3-LS3-2)	9. Investigating Plant Growth	How does the environment affect some traits of plants?
	10. Environments and Traits	How does the environment affect the traits of living things?
	11. Environments and Traits—Investigation Results	How did the environment affect the traits of the plant in my investigation?
D. Advantages of Specific Variations (3-LS4-2)	12. Helpful Traits	Which traits are helpful to organisms, and which traits are not?
	13. Traits, Survival, and Differing Environments	Why are traits important when environments change?
	14. Traits and Advantage	How can variation of a trait be an advantage or disadvantage?

PART	LESSON	BIG QUESTION
Unit Review and Assessment	Unit Review	What have I learned about life cycles, traits, and variations?
	Unit Assessment	What have I learned about life cycles, traits, and variations?

Activity Pages and Unit Assessment

Activity Pages



AP 1.1

AP 2.1

AP 3.1

AP 4.1

AP 4.2

AP 4.3

AP 5.1

AP 6.1

AP 7.1

AP 8.1

AP 8.2

AP 9.1

AP 10.1

AP 11.1

AP 12.1

AP 13.1

AP 14.1

AP UR.1

AP UR.2

AP UR.3

Black line reproducible masters for Activity Pages and a Unit Assessment, as well as an Answer Key, are included in Teacher Resources on pages 125–165. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced.

Students' achievement of the NGSS Performance Expectations is marked by their completion of tasks throughout the unit. However, a combined Unit Assessment is provided as a summative close to the unit.

Lesson 1—The Life of a Plant (AP 1.1)

Lesson 2—Modeling a Life Cycle (AP 2.1)

Lesson 3—Modeling Plant Life Cycles (AP 3.1)

Lesson 4—Model Checklist (AP 4.1)

Lesson 4—Comparing Life Cycles (AP 4.2)

Lesson 4—Take-Home Modeling Activity (AP 4.3)

Lesson 5—Plant and Animal Traits (AP 5.1)

Lesson 6—Box and T-Chart (AP 6.1)

Lesson 7—Cheetah Traits (AP 7.1)

Lesson 8—Looking at Leaves (AP 8.1)

Lesson 8—Traits in a Population (AP 8.2)

Lesson 9—Environmental Changes (AP 9.1)

Lesson 10—What Is All Around Me? (AP 10.1)

Lesson 11—Evidence of Changes (AP 11.1)

Lesson 12—Helpful Traits Scavenger Hunt (AP 12.1)

Lesson 13—Whales (AP 13.1)

Lesson 14—A Prickly Tale (AP 14.1)

Unit Review—Science Categories (AP UR.1)

Unit Review—Vocabulary Crossword Puzzle (AP UR.2)

Unit Review—Vocabulary Review (AP UR.3)

Online Resources for Science

Online Resources



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

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

www.coreknowledge.org/cksci-online-resources

Teaching Strategies

Start with the familiar.

Lead with an experience. Begin each lesson with a demonstration, activity, or question about a phenomenon to engage students and focus their attention on the topic. Start with the familiar. Every science topic introduced to students relates in some way to their known world and everyday experiences. The purpose of every lesson is to build a bridge between what is familiar to students and broader knowledge about the way the world works.

Ask the Big Question.

At the beginning of each Teacher Guide lesson, you will find a Big Question and Core Lesson segment devoted to encouraging students to think about this question as they are introduced to new science content. Use this opportunity to engage students in conversation, to think about how their own real-world experiences relate to the topic, or to participate in a demonstration that relates to the Big Question.

Encourage scientific thinking.

Approach the lessons with students not as learning about science but as learning about the world with a scientific mind. Science learning models science practice.

Throughout the lessons, encourage students to ask questions about what they observe, do, and read. Record relevant questions in a prominent place in the classroom. Guide students back to these questions as opportunities to answer them emerge from readings, demonstrations, and activities.

Use continuous Core Vocabulary instruction.

As a continuous vocabulary-building strategy, have students develop a deck of vocabulary cards, adding a card for each Core Vocabulary term as it is introduced. Students can add illustrations and examples to the cards as their comprehension of terms expands. During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Students will be given the opportunity to preview Core Vocabulary words early in the lessons and to engage in Word Work activities toward the end of the lessons. Encourage students to come up with definitions in their own words and to use the words in their own sentences.

Core Vocabulary words for each lesson, as well as other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary definitions in the Word Work lesson segments, as well as in the Glossary on pages 166–167.

Emphasize observation and experience.

Lessons employ various ways for students to learn, including watching, listening, reading, doing, discussing, and writing. To meet the NGSS Performance Expectations, which are multidimensional standards, students must not only gain factual knowledge associated with Disciplinary Core Ideas, but also *use* the content knowledge they acquire.

Use science practices.

Give students opportunities to discover new content knowledge through investigation and to use their new knowledge both in problem-solving exercises and as evidence to support reasoning. Students learn what science and engineering practices are by engaging in those same practices as they learn.

Core Lesson segments are designed to reinforce the idea of science as an active practice, while helping students meet NGSS Performance Expectations. Each lesson segment is introduced by a sentence emphasizing active engagement with an activity.

Make frequent connections.

Use a combination of demonstrations and reading materials, rich with examples, to help students recognize how the science concepts they are learning apply in their everyday lives. Prompt students to relate lesson content to their own experiences, to relate the new and unfamiliar to the familiar, and to connect ideas and examples across disciplines. Refer to the Crosscutting Concepts cited in the lessons, often included in the NGSS References listed at the start of each lesson.

Monitor student progress.

Use verbal questioning, student work, the Check for Understanding assessments at the end of each lesson, and the Unit Assessment at the end of the unit (see pages 155–159) to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.

Effective and Safe Classroom Activities

Online Resources

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

These resources, included at the back of the Teacher Guide on pages 168–172, consist of the following:

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

These resources may also be accessed within the CKSci Online Resources Guide for this unit, available at

www.coreknowledge.org/cksci-online-resources

MATERIALS AND EQUIPMENT

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

Part A: Organisms Have Life Cycles

Lesson 1

- bean pods with seeds (or seed packets)
- paper cups (1 per student)
- potting soil
- water
- eyedroppers (1 per student)
- clear tape
- permanent markers
- stirring sticks
- 2 clear CD cases
- seed catalog
- specialized lamp that is used for growing indoor plants (optional)
- index cards for student vocabulary deck (6 per student)
- internet access and the means to project images/video for whole-class viewing

Lesson 2

- reference books and other research materials
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (3 per student)

Lesson 3

- reference books and other research materials
- index cards for student vocabulary deck (2 per student)

Lesson 4

- poster board (assorted colors)
- construction paper (assorted colors)
- markers
- scissors

Lesson 4, continued

- glue bottles/glue sticks
- shoeboxes (or small boxes or containers)
- colored pencils
- crayons
- craft pom-poms
- yarn
- felt (assorted colors)
- stapler
- hole punch or three-hole punch
- plastic straws
- chenille stick
- craft clay
- reference books with pictures of animal and plant life cycles
- computer/internet access for individual students to do research

Part B: Organisms Have Traits

Lesson 5

- large-form images of animals (or animal reference books with pictures)
- access to at least 2 different plants that students planted in Lesson 1
- 2 different types of houseplants or succulents
- index cards for student vocabulary deck (3 per student)
- internet access and the means to project images/video for whole-class viewing

Lesson 6

- variety of images depicting sibling animals (e.g., reference books, magazines)
- colored pencils or markers

Lesson 6, continued

- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (5 per student)

Lesson 7

- poster board
- markers, assorted colors
- internet access and the means to project images/video for whole-class viewing

Lesson 8

Day 1:

- assortment of plant leaves
- plastic baggies
- marbles in assorted colors
- index cards for student vocabulary deck (1 per student)
- internet access and the means to project images/video for whole-class viewing

Day 2:

- Lesson 7 graphical displays (from each pair of students), for reference only
- poster board
- markers, assorted colors
- internet access and the means to project images/video for whole-class viewing

Part C: The Environment Affects Traits

Lesson 9

- cardboard boxes
- measuring cups/measuring tools
- water
- poster board
- timer
- individual cups of plants
- cell phone with camera
- OPTIONAL: printer to print photos of developing plants

Lesson 10

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

Lesson 11

- Activity Page 9.1
- poster board
- markers, assorted colors
- OPTIONAL: printer to print photos of developing plants

Part D: Advantages of Specific Variations

Lesson 12

- front board or chart paper (make sure there is enough space for drawing)
- front board markers or chalk or, if an interactive board is being used, the proper drawing tools
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (2 per student)

Lesson 13

- index cards (enough for half of the students)
- sticky notes (enough for half of the students)
- water
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (3 per student)

Lesson 14

- writing paper
- assortment of colored pencils

Unit Review

- poster board
- sticky notes (variety of colors)
- markers
- question and answer cards/sheet
- timer

SAMPLE PACING GUIDE

The sample Pacing Guide suggests use of the unit’s resources across a nineteen-day period. However, there are many ways that you may choose to individualize the unit for your students, based on their interests and needs. You may elect to use the blank Pacing Guide on pages 15–16 to reflect alternate activity choices and alternate pacing for your class. If you plan to create a customized pacing guide for your class, we strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson.

Online Resources



For a yearlong pacing guide, please use the link found in the Online Resources Guide for this unit. This yearlong view of pacing also includes information about how this CKSci unit relates to the pacing of other programs, such as CKLA and CKHG in the *Core Knowledge Curriculum Series™*.

www.coreknowledge.org/cksci-online-resources

TG–Teacher Guide; SR–Student Reader; AP–Activity Page

Week 1

Day 1	Day 2	Day 3	Day 4	Day 5
<i>The Beginning of Life for a Plant</i> TG Lesson 1 AP 1.1	<i>Animals Have Life Cycles</i> TG Lesson 2 SR Chapter 1 AP 2.1	<i>Plants Have Life Cycles</i> TG Lesson 3 SR Chapter 2 AP 3.1	<i>Modeling a Life Cycle</i> DAY 1 TG Lesson 4 AP 4.1	<i>Modeling a Life Cycle</i> DAY 2 TG Lesson 4

Week 2

Day 6	Day 7	Day 8	Day 9	Day 10
<i>Modeling a Life Cycle</i> DAY 3 TG Lesson 4 AP 4.2, 4.3	<i>Noticing Different Traits</i> TG Lesson 5 AP 5.1	<i>Traits of Parents, Offspring, and Siblings</i> TG Lesson 6 SR Chapter 3 AP 6.1	<i>Studying Family Traits</i> TG Lesson 7 AP 7.1	<i>Traits Vary Within Populations and Species</i> DAY 1 TG Lesson 8 SR Chapter 4 AP 8.1

Week 3

Day 11	Day 12	Day 13	Day 14	Day 15
<i>Traits Vary Within Populations and Species</i> DAY 2 TG Lesson 8 AP 8.2	<i>Investigating Plant Growth</i> TG Lesson 9 AP 9.1	<i>Environments and Traits</i> TG Lesson 10 SR Chapter 5 AP 10.1	<i>Environments and Traits—Investigation Results</i> TG Lesson 11 AP 11.1	<i>Helpful Traits</i> TG Lesson 12 SR Chapter 6 AP 12.1

Week 4

Day 16	Day 17	Day 18	Day 19
<i>Traits, Survival, and Differing Environments</i> TG Lesson 13 SR Chapter 7 AP 13.1	<i>Traits and Advantage</i> TG Lesson 14 AP 14.1	<i>Science Categories Review Game</i> TG Unit Review AP UR.1, UR.2, UR.3	Unit Assessment AP Unit Assessment

PACING GUIDE

Nineteen days have been allocated to the *Life Cycles, Traits, and Variations* unit to complete all Grade 3 science units in the *Core Knowledge Curriculum Series™*. If you cannot complete the unit in nineteen consecutive days of science instruction, use the space that follows to plan lesson delivery on an alternate schedule.

Week 1

Day 1

Day 2

Day 3

Day 4

Day 5

--	--	--	--	--

Week 2

Day 6

Day 7

Day 8

Day 9

Day 10

--	--	--	--	--

Week 3

Day 11

Day 12

Day 13

Day 14

Day 15

--	--	--	--	--

Week 4

Day 16

Day 17

Day 18

Day 19

Day 20

--	--	--	--	--

Week 5**Day 21****Day 22****Day 23****Day 24****Day 25**

--	--	--	--	--

Week 6**Day 26****Day 27****Day 28****Day 29****Day 30**

--	--	--	--	--

Week 7**Day 31****Day 32****Day 33****Day 34****Day 35**

--	--	--	--	--

Week 8**Day 36****Day 37****Day 38****Day 39****Day 40**

--	--	--	--	--

PART A

Organisms Have Life Cycles

OVERVIEW

Lesson	Big Question	Advance Preparation
1. The Beginning of Life for a Plant	How does a planted seed change?	Gather materials for hands-on investigation. (See Materials and Equipment, page 12.)
2. Animals Have Life Cycles	How do different types of animals change throughout their lives?	Read Student Reader, Chapter 1.
3. Plants Have Life Cycles	How do different types of plants change over their lifetimes?	Read Student Reader, Chapter 2.
4. Modeling a Life Cycle (3 days)	How can I model the common stages of a life cycle?	Gather materials for hands-on investigation. (See Materials and Equipment, page 12.)

Part A: What's the Story?

All organisms, including plants and animals, go through stages of growth and development known as *life cycles*. This series of lessons helps students learn about the similarities and differences between the life cycles of plants and animals, including the stages that are common to both types of organisms (birth, growth, reproduction, and death). Please note that the human life cycle is not used as an example in this series of lessons.

In Lesson 1, students begin by setting the foundation for the remainder of the unit. Students plant seeds, such as lima beans and radishes, which they observe as the seeds grow and develop across the remainder of the unit. Like all organisms, plants go through the stages of their life cycle if their needs are met, and this lesson introduces students to the beginning of a plant's life cycle—germination.

In Lesson 2, students read and learn about the various stages in the life cycles of different types of animals. This lesson addresses the similarities and differences between animals that give birth to live young, lay eggs, or go through different types of metamorphoses in their development. Students then draw a simple model of an animal's life cycle in preparation for the hands-on activity in Lesson 4.

In Lesson 3, students read and learn about the various stages in the life cycles of different types of plants. This lesson addresses the similarities and differences between flowering plants, which produce seeds, and ferns, which do not. Students then draw a simple model of a plant's life cycle in preparation for the hands-on activity in Lesson 4.

In Lesson 4, students conduct a hands-on activity in which they build three-dimensional models of plant and animal life cycles. The goals of this lesson are for students to compare their models of different organisms and to recognize the common stages of all organism life cycles (birth, growth, reproduction, and death).

So, to repeat, **all organisms have life cycles with common stages**. Help your students grasp this concept, and you will prepare them to meet or exceed the NGSS Performance Expectation, 3-PS1-1. In doing so, you will also lay the groundwork for meeting the NGSS expectations addressed in the rest of this unit.

LESSON 1

The Beginning of Life for a Plant

Big Question: How does a planted seed change?

AT A GLANCE

Learning Objective

- ✓ Describe the changes that you expect to see occur in a planted seed.

Lesson Activities

- teacher demonstration
- hands-on activity
- ongoing student observation
- discussion

NGSS References

Disciplinary Core Idea LS1.B: Growth and Development of Organisms

Crosscutting Concept: Patterns

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to this lesson because a life cycle can be best illustrated through the use of models for students to visualize. Models can help students identify patterns within life cycles, to reinforce understanding that stages repeat in the life cycle.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

flowering plant
germination
growth

life cycle
organism

pattern
plant

seed
stages

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Activity Page



AP 1.1

Activity Page

The Life of a Plant (AP 1.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- bean pods with seeds (or seed packets)
- paper cups (1 per student)
- potting soil
- water
- eyedroppers (1 per student)
- clear tape
- permanent markers
- stirring sticks
- 2 clear CD cases
- seed catalog
- specialized lamp that is used for growing indoor plants (optional)
- index cards for student vocabulary deck (6 per student)
- internet access and the means to project images/video for whole-class viewing

Preparation and Rationale

Prepare for this unit well in advance by planting and growing your own bean plant for approximately 40 days. You will then have the mature plant, and with good timing, you will have flowers and pods from which you can then collect the seeds that will be given to students to plant themselves. This preparation may help students visualize the plant life cycle and the connection between offspring and parent plants.

ALERT—Sprout half a dozen extra plants to replace any student plants that die during this activity.

If you cannot plant and grow your own bean plant, purchase packets of seeds instead. A seed catalog is a good place to start for recommended seeds that grow relatively quickly and well in a classroom setting, but some specific recommendations for this hands-on activity are Wisconsin Fast Plants® and lima beans.

You will need to set aside space next to the classroom window. If your classroom does not have a window, prepare a safe area for the plants outside. If growing them outside is not an option, see if you can get a specialized lamp that is used for growing indoor plants.

Note to Teachers

This lesson sets the foundation for the phenomena that students will learn about and observe later in the unit.

- In this lesson, students plant seeds into cups and provide ongoing care to ensure the plants' growth and development. Students continually care for the plants and observe their growth over days and weeks to support 3-LS1-1, ultimately describing patterns observed across the life cycles of multiple kinds of plants.
- As students plant their seeds into cups, you will plant seeds into clear CD cases. The purpose of this is to be able to show students at a later time what happens underneath the soil when the plant grows (as students will not be able to see what happens beneath the soil when planting their seeds into cups). After students are shown the cross section of the plant's roots beneath the soil, the CD cases can be discarded.
- In later lessons, students continue to study the plants to understand that they look similar to their parents and siblings, supporting 3-LS3-1.
- Finally, students get to see what happens when the environment changes, such as when some plants receive more sunlight and other plants receive less sunlight, supporting 3-LS3-2.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

10 MIN

How does a planted seed change? Tell students there are many, many types of seeds and beans and that each kind can grow into a plant. Different seeds grow different plants.

Explain that in today's class session they will plant seeds. They will then monitor and care for these seeds over the coming weeks to watch them grow into plants. Students will work individually to plant a seed into a paper cup.

Tell students that as they plant seeds into cups, you will plant seeds into clear CD cases. Explain that planting the seeds into a clear CD case will eventually allow the students to see what is happening beneath the soil as the plant grows its roots.

2. Preview the investigation

5 MIN

Activity Page



AP 1.1

Distribute and review The Life of a Plant (AP 1.1). Let students know that this is a student-led investigation to plant seeds into paper cups. Review the observation section and table with students, but let them know that they will not complete the observation section of AP 1.1 for several days. Keep a calendar to remind students to observe the plants and record their observations over the course of several lessons. Refer to the Teacher Resource: Observation Schedule at the end of this lesson for a reference of how and when to guide students through these observations. After each observation, discuss what students are seeing in terms of life cycle changes.

Should any of the plants die throughout this process, call student attention to the process of death in the life cycle.

Let students know that there are no correct answers for the observations of the plants and that students can include as many observations as they want. Give examples of the types of observations students might make, such as the following:

- size
- color
- structure (e.g., number of leaves)

Preview Core Vocabulary Terms

Before students get started, write the following terms on the board or chart paper. As students work through the activity, call out these core terms so that students begin to become familiar with them. These terms will be more formally taught in later lessons.

flowering plant
germination

life cycle
organism

plant
seed

3. Facilitate the investigation.

15 MIN

Give students time to collect the materials they want to use for their investigations. Have students write their names on the planting cups before they start filling the cups with soil. Although this is a student-led investigation, you should provide guidance and support to ensure successful plant growth.

ALERT—Successful plant growth is crucial to the ability to observe and study these plants in later lessons of the unit. In this unit, students will refer back to these plants to observe their growth, make comparisons about plant traits, and understand how changes in the environment affect plant growth and survival.

As students get started, circulate throughout the room, and provide support if necessary.

SUPPORT—If you see students struggle with how to plant their seeds, offer some guidance, including the following:

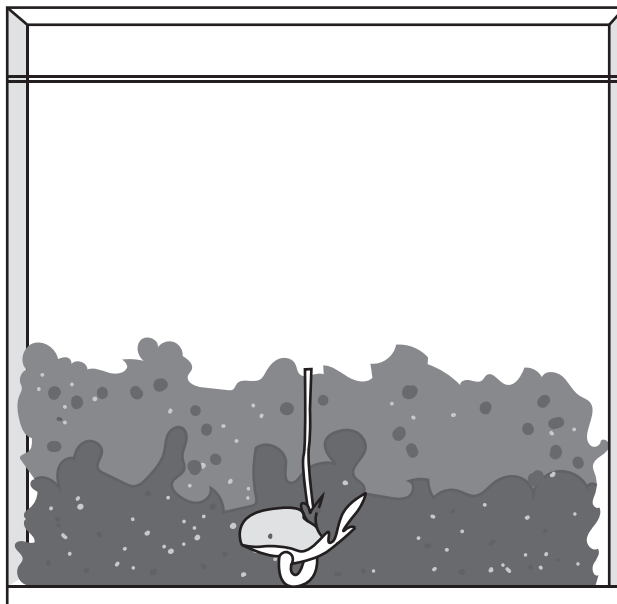
- Only fill the cup halfway with soil before planting the seed.
- Place the seed in the center of the cup (as opposed to near the edges).
- Cover the seed with more soil.
- Use the eyedropper to drip water on the soil.

Guide students on the proper way to handle plant seeds: gently without applying too much pressure, which will crack or squash the seed. Remind students to not overwater their seeds. They should add enough water to fully saturate the dirt, but not so much that it will create an overspill of water.

While students work on their activity, plant your own seeds in a couple of CD cases. (The purpose of using more than one CD case is to provide a backup in case one set of seeds does not grow.) Follow these steps:

- Open the CD case. (Remove any paper from inside the case.)
- Place a handful of potting soil in a paper cup.
- Use the eyedropper to drop water in the cup. Add enough water to saturate the soil and get it sticky.
- Use the stirring stick to mix the water and soil together.
- Fill the CD case halfway with the soil. Keep the half that is closest to the case's hinge empty (no soil). The plant needs this space to grow.
- Plant the seed into the soil.
- Water the seed with an eyedropper.
- Close the case. Stand it upright so that the hinge is at the top.
- Use tape to close any gaps in the CD case. Keep the gap in the hinge open.

NOTE—Plant the bean in the middle of the soil with the concave side facing down, away from the hinge of the CD case. The bean should look like a frown instead of a smile when planted correctly. (If you are using tiny seeds, such as radish seeds, plant them at the top edge of the potting soil in the CD case.)



As you and students work on the activity, explain to them the purpose of planting seeds in a paper cup and in a clear CD case. The paper cup will give the seed more room to grow bigger, but the clear CD case allows students to see what is happening beneath the soil. Explain that once the plants start to grow, students will be able to see the roots in the soil within the CD case. Roots will also form in the paper cup, but students will not be able to see them.

Collect students' cups, or have students set their cups near a classroom window. Alternatively, put the cups in a safe area outside or underneath a specialized lamp used for growing indoor plants.

Tell students that every three or four days, they will check on and water their plants and observe how their plants are growing. Go over how to care for the plants on page 2 of Activity Page 1.1.

SUPPORT—Students will check on their plants every three or four days. Each time they check on their plants, they should only add ten to twenty drops of water from the eyedropper. As students check on their plants, remind them to not disturb the soil or try to search for their seeds in the cups.

As the ongoing investigation continues, show students the seeds that you planted in the clear CD cases, and allow them to observe what is happening beneath the soil. Since you all planted the same kinds of seeds, you can tell students that their seeds look the same way underneath the soil in the cups.

4. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Have students write each term in the upper left corner of an index card and underline it (one term per card):

flowering plant
germination

life cycle
organism

plant
seed

Word Work

- **plant:** Point out that *plant* can be a noun or a verb. Explain that *plant* is a broad term and that there are many different kinds of plants. Ask volunteers to use *plant* in a sentence, first as a noun and then as a verb. Write two sentences on the board or chart paper (one using *plant* as a noun, the other as a verb): *The plant is near the window* and *I will plant the bean sprouts now*. Have students copy the sentences on their card and underline the word *plant*. Ask volunteers to explain how they know which use of the word *plant* is a noun and which is a verb.

Introduce students to the rest of the words, and have them prepare their cards. Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add definitions to the rest of these cards in later lessons.

5. Summarize and discuss.

5 MIN

Review with students how they planted their seeds into cups, including what materials they used. Draw attention to similarities, such as how much soil students used or where they planted the seed within the cup. Hold a discussion about what they think will happen to their plants over time.

If time permits, show students a time-lapse video of a plant growing to give them an idea of what will happen with their plants.

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 1.1) for sample student responses.

- Only collect the completed The Life of a Plant (AP 1.1) after students complete their observation tables at the end, which will be days after this lesson takes place, as the plants require ongoing observation.
- Scan the student responses, checking for understanding of the investigation itself, as well as the types of things to observe in the plants as they grow and change.

Teacher Resource: Observation Schedule

Write the dates in the date column below for when you plan to have students make the following observations:

Plant Growth Phase	Date
When plants have sprouted, approximately three days after planting, have students revisit their seeds to observe changes. Instruct students to record what they observe, and then discuss. Explain that in flowering plants, the stage where the tiny plant sprouts from the seed is called <i>germination</i> . This is similar to the life cycle step called <i>birth</i> for animals.	
Have students observe the plants when they have leaves but no flowers. Explain that this is part of the life cycle known as <i>growth</i> . Instruct students to record what they observe, and then discuss.	
Have students observe the plants when they have leaves and flowers. Explain that this part of the life cycle is known as <i>maturity</i> . Instruct students to record what they observe, and then discuss.	
Have students observe when the flowers are in full bloom and going to seed. Explain that this is an example of reproduction. This is similar to the life cycle step of reproduction for animals. Instruct students to record what they observe, and then discuss.	

LESSON 2

Animals Have Life Cycles

Big Question: How do different types of animals change throughout their lives?

AT A GLANCE

Learning Objectives

- ✓ Identify and describe each stage of the life cycle of a chicken and a mouse.
- ✓ Identify and describe each stage of the life cycle of a butterfly and a frog.

Lesson Activities

- reading
- discussion and writing

NGSS References

Disciplinary Core Idea LS1.B: Growth and Development of Organisms

Crosscutting Concept: Patterns

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to this lesson because life cycles are often represented by models, specifically to help people understand and describe phenomena that occur over the course of time. In this lesson, students observe animal life cycle models and then develop their own simple drawing of an assigned animal life cycle based on what they have learned.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

adolescence

animal

birth

death

life cycle

metamorphosis

organism

pattern

reproduction

stages

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 1

Activity Page



AP 2.1

Student Reader, Chapter 1
“Animals Have Life Cycles”

Activity Page
Modeling a Life Cycle (AP 2.1)

Make sufficient copies for your students prior to conducting the lesson.

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
- index cards for student vocabulary deck (3 per student)

Note to Teachers

Set some time aside for students to observe their planted seeds from Lesson 1. Refer to your Teacher Resource: Observation Schedule at the end of Lesson 1 for the timing of student observation periods.

1. Focus student attention on the Big Question.

5 MIN

Online Resources



How do different types of animals change throughout their lives? Open the lesson with a video that shows a mosquito life cycle model. (See the Online Resources for a link to a suggested video.) (See **Know the Standards** for support.)

SUPPORT—Tell students that as they watch, they should tell when birth, growth, reproduction, and death occur.

Ask what students can observe in the video:

- » What changes do mosquitos go through during their lifetimes?
- » How do you know?
- » What do you think are some of the stages in the mosquito's life cycle?

Have students keep the video in mind as they go through the remainder of the lesson. They will be asked to compare what they have learned in the video to what they will learn from their Student Reader.

2. Read and discuss: "Animals Have Life Cycles."

20 MIN

Preview Core Vocabulary

Direct students to take out their existing Core Vocabulary cards from the previous lesson for these terms:

organism **life cycle**

Have students prepare three additional cards for the following words:

adolescence **metamorphosis** **reproduction**

Instruct students to add definitions to all the cards as they read the chapter. Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will continue to refer to the deck throughout the unit.

Know the Standards

How are models used when teaching about life cycles? Scientific models can take many forms, including illustrations, computer models, and even time-lapse videos of real-world phenomena that take too long to observe directly. Videos and flow charts are common types of models used to describe cycles and patterns of life and growth. Connect what students observe in the video to what they are about to read in the Student Reader, such as thinking about time scales as noted in the models.



Read together, or have students read independently, “Animals Have Life Cycles,” Chapter 1 in the Student Reader. The selection introduces the idea that all animals, regardless of type, go through common stages (birth, growth, reproduction, death) and that some stages are very similar when comparing different animals while other stages vary.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 1

After students have read the page, write the following words on the board or chart paper: *death, birth, reproduce, grow*. Then have students put the terms into the order in which they happen for a single polar bear that does not have any young. (See **Know the Science 1.**) Ask students if they think other animals’ life cycles happen in the same order. Have volunteers explain their answers.

Pages 2–3

Emphasize to students that without birth, there is no growth; without reproduction, there is no birth. All of these parts of the life cycle depend on each other to keep life moving forward.

Prompt students to think about how the life cycle of a mouse compares to the life cycle of a mosquito. Ask: How is the life cycle of the mouse similar to the life cycle of the mosquito you saw in the video at the beginning of the lesson? How are the two life cycles different?

SUPPORT—If needed and there’s time, allow students to rewatch the video about the life cycle of the mosquito. Ask students to note particular features and characteristics of a developing mosquito, and record student ideas on the board or chart paper. Using the visual model of a mouse life cycle as a guide, draw a collaborative model of a mosquito’s life cycle as a class to help students compare the two organisms.

CHALLENGE—Have students find reference material (e.g., online videos) about other organisms that have similar life cycles to the mouse. Use this opportunity to emphasize the diversity of life and preview the species that students will be assigned to work on in later lessons. For instance, there are aquatic animals, such as whales, that give birth like mice.

Know the Science

1. What is the correct order for a bear’s life cycle? *There is a clear order for a single polar bear, but not for multiple generations.* There is a difference between the cycle model, which includes multiple generations of an organism, and comparing that scale to a linear model, such as that which includes a single bear. For a species or multiple generations of an organism, there is no linear order in which the life cycle occurs, as death is not the “end” of the cycle. Since there are future generations, life continues, and death does not stop the life cycle. To think that death is the end of the cycle mixes up the scale of the model in question. Therefore, when asking students to put the stages of the cycle in correct order, this linear model should only apply to an individual organism that does not reproduce or have any young.

Page 4

Reread the first paragraph aloud, emphasizing the term *young*. Discuss with students that *young* can be used as an adjective (*the young girl played outside*) or as a noun (*the female mouse protects her young*). In this second example, *young* refers to the mouse's babies. A hen protects her young as well, helping the chicks survive and grow.

SUPPORT—Discuss with students whether they have ever seen an animal born from an egg. After students read this page, ask the following:

- » Where do the eggs come from?
- » What animals, other than birds, are born from hard-shelled eggs? (*most reptiles, including crocodiles, turtles, and most snakes*)

ALERT—Be sure to avoid the misconception that all reptiles lay hard-shelled eggs, as this is an overgeneralization. Some reptiles—such as some species of snakes, skinks, and chameleons—give birth to live young. These are the exceptions, not the rule, however.

CHALLENGE—Have students find reference material (e.g., online videos) about other interesting organisms that have similar life cycles to that of the chicken, such as the largest egg-laying snakes.

Page 5

Point out to students that a mosquito is also an insect. Ask students how the video model of its life cycle compares to that of the butterfly.

SUPPORT—Have students name other insects (*ants, bees, grasshoppers, etc.*), and ask whether their life cycles would be similar to or different from the butterfly's and the mosquito's. For instance, many ants and bees also lay eggs that hatch as pupae and undergo metamorphosis. Many grasshoppers undergo incomplete metamorphosis, as the hatchlings/nymphs look very similar to the adults.

Page 6

Write the following terms on the board or chart paper: *live birth, laying eggs, metamorphosis*. Ask students to provide examples of animals not listed in this lesson. Then ask them which life cycle each animal would likely have based on its similarities to and differences from the animals discussed in the Student Reader.

SUPPORT—Make sure students understand the meaning of the term *hind*, as in *hind legs*. Discuss other animals that have hind legs, such as horses, cows, and dogs.

3. Teach Core Vocabulary.

5 MIN

Word Work

Have volunteers share the definitions they recorded, as directed, on their Core Vocabulary cards during the reading and discussion of the chapter. Encourage students to adjust their notes as they learn clarifying details about each term. Students' definitions do not have to be verbatim definitions provided in the Student Reader. Have students add an example to each term's card.

- **organism:** (n. any living thing) (*Possible examples: trees, birds, mushrooms*)
- **life cycle:** (n. the set of stages of an organism's life) (*Birth and death are two examples of these stages.*)

- **adolescence:** (n. a stage of the life cycle when a young animal is developing into an adult) Point out that adolescence is a life cycle stage and that an individual organism that is in this stage is called an *adolescent*. (Example: In humans, teenagers are adolescents.)
- **reproduction:** (n. the process of making new organisms) Explain that organisms that have reproduced are called *parents*. (Example: A bird with eggs in its nest is in the process of reproduction.)
- **metamorphosis:** (n. a change of form during the life cycle of some animals) For students, insects and amphibians will be the most familiar animals that undergo metamorphosis. Have students add an example of two forms of the same animal. (Sample answer: caterpillar, butterfly)

4. Lead a discussion.

10 MIN

Activity Page



AP 2.1

Introduce Modeling a Life Cycle (AP 2.1). Explain to students that they will complete the Activity Page based on what they have learned so far in the lesson. Allow them to choose any animal they wish that has not been used in the lesson. Encourage students to compare their animal to one of those covered in Student Reader Chapter 1 “Animals Have Life Cycles.” From that comparison, invite them to draw their animal’s life cycle. Explain that this activity will help them prepare to build a more complex life cycle model in Lesson 4.

SUPPORT—Some students may struggle to identify the type of animal they will choose. If so, offer a brief list of possibilities from the following categories: insects, mammals, birds, reptiles, fish, amphibians. Specific examples are grasshoppers, spiders, ants, cows, horses, cats, dogs, hawks, hummingbirds, falcons, lizards, snakes, sharks, and newts. You may allow students time to use reference books or the internet to identify their animal and its life cycle before beginning their models.

If needed, help students by writing words related to the different cycles on the board or chart paper, but do not place them in the correct order. These can include *birth, death, growth, reproduction, adolescence, metamorphosis*, and so on. Explain to students that they may draw from these as they work on the life cycle models.

Lead a discussion about the examples students drew on their Activity Page. Ask volunteers to share their animal life cycle models. Draw attention to similar examples that different students have identified. In every case, have students describe stages that appear in all animals’ life cycles regardless of type. (See **Know the Science 2** for support with analysis.)

Know the Science

2. What life cycle stages are common to all animals? Birth, growth, reproduction, death. All types of animals are born in one way or another. This means that they are the product of reproduction, or the process by which organisms have offspring. They start out small and grow larger and more mature over time. Once they reach maturity, they, too, can reproduce. At the end of an animal’s life, it dies. The life cycle continues if the animal has reproduced and given birth to any young.

- Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection.
 - » Were any of your life cycle models like the models we read about in the Student Reader? Which one(s)?
 - » Were any of the life cycle models different from what we read about in the Student Reader? Which example is the most different from the organisms that we read about?

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 2.1) for correct answers and sample student responses.

- Collect the completed Modeling a Life Cycle (AP 2.1). Scan the models that students made. If models contain gaps in the animal life cycle, engage in further discussion, emphasizing the stages that are missing.
- Address any common misconceptions, such as that the life cycle stops at death. This is only true if the animal does not reproduce. However, the life cycle for a species continues.

LESSON 3

Plants Have Life Cycles

Big Question: How do different types of plants change over their lifetimes?

AT A GLANCE

Learning Objectives

- ✓ Identify and describe each stage of the life cycle of a flowering plant.
- ✓ Identify and describe each stage of the life cycle of a fern.

Lesson Activities

- reading
- discussion and writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS1.B: Growth and Development of Organisms

Crosscutting Concept: Patterns

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to this lesson because plant life cycles are often represented by models. Models can help visualize the causal direction of the life cycle of plants. In this lesson, students observe plant life cycle models and then draw a simple one based on what they have learned.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

death

flowering plant
germination

growth

life cycle
organism

pollination

reproduction
seed

spore

stages

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 2

Student Reader, Chapter 2
“Plants Have Life Cycles”

Activity Page
Modeling Plant Life Cycles
(AP 3.1)

Activity Page



AP 3.1

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- reference books and other research materials
- index cards for student vocabulary deck (2 per student)

Note to Teachers

Set some time aside for students to observe their planted seeds from Lesson 1. Refer to your Teacher Resource: Observation Schedule at the end of Lesson 1 for the timing of student observation periods.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How do different types of plants change over their lifetimes? Ask students what kind of plants they have observed at home, at school, or in other places. Have them describe these plants, telling what color they are, how big they are, and what kind of leaves they might have. Prompt students to think about the kinds of seeds, flowers, or other structures that are component pieces of the plants as well. Then ask the following:

- » Do the plants you have observed look different at different times of year?
- » In the time that you have seen them, have they changed?
- » How have they changed?

Have students think back to the previous lesson, where they learned about animal life cycles. Prompt them to think about similarities between how plants and animals change during their lives. Ask the following:

- » Do plants have life cycles?
- » Are plants born, do they grow and reproduce, and do they die?
- » Do you think that plant life cycles are like animal life cycles? Why?

SUPPORT—Allow volunteers to share with a partner their experiences with growing plants and caring for pets. Ask students to turn and talk to someone sitting near them to discuss what plants and animals need in order to survive and grow. Students can also draw upon their experience of planting seeds in Lesson 1 to recall what it is like to grow and care for plants.

2. Read and discuss: “Plants Have Life Cycles.”

20 MIN

Student Reader



Ch. 2

Read together, or have students read independently, “Plants Have Life Cycles,” Chapter 2 in the Student Reader. The selection reinforces the ideas that all plants, regardless of type, go through stages from germination (which is similar in some ways to birth), to growth, to reproduction, and to death and that some stages are the same for all plants while other stages vary.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to look for these new terms as they read.

flowering plant
germination

pollination
seed

spore

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 7

Ask students if they have ever eaten a strawberry or other kind of fruit. Have them name other fruits. Point out that, like strawberries, all fruits come from flowering plants. Ask the following:

- » Do all fruits have seeds associated with them?
- » What do you think the purpose of the fruit is?
- » How do you think the fruit can help a plant continue its life cycle?

Understand that students likely will not know the answers to these questions. Tell them that they will learn more about fruits and other aspects and parts of plants as the lesson continues.

Pages 8–9

Point out to students that in some flowering plants, seeds are protected by fruits. Ask students to identify fruits they have eaten that contain seeds. (*Examples include apples, cherries, grapes, oranges, plums, watermelons, and pears.*) Ask the following:

- » How does the fruit help protect the seed? (*The fruit keeps the seed moist.*)

SUPPORT—If needed and there’s time, allow students to use their research materials to look up fruits and their purpose.

Reinforce prior knowledge of plant needs, such as water and sunlight. Discuss the fact that without germination, there can be no growth. Growth is a life cycle stage

that is common between plants and animals. Help students describe their thinking about the concepts of birth and germination. Ask students to explain how these processes are similar or different. (See **Know the Science 1** to help with analysis and support.)

CHALLENGE—Ask students to find a reference to the oddest-looking fruits that they can find. Have students share what they find out about the plants that grow these fruits, including where the plants can be found, what the seeds look like, and so on.

Pages 10–11

Now that students have read about the life cycles of both flowering plants and ferns, prompt them to compare the two. Ask the following:

- » How are the life cycles of flowering plants and ferns similar?
- » How are the life cycles of flowering plants and ferns different?

Page 12

Write the following terms on the board or chart paper: *seed, fruit, flower, spore*. Have students identify whether each word goes with a flowering plant or a fern.

SUPPORT—If students struggle to categorize the plant-related words, allow them to look back over their Student Reader.

3. Encourage discussion.

10 MIN

Activity Page



AP 3.1

Distribute and review Modeling Plant Life Cycles (AP 3.1). Explain to students that they will complete the Activity Page based on what they have learned so far in the lesson. Allow them to choose any plant they wish if it has not been used in the lesson. Encourage students to compare their plant to one of those covered in Student Reader Chapter 2 “Plants Have Life Cycles.” From that comparison, invite them to draw their plant’s life cycle. Explain that this activity will help them prepare to build a more complex life cycle model in Lesson 4.

SUPPORT—Some students may struggle to identify the type of plant they chose (flowering plant or fern). If so, allow them time to use reference books or the internet to identify it and its life cycle before beginning their drawings.

If needed, help students by writing words related to the different cycles on the board or chart paper, but do not place them in the correct order. These can include *germination, death, growth, pollination, seeds, reproduction*, and so on. Explain to students that they may draw from these as they work on the life cycle models.

Know the Science

1. Is germination the same as birth? No. Germination is a process by which a plant grows from a seed. When a seedling begins to sprout from a seed that has been planted, this is an example of germination. Although some may oversimplify this process and consider it the “birth” of a plant, this is not the same as the birth process in the animal life cycle. Students should be able to draw parallels between the two processes but should also know that they are not one and the same.

Lead a discussion about the examples students recorded on their Activity Page. Ask volunteers to share their plant life cycle models. Draw attention to similar examples that different students have identified. In every case, have students describe stages that appear in all plants' life cycles regardless of type. (See **Know the Science 2** for support with analysis.)

- Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection.
 - » Were any of the life cycle models similar to or different from the models we read about in the Student Reader?

4. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Students have already prepared cards for the following terms.

flowering plant **seed** **germination**

Have students prepare new Core Vocabulary cards for these terms and add definitions in their own words to all of the cards based on what they read in the chapter.

pollination **spore**

Word Work

Revisit the following terms, which were introduced in previous lessons.

- **flowering plant:** (n. a plant that produces flowers during its life cycle) First, have students write the definition in their own words. Then have students draw an example of a flowering plant on their card.
- **seed:** (n. the part of a plant that protects material that sprouts into a new plant) Point out that *seed* can be both a noun and a verb. Ask volunteers to use *seed* in a sentence, first as a noun and then as a verb. (*Noun: The seed grew into a new plant. Verb: The farmer waited for the right conditions to seed her field.*)

Know the Science

2. What life cycles are common to all plants? *Germination (birth), growth, reproduction, death.*

All types of plants “begin” when parent plants reproduce. The seed or the spore germinates and develops into a new plant. The plant grows and is eventually mature enough to reproduce as well. At the end of its life, it dies. Remind students that although the individual will die, the species of organism will continue if they reproduce.

- **germination:** (n. the beginning of the growth process when a plant sprout comes out of a seed) When a plant germinates, it develops from a seed or spore and grows. Ask students to write on their card which stage in an animal's life cycle is closest to germination. (*birth*)

Address the two new Core Vocabulary terms.

- **pollination:** (n. the transfer of pollen that causes flowering plants to reproduce) Have students complete the sentence frame: Pollination happens when pollen transfers from (*one flower*) to (*another flower*).
- **spore:** (n. a tiny structure on some nonflowering plants that can grow into a new plant) Tell students that spores are very tiny. They look like dusty material similar to pollen. But spores do not need to transfer from one plant to another to make a new plant. Have students record how spores are different from pollen.

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 3.1) for correct answers and sample student responses.

- Collect the completed Modeling Plant Life Cycles (AP 3.1). Scan the models that students made. If models contain gaps in the plant life cycle, engage in further discussion, emphasizing the stages that are missing.
- Address any common misconceptions, such as that the life cycle stops at death. This is only true if the plant has not reproduced. However, the life cycle continues for the species as a whole.

LESSON 4

Modeling a Life Cycle

Big Question: How can I model the common stages of a life cycle?

AT A GLANCE

Learning Objectives

- ✓ Develop a model to describe how an organism goes through its life cycle.
- ✓ Compare models of multiple life cycles to determine common patterns.
- ✓ Describe the stages common to all life cycles.

Lesson Activities (3 days)

- teacher demonstration
- hands-on activity
- student observation
- discussion

NGSS References

Disciplinary Core Idea LS1.B: Growth and Development of Organisms

Crosscutting Concept: Patterns

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to this lesson because models can help describe and explain phenomena. In this three-day lesson, students will develop individual models of plant and animal organisms and discuss comparisons based on patterns of the life cycle across all organisms.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced during this lesson.

birth
death

growth
life cycle

pattern
stages

Instructional Resources

Activity Pages



AP 4.1

AP 4.2

AP 4.3

Activity Pages

Model Checklist (AP 4.1)

Comparing Life Cycles (AP 4.2)

Take-Home Modeling Activity
(AP 4.3)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- poster board (assorted colors)
- construction paper (assorted colors)
- markers
- scissors
- glue bottles/glue sticks
- shoeboxes (or small boxes or containers)
- colored pencils
- crayons
- craft pom-poms
- yarn
- felt (assorted colors)
- stapler
- hole punch or three-hole punch
- plastic straws
- chenille stick
- craft clay
- reference books with pictures of animal and plant life cycles
- computer/internet access for individual students to do research

Prepare in Advance

Prepare for this lesson in advance by making sample life cycle models to show students for inspiration. Show students examples of models that incorporate materials such as the following:

- four-sided box
- flip-book
- diorama
- pinwheel

If you do not have computers or internet access in the classroom, make sure to provide reference books (with pictures), magazines, and so on so that students can learn about the life cycles of particular plants and animals. See the Teacher Resource: Plants and Animals at the end of this lesson for possible animal and plant ideas that could be assigned to, or selected by students.

Prepare for Day 3 of this lesson by setting out all the plant and animal life cycle models, before class starts, for students to complete a gallery walk and compare their model with others.

Note to Teachers

Set some time aside for students to observe their planted seeds from Lesson 1. Refer to your Teacher Resource: Observation Schedule at the end of Lesson 1 for the timing of student observation periods.

1. Day 1: Focus student attention on the Big Question.

10 MIN

Activity Page



AP 4.1

How can I model the common stages of a life cycle? Explain to students that, in order to apply their learning about life cycles so far, they will make two life cycle models: one for an animal and one for a plant.

Distribute and review Model Checklist (AP 4.1). Tell students that they will work individually to make their models and that they can choose to make one of the following types of models:

- four-sided box
- flip-book
- diorama
- pinwheel

SUPPORT—Show students your sample models so they can see examples of what each type of model should look like. Tell students that they will not be graded on their artistic ability, but rather on how well they understand the common life cycle stages.

Review Activity Page 4.1 with students so they are clear on the requirements for their models. Tell them that they should refer to this Activity Page when making their checklists to make sure they include all the important parts.

Reassure students that there will be enough time to build these models. On the first day, they will work on the plant life cycle models. On the second day, they will work on the animal life cycle models. And on the third day, they will do a gallery walk to look at other students' models and identify the common life cycle stages.

2. Encourage student questions.

5 MIN

Lead a discussion about the model examples you show to students. Students may have questions about how to make certain parts of a model, such as how to put the pinwheel together. Answer questions, and assure them that you will go around the room to answer more questions as they get started. If time allows, record student questions on the board or chart paper for all to consider as they work.

3. Support student modeling.

25 MIN

Tell students that they can pick the type of plant—such as a buttercup or an orange tree—to use for their life cycle or refer them to the choices on the Teacher Resource: Plants and Animals at the end of this lesson. Remind students that their life cycles must depict the following stages: birth, growth, reproduction, and death.



Give students time to collect the materials they want to use for their models. Refer them to the reference materials and, if available, computers for internet research. Give students a list of suggested kid-friendly websites to use for researching plant life cycles.

Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Circulate throughout the room, providing support when necessary. Ask prompting questions, such as the following (See **Know the Science 1** and **2**):

- » Do all organisms have the same life cycle? Prompt students to reveal their thinking through examples and specific comparisons.
- » Do all organisms have the same major stages? Again, probe for examples, and note quality use of scientific language to describe similarities.

SUPPORT—If students need help constructing their models, ask them questions to get them to think creatively about a solution. Refer back to the examples shared at the beginning of class, and help students identify sources of images and text that may help them add detail to their own models. If time allows, have students individually reread portions of the Student Reader Chapters 1 and 2 to ignite their thinking.

Have students write their names and identify the plant somewhere on their models. Tell students that in the next class session, they can continue working on these models and start on their animal life cycle models.

4. Check for understanding.

5 MIN

Formative Assessment Opportunity

Scan the plant models as students are working. Choose one or two questions to present to the class for a brief closing discussion. *What are some similarities between flowering plants? What are some similarities between nonflowering plants?* Use the discussion as an opportunity to reinforce main ideas and to correct misconceptions.

Remind students that Day 2's classroom session will be about modeling animal life cycles.

Know the Science

1. Do all organisms have the same life cycle? No. Different organisms have life cycles that look different at different stages and have variations. For example, some plants flower, and some do not. The life cycle of a flowering plant looks slightly different from that of a nonflowering plant.

2. Do all life cycles have the same major stages? Yes, with exceptions. All multicellular organisms have a life cycle that follows the same patterns and has the same common stages: birth (germination), growth, reproduction, and death. Unicellular organisms, such as bacteria, often reproduce by fission and thus do not have these four stages of a life cycle.

1. Day 2: Focus student attention on the Big Question.

5 MIN

How can I model the common stages of a life cycle? Remind students that in the last class they worked on life cycle models for plants. Tell students that today they will make life cycle models for animals.

Tell students that they do not have to make the same kind of model for their animals as they did for their plants. For example, if a student made a diorama for the plant life cycle model, it is okay for that student to choose a flip-book for the animal life cycle model.

2. Encourage student questions.

5 MIN

Before students begin working on their new models, have them share any questions they may have. These questions can be about the previous model they made or the model they are about to make. Engage in a short class discussion, encouraging other students to answer questions they know the answers to, such as these:

- » What is a difference between the life cycles of flowering and nonflowering plants? (*Nonflowering plants reproduce with spores, and flowering plants reproduce with seeds.*)
- » Do all animals have the same life cycle? (*no*)

3. Support student modeling.

30 MIN

Let students know that, if necessary, they can use the first few minutes of class to finish up their plant life cycle models.

Tell students that they can pick a type of animal that interests them to use for their animal life cycle model. Remind students that their animal life cycle models must depict the following stages: birth, growth, reproduction, and death. Students should also include an exit ramp on their life cycle for the stage of death.

Give students time to collect the materials they want to use for their models. Refer them to the reference materials or computers for internet research.

- Give students a list of suggested websites to use for researching animal life cycles online.

SUPPORT—Circulate throughout the room, providing support as necessary. If students need help constructing their models, ask them questions to get them to think creatively about a solution. Refer back to the examples shared previously, and help students identify sources of images and text that may help them add detail to their own models. If time allows, have students individually reread portions of Student Reader Chapters 1 and 2 to ignite their thinking.

Before the final ten minutes of class, tell students that they must finish up their animal life cycle models in this class period because they will not have time to work on them in the next class session.

Have students write their names and the type of animal somewhere on their models.

4. Check for understanding.

5 MIN

Formative Assessment Opportunity

Scan the models that students have been working on.

- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions.

1. Day 3: Focus student attention on the Big Question.

5 MIN

How can I model the common stages of a life cycle? Remind students that in the last two class periods they made models of plant and animal life cycles. Tell students that today they will perform a gallery walk to review everyone's models and make connections between specific plants and animals.

Activity Page



AP 4.2

Distribute and review Comparing Life Cycles (AP 4.2). Prompt students to take their time to study the different models.

Review the Activity Page example that has been done for them. Model for students how to complete the table based on what they learn from their classmates' models.

Let students know that they are not expected to review all of the models in the gallery. However, they should review a good balance of both plant and animal models and try to review different kinds of each (e.g., studying examples of different groups: a reptile, bird, and mammal; a conifer, fern, and flowering plant).

2. Support student observations.

30 MIN

As students perform the gallery walk to record their observations of other models, circulate throughout the room to ensure that students

- understand how to complete the table,
- find the information they need on the model,
- do not judge other students' work based on artistic ability, and
- refer back to the rubric for creating the models to help them focus on the point or objective of the model.

3. Encourage student questions.

5 MIN

As students perform the gallery walk, they will be applying their knowledge of the Disciplinary Core Idea LS1.B Growth and Development of Organisms to Crosscutting Concept Patterns as they develop and practice their ability to recognize patterns among similar organisms.

After the gallery walk, bring the whole class back together, and lead a discussion about the things that students recorded. Encourage students to discuss the patterns that they identified within the life cycles of specific organisms. Guide them into a conversation of causal direction in which the focus of the discussion is on the fact that organisms will not grow without being born and they cannot be born without reproduction. Additionally, reproduction cannot take place unless organisms grow and mature as adults. As a result, the life cycle process fully depends on the previous stage in the cycle in order for the next stage to be carried out and for the cycle to continue.

Ask students if, overall, they were able to identify common life cycle stages in various models or whether all of them are very different. Invite volunteers to share examples of two or more life cycles with common stages.

Distribute and review Take-Home Modeling Activity (AP 4.3). Explain to students that they should show these letters to their family members or guardians.

Activity Page



AP 4.3

4. Check for understanding.

5 MIN

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 4.2) for sample student responses.

- As students perform the gallery walk, circulate throughout the room, and scan the models that students made. Check for understanding of the order in which the life cycle processes occur, as well as proper depiction of how the life cycle “ends.” Additionally, check to make sure that students followed the guidelines for each type of model they made.
- Scan the tables that students have been working on. Check for understanding of how each part of the life cycle is modeled. Make sure students are accurately identifying the parts of the life cycle based on how they are depicted by the student models in the classroom.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas. Elicit from students that regardless of the type of organism, an organism will not grow without being born and that without reproduction, no births will occur.
- Address any student misconceptions that may have been depicted in the models. For instance, the life cycle for an individual organism only ends if that individual does not reproduce or have any young. However, even if the life cycle ends for that individual, it still continues for the rest of the organisms in that species.

Activity Page



Answer Key

Teacher Resource: Plants and Animals

Use the possible animals and plants in the tables to assign to students, or have them select from these examples. (Note: You are not limited to this selection.)

If possible, try to identify animals and plants found in your local area to provide real-world connections for students.

Animals

Mammals	Insects	Reptiles	Amphibians	Birds
• Deer	• Grasshopper	• Chameleon	• American bullfrog	• Parrot
• Gorilla	• Ladybug	• Crocodile	• Tomato frog	• Pigeon
• Coyote	• Fly	• Gecko	• Salamander	• Dove
• Lion	• Termite	• Iguana	• Caecilian	• Hummingbird
• Zebra	• Cricket	• Dragon lizard	• Alligator newt	• Swallow
• Pig	• Praying mantis	• Rattlesnake	• Mudpuppy	• Owl
• Bat	• Aphid	• King cobra	• Three-toed amphiuma	• Penguin
• Buffalo	• Wasp	• Turtle		• Finch
• Elephant	• Dragonfly	• Tortoise		• Crane

Plants

Flowering Plants	Nonflowering Plants
• Orchid	• Fern
• Rose	• Moss
• Cactus	
• Sunflower	
• Blueberry	
• Buttercup	
• Orange tree	

PART B

Organisms Have Traits

OVERVIEW

Lesson	Big Question	Advance Preparation
5. Noticing Different Traits	What are examples of physical traits in plants and animals?	Gather materials for a teacher demo. (See Materials and Equipment, page 12.)
6. Traits of Parents, Offspring, and Siblings	How are traits similar and different within families?	Read Student Reader, Chapter 3.
7. Studying Family Traits	How do the traits of an individual compare to those of its parents and siblings?	Gather materials for hands-on investigation. (See Materials and Equipment, page 13.)
8. Traits Vary Within Populations and Species (2 days)	How do traits vary within groups of the same type of organism?	Read Student Reader, Chapter 4. Gather materials for hands-on investigation. (See Materials and Equipment, page 13.)

Part B: What's the Story?

Students learned in Part A “Organisms Have Life Cycles” (Lessons 1–4) that plants and animals change throughout their lives. All living organisms go through a life cycle, many changing forms as they continue to grow, and some stages are common to all life cycles. Students also planted bean seeds that they will continue to monitor throughout the lessons in this Part B.

In Part B “Organisms Have Traits” (Lessons 5–8), students take a closer look at the physical traits that characterize specific types of plants and animals, considering how traits can vary among families and populations.

In Lesson 5, we start by observing and discussing examples of physical traits. Students practice identifying traits and describing them in a scientific manner. They also learn to recognize what is and is not a trait. The goal is for students to understand that members of a family share many traits, even if they do not all look the same.

In Lesson 6, students read and learn about examples of traits shared by parents, offspring, and siblings. This lesson reinforces the basics of what students explored through open discussion in Lesson 5, addressing the variation among traits within families based on the phenomenon of inheritance.

In Lesson 7, students conduct research on family traits and will make a graphical representation on trait variations among siblings to present to the class. They learn that parents and siblings within a family share many traits but that there are also many differences among those traits within the family.

In Lesson 8, students extend what they know about traits across two more days of instruction to explore variations within populations. During Day 1, students develop a working definition of a population. Populations are groups of the same type of organism within a defined area. The content in this lesson progresses from individuals to families and then to populations of a single species. In Day 2, which concludes Part B, students make a graphical representation that shows variation among individuals within a population. The goal of this lesson is for students to understand that traits can vary within groups of the same type of organism.

So, to repeat, **all organisms have traits, and specific traits vary among families and populations.** Help your students grasp this concept, and you support them to meet or exceed the Performance Expectation, 3-LS3-1. You will also lay the groundwork for meeting the NGSS expectations addressed in Parts C and D of this unit.

LESSON 5

Noticing Different Traits

Big Question: What are examples of physical traits in plants and animals?

AT A GLANCE

Learning Objectives

- ✓ Give examples of an organism's traits.
- ✓ Compare and contrast the physical traits of multiple organisms.

Lesson Activities

- teacher demonstration
- student observation
- writing, discussion

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Patterns are important to this lesson because patterns can be seen in the similar and different traits that organisms inherit from their parents. In this lesson, students are introduced to the idea of physical traits and summarize patterns after gathering observational data.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

individual

physical trait

siblings

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards, that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary term designated in green on the previous page.

Instructional Resources

Activity Page



AP 5.1

Activity Page

Plant and Animal Traits (AP 5.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- large-form images of animals (or animal reference books with pictures)
- access to at least 2 different plants (can include one students planted in Lesson 1)
- 2 different types of houseplants or succulents
- index cards for student vocabulary deck (3 per student)
- internet access and the means to project images/video for whole-class viewing

If you cannot bring in an assortment of houseplants, plan for students to go outside to observe live plants around the school grounds.

If you do not have a classroom computer or access to large-form images of animals, consider taking students to the library or the computer lab to research animal reference books or online resources. (See the Online Resources for a link to suggested images of animals/families of animals.)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What are examples of physical traits in plants and animals? Tell students that the physical features of a plant and animal are known as traits. Give students examples of traits, such as the following (see **Know the Science 1**):

- Oak trees produce acorns.
- Orchids produce very unique-looking flowers.
- Whales have blowholes.
- Giraffes have long necks.

Know the Science

1. What is the scope of this lesson? *To identify and describe physical traits!* In this lesson, it is important to avoid going too far regarding any “because” statements. For instance, we want to direct student attention to describing the traits in detail, rather than stating that giraffes have long necks for any particular reason. Form and function will be explored in greater depth in Part D of this unit, as well as in Grade 4.



SUPPORT—Ask students to turn and talk to a neighbor to identify other plant and animal traits to generate more examples to share with the class.

Distribute and review Plant and Animal Traits (AP 5.1). Share that students will study four plants and three animals. Two of the plants will be those that they planted in Lesson 1 (e.g., lima bean plants). The others will be plants brought in by the teacher or plants that students go outside to observe.

The goal of this activity is for students to look at and focus on physical characteristics of an organism only. For instance, students do not have to tell whether or not an animal moves slowly or eats a lot of food.

SUPPORT—If necessary, use question prompts to focus students on the physical, rather than behavioral, traits of animals and plants. Ask, “Is this a behavior?” or, “Does this describe how the animal acts or how the animal looks?”

There is no limit to how many physical traits students can list in the activity. There are also no right or wrong answers. The goal is to just record as many traits as they can observe.

Be sure to prompt students to review Activity Page 5.1, where they will answer questions to summarize their observations.

Preview Core Vocabulary Term

Before students get started, write the following on the board or chart paper:

physical trait → a characteristic of what the organism looks like

Near or beneath this idea, write examples of organisms and their traits that students themselves have identified, such as “fish → gills” and “dogs → four legs,” and so on.

2. Support student observations.

20 MIN

Show students where to find the various organisms that they will observe, including pictures or reference materials to observe various animals.

Students will observe a total of seven organisms: four plants and three animals. Two out of the four plants will be any of the plants that students planted in Lesson 1. Allow students to observe the organisms in any order they like, or you can assign students to look at plants first or animals first.

As students study the organisms, ask guiding questions, such as these:

- » What can you tell about the organism’s size?
- » What is the organism’s color?
- » Does the organism have a certain shape?
- » Does the organism have fur, scales, or something else covering its body?
- » Does the organism have legs or no legs? How many?

Give students time to make and record their observations on Activity Page 5.1. Circulate throughout the room, monitoring progress, and support students as they work to answer the questions.

SUPPORT—Provide assistance as necessary by asking students to compare traits they notice about different kinds of plants and different types of animals. Provide examples of traits about organisms that are different than the example students have selected, such as, “A shark has many sharp teeth. How might you describe the teeth of your animal?” or, “This plant has broad green leaves. How would you describe the leaves on your plant?”

Transition back to whole-class discussion by prompting the class to think about a good working definition of the term *trait*, in their own words. To provide more opportunities for students to share their thinking with others, ask partners to turn and talk in order to develop this working definition.

3. Encourage student questions.

5 MIN

Draw student attention back to the idea drawn/displayed at the beginning of the lesson:

physical trait → a characteristic of what the organism looks like

Lead a discussion about the traits students recorded, using the examples of organisms that they selected. Invite volunteers to share some of the traits they listed. Ask students to identify similarities and differences between the two kinds of plants. For example:

- Similarities: both plants are green; both plants have leaves.
- Differences: one plant is bigger; one plant has more leaves.

Have students discuss whether those seedling plants share similarities or have differences with the two outdoor plants or houseplants.

Then, ask students to talk about the similarities and differences among the three animals. For example:

- Similarities: they all have eyes; they all have fur.
- Differences: one animal has legs; one animal has fins.

SUPPORT—If necessary, emphasize to students that individual organisms have traits that are, in some ways, the same as or different than those of other individuals.

Explain to students that some of the seeds they planted in Lesson 1 came from the same parent plant. This makes all of those plants siblings. The plants are not identical, but they are very similar because they are part of a family. Note for students that they will dive deeper to investigate the similarities/differences between parents, children (offspring), and siblings during Lesson 6.

4. Demonstrate examples and guide discussion.

5 MIN

Choose one or both of the following examples to stimulate further discussion. Analyze with students 1) the physical traits that can be seen in each example, 2) where these traits may come from, and 3) why some traits are similar or different. (See **Know the Science 2** for support with this analysis and discussion.)

- If there are any classroom pets in your school, provide students with the opportunity to make observations. Ask students to identify traits they can observe in the animal. For example:
 - » What color is the animal?
 - » What structures do you see?
 - » Is the animal's body covering soft or hard? Does it have scales or feathers or hair?
- Show a video of an animal being observed for its traits. (See the Online Resources for a link to a suggested video.) Ask what kinds of traits students can observe.
 - » Where do those traits come from?
 - » Does this animal have parents? Do those parents have some of these traits, too?

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

- Encourage students to link details in this analysis discussion back to the observation activity they did at the beginning of the lesson.
 - » Are there more examples of physical traits that you would add to your chart?
 - » How are your examples of physical traits similar to the ones you saw from the classroom pet or the video?

Know the Science

2. Where do inherited traits come from? Parents. All organisms—whether they are plants or animals—inherit traits from their parents. It is possible that some offspring will look almost exactly like their parents while other offspring may look a bit less like their parents. This is because the inheritance process allows for variation between parents and offspring. You can also see and compare variation between siblings. Some siblings look alike, while others may look less similar. Students will learn more about the inheritance of traits in a later lesson, but for now they should understand that plant and animal organisms get their traits from their parents.

5. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary term that was displayed on the board or chart paper earlier in the lesson. Add the other two terms. Have students write the terms in the upper left corner of index cards and underline them.

individual

physical trait

siblings

Word Work

- **individual:** (n. a single living organism) Explain that, in these lessons that explore details about living things, any one living thing is an individual. Have students write a definition on the card in their own words.
- **siblings:** (n. organisms that come from the same parents) Tell students the definition of *siblings*, and ask them to suggest examples. (*brothers, sisters, puppies from the same litter*)
- **physical trait:** (n. a feature of a living thing's body) Point out that traits can refer to physical and behavioral characteristics but that the focus of this unit is on the physical traits of plants and animals. Physical traits include things such as structures and body features. Ask volunteers to use *trait* in a sentence. Encourage sentences that use *trait* in relation to plants or animals (not humans). Have students copy the sentences on their card and underline the word *trait*.

Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add to their deck in later lessons.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 5.1) for correct answers and sample student responses.

- Collect the completed Plant and Animal Traits (AP 5.1). Scan the charts that students filled out to check for understanding, noting and/or providing feedback on student responses that are not physical traits.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions.

LESSON 6

Traits of Parents, Offspring, and Siblings

Big Question: How are traits similar and different within families?

AT A GLANCE

Learning Objectives

- ✓ Analyze data to identify patterns in the traits of parents and offspring.
- ✓ Analyze data to describe variations among organisms of the same species, including within families.
- ✓ Compare and contrast the physical traits of multiple organisms (review from Lesson 5), specifically organisms from different species.

Lesson Activities

- student observation
- reading, discussion
- data analysis

NGSS References

Disciplinary Core Ideas LS3.A: Inheritance of Traits

Disciplinary Core Ideas LS3.B: Variation of Traits

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data is important to this lesson because traits and heredity among organisms can be better understood when they are described and represented systematically. In this lesson, students use data-recording tools such as the box and T-chart to organize similarities and differences among living things.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

identical
individual
inherit

multiples
offspring
physical trait

siblings
species
vary/variation

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 3

Student Reader, Chapter 3
“Traits of Parents, Offspring,
and Siblings”

Activity Page



AP 6.1

Activity Page
Box and T-Chart (AP 6.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- variety of images depicting sibling animals (e.g., reference books, magazines)
- colored pencils or markers
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (5 per student)

To prepare for this lesson, identify 3–4 images of siblings, such as a litter of kittens, that can be displayed to encourage whole-class and partner discussions.

1. Focus student attention on the Big Question.

5 MIN

Online Resources



How are traits similar and different within families? To build on what students learned in Lesson 5, open this lesson with a brief video that shows a litter of puppies in which there are clear variations in how the puppies look. (See the Online Resources for a link to a suggested video.) You can remind students that physical characteristics (features) are called *traits*. Use the video to elicit students' prior knowledge and to pique their interest about the topics in the Student Reader. Then, use the following questions to encourage discussion:

- » What physical features, or traits, do the puppies have in common? (*size, number of legs and ears, body shape, fur*)
- » How are their traits different? (*different colors of fur, different patterns in their fur, different heights*)
- » Do the puppies have more traits that are the same or different from one another? Explain your thinking. (*They have more traits that are the same, such as the number of legs they have and the shape of their ears.*)

Explain that there are two types of traits: those that describe the *parts* of organisms and those that describe the *behavior* of organisms. Point out that fur colors and patterns are *physical* traits and that ways the puppies act with people are *behavioral* traits. Have students keep the video in mind as they go through the remainder of the lesson. After reading Chapter 3 in the Student Reader, they will be asked to remember and organize what they observed in the video.

2. Read and discuss: "Traits of Parents, Offspring, and Siblings."

20 MIN

Student Reader



Ch. 3

Read together, or have students read independently, "Traits of Parents, Offspring, and Siblings," Chapter 2 in the Student Reader. The selection guides students to consider that organisms often have certain physical traits in common. Another important takeaway from this chapter is that many of an organism's traits are inherited (passed to the individual) from its parents.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to pay special attention to these terms as they read.

Each time they encounter a term in the text, have them find the meaning in the vocabulary box and then try to use the term in an original sentence. When students encounter *variation* and *vary*, ask them to read the words aloud to identify the common root in both.

identical
individual

inherit
offspring

physical trait
siblings

species
vary/variation

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Pages 13–14

After students have read the pages, ask them to look carefully at the photo of the chickens. Ask the following:

- » How do the feather patterns of the individual chickens differ? (*Some have all white feathers; some have a mix of gray, brown, and white feathers; one has feathers that are mostly black.*)
- » What traits are the same for all of the chickens? (*red combs, yellow legs, gray beaks, similar sizes*)

Page 15

Prompt students to compare and contrast the parent with its offspring. Ask the following:

- » Which individual is the parent? (*the tall bird*) Which is the offspring? (*the smaller bird*)
- » How are their physical traits different? (*the colors of their legs and feathers, their sizes, the lengths of their necks, the colors of their beaks*)
- » Which physical traits did the baby inherit from its parent? (*Answers may include body shape, feathers, long legs, and long necks.*)

CHALLENGE—If time permits, see if students can identify where, on the page, the term *young* is being used as a noun and where it is being used as an adjective.

SUPPORT—When discussing the concept of inheritance with students, encourage them to look for recognizable patterns of similarities and differences among the parents and offspring. Patterns can be used to help identify the types of traits that are inherited or passed down. (See **Know the Standards 1.**)

Pages 16–17

Ask students if they are familiar with green peas. Review the page with students, and have them identify the types of physical traits that Mendel studied in pea plants (*height, color, size, etc.*).

Know the Standards

1. How is the concept of heredity (Disciplinary Core Idea LS3) developed from one grade band to the next? NGSS learning progressions for the topic of heredity begin in Grade 1. Primary students observe that young plants and animals look like, but not exactly like, their parents. In Grade 3, students explore the phenomenon of traits being passed from parents to their offspring. It is not until middle school that the mechanisms for inheritance and variation of traits (i.e., chromosomes, genes, and mutations) are introduced. High school instruction focuses on the nature and behavior of the DNA molecule. At this stage in upper elementary grades, students are not expected to predict how or which traits will be passed on through generations but instead recognize patterns within given examples.

Then have students look carefully at the photos of the four o'clock plants.
Ask the following:

- What traits could the offspring likely inherit from the parents? (*colors and shapes*)

SUPPORT—Reinforce the idea that offspring have *both* similarities to and differences from their parents. Allow students to watch the video about the Denali sled dog puppies again and compare the mother (on the leash) to the pups.

Page 18

Show students additional images of sibling animals with reference books or magazine pictures. Have students identify the similarities and differences in physical traits among the offspring. Encourage students to think about what the parents of the siblings may have looked like in order for the offspring to appear the way they do.

Page 19

TEACHER NOTE: Use and encourage sensitivity if working in a classroom with twin siblings.

Ask: Have you ever known siblings that are *identical* twins? Tell us about the similarities and differences in the twins' physical traits. (Look for evidence that students understand that identical twins share nearly all the same physical traits. If students describe fraternal twins, ask them to explain why they are not identical.) Explain that even identical twins can have some minor differences.

CHALLENGE—Ask students to find examples of animals that give birth to the greatest number of offspring at once, including mammals, birds, insects, and reptiles.

Page 20

The concept of species can be challenging for young students. Point out that there are species of plants, seaweeds, and mushrooms as well as animals. Also explain that the name of a kind of living thing can often identify what species it is. For example, African elephants and Asian elephants are different species, even though they are both elephants. The traits that differ between these two species include their height, the shape of their ears, and the number of toenails on each foot.

A species is defined by two biological elements. Species share many physical traits. Species must also be able to reproduce and give birth to offspring that are capable of reproducing themselves.

CHALLENGE—Challenge students to think of other examples of pairs of similar species. Make a list on the front board or chart paper of the examples that students come up with. Have students describe how the two species vary to the class. (*Possible examples: bald eagle/golden eagle [white feathers on the head], red squirrel/gray squirrel [fur color], white oak tree/red oak tree [shape of leaves, color of wood]*)

SUPPORT—Remind students of their observations of different animals (species) during Lesson 5. The four examples of plants were different species. The three different animals were different species, too.

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words written on the board or chart paper earlier in the lesson.

identical
individual

inherit
offspring

physical trait
siblings

species
vary/variation

Students prepared Core Vocabulary cards for *individual*, *siblings*, and *physical trait* in the previous lesson. Invite students to add to or adjust their notes on these terms based on new learning from the reading. Then, have students prepare a new card for each of the remaining terms.

Word Work

- **offspring:** (n. a young organism produced by parents) Clarify that the noun *offspring* can be both singular and plural. Have students write a sentence that includes both the words *parent* and *offspring*. (*Sample: I am the offspring of my parents.*)
- **inherit:** (v. to receive from parents) Have students list two or three examples of traits that offspring inherit from parents. (*Sample answers: number of legs, fur color, leaf shape*)
- **identical:** (adj. exactly the same) Ask students what must occur for two individuals to have identical traits, and have them write the answer on their Core Vocabulary card. (*The two individuals must be twin siblings who inherited the same traits from their parents.*)
- **species:** (n. a group of similar individuals that can reproduce together) Use the example of dogs and cats to help students understand species. Dogs of different breeds can have very different traits, especially size. But dogs can interbreed, so they are considered the same species. However, dogs and cats cannot interbreed. They are both four-legged, furry, carnivorous animals, but they cannot produce offspring together. They are different species.
- **vary:** (v. to change or differ); **variation:** (n. a difference between things or in one thing over time) Have students complete each of the following sentences with an example.
 - (*Sample answer: Fur color*) is a variation between puppies from the same parents.
 - (*Sample answer: Size*) is a trait that can vary between dogs or across one dog's life cycle.

4. Facilitate student analysis.

10 MIN

Activity Page



AP 6.1

Distribute and review Box and T-Chart (AP 6.1). Tell students that they will rewatch the video from Step 1 and, as a class, will fill out the Activity Page while you draw your own box and T-chart on the front board or chart paper to work through the concepts with students. Draw or display a large box and T-chart that the whole class can see. (See **Know the Standards 2** for support.)

Allow students to watch the video from Step 1 again. Pause the video at 4:02 so students can study the puppies. Ask students to pay particular attention to the black puppy and label one side of the box and T-chart “Black puppy,” labeling the other side “Siblings.” Ask volunteers to identify as many physical traits of the black puppy as possible, and capture their ideas on a separate section of the board or chart paper while students record it on their Activity Pages. Then, ask students to think about the similar traits that the siblings had compared to the black puppy. Add these traits to the box for similarities. Then, prompt students to consider the differences between the siblings when compared to the black puppy. As students identify differences, write them in the correct column of the T-chart, noting and organizing traits of the siblings and unique traits of the black puppy while students capture this information on their Activity Pages.

SUPPORT—If needed, prompt students to carefully compare the sibling puppies’ heights, fur colors, markings, and so on.

- Ask: Where did the puppies get their traits? (*They inherited them from their parents.*)
- The video shows the mother dog but not the father. Ask: Based on how the offspring look, can you predict how their father looked? (*Answers will vary, but students should recognize that parents and offspring have similar traits.*)

Know the Standards

2. Why are we making a T-chart? Data organization and analysis! T-charts are a simple and effective way for students to compare and contrast observations in science. Scientists who focus on heredity use many graphical or visual tools for organizing and categorizing information. They then study and analyze these graphical representations of their data in order to look for similarities and differences among families, populations, and species. Graphical and visual tools can help scientists spot patterns more easily as they try to make sense of natural phenomena.

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 6.1) for correct answers and sample student responses.

- Collect the Box and T-Chart (AP 6.1). Review student responses for completeness and proper understanding of the similarities and differences in the physical traits of the puppies. Make sure students used complete sentences to summarize their thinking in a statement or two at the bottom of the chart.

LESSON 7

Studying Family Traits

Big Question: How do the traits of an individual compare to those of its parents and siblings?

AT A GLANCE

Learning Objectives

- ✓ Collect data and organize them in a table to reveal patterns of traits shared by parents and offspring.
- ✓ Create a graphical representation that shows variation of traits among siblings.

Lesson Activities

- student investigation
- discussion and writing

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Patterns and **Analyzing and Interpreting Data** are important to the topic of traits and heredity because patterns can be better identified, studied, and classified when they are represented graphically and logically. In this lesson, students focus on the traits shared by parents and offspring.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary Terms are introduced during this lesson.

identical
individual
inherit

offspring
physical trait
siblings

species
vary/variation

Instructional Resources

Activity Page



AP 7.1

Activity Page

Cheetah Traits (AP 7.1)

Make sufficient copies for your students prior to conducting the lesson.

Read the instructional steps on the Activity Page in advance to prepare to facilitate the student investigation.

Materials and Equipment

Collect or prepare the following items:

- poster board
- markers, assorted colors
- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Online Resources



How do the traits of an individual compare to those of its parents and siblings?

To build on what students learned in Lesson 6, open this lesson by showing students an image of a parent cat with its kittens. (See the Online Resources for a link to a suggested image.) Review terminology and concepts related to traits and inheritance by using the following questions to prompt discussion:

- What traits did the parent pass down to its offspring? (*two pointy ears; two eyes; four paws; fur color, stripes*)
- What is different between the parent and the offspring? (*eye color*)
- What traits do the sibling kittens have in common? (*fur color, dark stripes*)
- What traits are different among the siblings? (*different stripe patterns*)

Ask students how they know that the kittens inherited some of the traits from their parent. (*Parents pass their traits down to offspring. There are physical similarities between the parent and the offspring.*) Then ask students to consider why certain siblings look different from others (*variation of traits*). Reiterate that not all siblings inherit the exact same traits but that their traits are inherited from their shared parent(s).

2. Encourage student questions.

5 MIN

Prompt students to pose their own questions about traits and inheritance. Have students turn to a neighbor and discuss other ways that variations of traits exist in the animal kingdom. Ask pairs of students to address the following question: “Do zebra siblings have similar patterns of stripes?” Then encourage students to think about nonhuman examples; other examples may include bunnies, lions, and giraffes.

3. Preview the investigation.

5 MIN

Activity Page



AP 7.1

Online Resources



Distribute an image of a single cheetah to promote student thinking and engagement. (See the Online Resources for a link to a suggested image.)

Distribute and review Cheetah Traits (AP 7.1). Tell students that they will investigate and analyze physical traits among animal siblings, specifically cheetah siblings. (See **Know the Science** for support with analysis.) Students will investigate this concept by doing the following:

- reading a scenario
- organizing data
- answering questions
- interpreting the data to make a graphical representation
- displaying the graphical representation to the class

For specific background information about cheetahs, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

4. Facilitate the investigation.

20 MIN

Divide students into pairs. Ensure all pairs of students have poster board and markers of assorted colors.

As students work on their Activity Pages, circulate throughout the room to ensure that students are correctly completing the data table. The data table will help students organize the information so that they can easily see patterns. These patterns will be displayed in their graphical representations.

Know the Science

What are students learning through this investigation? *That data can serve as evidence and that there are patterns in trait variations!* Patterns can be used in science to help classify and sort natural phenomena. There is variation among siblings because offspring do not inherit identical traits from their parents. Patterns can be identified based on traits that are similar and those that are different by looking at a variety of factors. Some of the factors that scientists consider when studying physical traits include—but are not limited to—gender, behavior, height, weight, and coloration. Scientists study patterns in these traits to help reveal why certain types of physical traits exist among siblings and why others do not. By organizing trait data into tables, patterns can be more easily identified and used to make scientific conclusions.

SUPPORT—If needed, help students by modeling where certain data belongs within the data table. Point out the rows and columns in the table. Make sure students understand how the data is to be identified in the scenario and how it is related to the table. Prompt students to mark up and take notes on their Activity Pages to help them organize the information. For example, you may use the following prompts to help:

- Circle all the data that provide information about fur color.
- Underline all the data that refer to the number of spots.
- Highlight all the data that mention size.

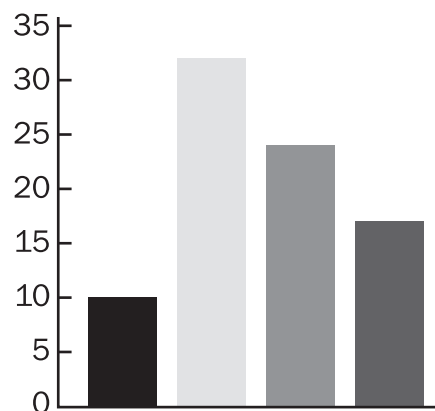
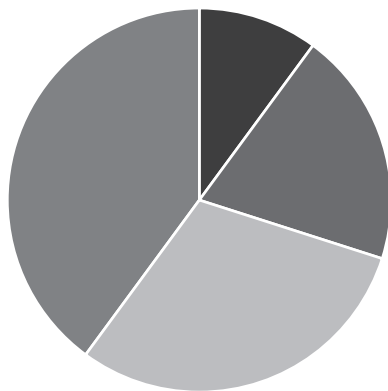
Give students time to complete their data tables based on the field journal. After approximately ten minutes, prompt students to start working on their graphical representations. Remind students that for their graphical representations, they can choose either a pie chart or a bar graph.

SUPPORT—Organizing data into graphical representations is a skill that can be tricky for some students. If needed, show students examples of a pie chart and a bar graph by drawing them on the front board or chart paper. If students require further help with graphical representations and how to use or display the data, work with the pairs to provide more specific assistance.

Ensure students understand how they are to use the data from the table for their graphical representations. Guide students to focus on graphical representations and data that show variation of traits among siblings. Make sure students interpret data accurately, graph the data on their poster board, and identify patterns. For example, students may choose to focus on patterns related to male vs. female cubs or on the patterns related to each of the litters (or both).

Use Science Practice

Putting data together is a key practice in science. Scientists need to figure out the most effective ways to put their data together to communicate their information/ results and use the information to analyze/interpret data.



Once pairs of students have had time to complete their data tables and make their graphical representations, bring the class back together for a whole-class discussion to summarize what students discovered. Students should be able to express patterns and support them with evidence from the data. Encourage student pairs to showcase their poster board graphs to the rest of the class.

Ask if any patterns can be found in the data. (yes)

- » What pattern did you find in this family of cheetahs? (*Example: Male cubs had more spots than female cubs. Each litter had more male cubs than female cubs.*)
- » What could you tell about the siblings' traits? (*Some have similar traits, such as relative size, while others have different traits, such as different numbers of spots.*)
- » Did the siblings have the same traits as their parents? (*Some do, and others do not, to varying degrees. For example, in Litter 1, the males had the same number of spots as the father [2,200], but in Litter 2, the males all had fewer spots [2,000].*)

Encourage Science Practice

Using student responses as examples, elicit from students that patterns can be found among the traits *and* the variations in siblings. Ask volunteers to summarize this point in their own words, and capture a whole-class summary statement on the board or chart paper. Specifically, note the data used to support their final summary/explanation of this phenomenon. The summary statement may be similar to the following:

A cheetah cub has similar, but not always the exact same, traits as their parents. For example, offspring may or may not have the same number of spots as their parents. Cubs also look a lot alike, but not exactly the same as their siblings. Brother and sister cubs may be the same relative size but have different fur colors.

Another example of a summary statement:

Families of cheetahs have similar traits, such as number of legs, eyes, ears, and spots. But there may be variations between family members, such as the number of spots, color of fur, and size of different siblings.

Ask if students have any questions about the scenario, and support students who have any misunderstandings.

TEACHER NOTE—Make sure students put their names on the poster board displays, and save these somewhere safe. You will use them again for reference in Lesson 8.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 7.1) for correct answers and sample student responses.

- Collect the completed Cheetah Traits (AP 7.1). Scan the completed data tables, and check for accuracy and organization.
- Check the graphical representations that student pairs made on the poster boards. Data in the graphs should reflect data from the table and scenario. If the graphs contain inaccuracies or missing labels, engage in further discussion, emphasizing the connections between the data and the patterns of traits and variations.

LESSON 8

Traits Vary Within Populations and Species

Big Question: How do traits vary within groups of the same type of organism?

AT A GLANCE

Learning Objectives

- ✓ Give examples of variation of traits within a population.
- ✓ Describe the relationship between populations and ecosystems.
- ✓ Tell that variation of traits can help certain individuals survive and reproduce.
- ✓ Define *species*.
- ✓ Create a graphical representation that shows variation of traits among individuals in a population.

Lesson Activities (2 days)

- student observation
- reading, discussion, writing
- vocabulary instruction
- student investigation

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Patterns are important to the topic of traits and heredity because patterns allow people to identify variations among organisms. Students begin this two-day lesson by observing variations within a group of leaves from the same species. Then they read about traits among populations and species. On Day 2, students focus on trait variation within a population, using graphical representations to organize and present data to arrive at logical conclusions about variation of traits.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

ecosystem

population

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 4

Activity Pages



AP 8.1

AP 8.2

Student Reader, Chapter 4

Traits Vary Within Populations and Species

Activity Pages

Looking at Leaves (AP 8.1)

Activity Page 8.2

Traits in a Population (AP 8.2)

Make sufficient copies for your students prior to conducting the lesson. Read the instructional steps on the Activity Page in advance to prepare to facilitate the student investigation.

Materials and Equipment

Collect or prepare the following items:

Day 1:

- assortment of plant leaves
- plastic baggies
- marbles in assorted colors
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

Day 2:

- Lesson 7 graphical displays (from each pair of students), for reference only
- poster board
- markers, assorted colors
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Prior to this lesson, collect plant/tree leaves from one population of one species. The goal is for students to be able to see that within a population, there are different leaves that clearly belong to different families based on similar traits. Sort the leaves into plastic baggies, each with leaves that belong to the same type of plant within a population, one baggie per pair of students.

SAFETY NOTE: Use caution when collecting leaves outside, and ensure that the leaves are not poisonous.

1. Day 1: Focus student attention on the Big Question.

10 MIN

Activity Page



AP 8.1

How do traits vary within groups of the same type of organism? Remind students that they already learned how traits can vary within families. Distribute and review Looking at Leaves (AP 8.1). Tell students that they will make observations of the plant leaves that they see. They will use their Activity Page to record similarities and differences and to answer questions.

Place students into pairs, and distribute the plastic baggies of assorted plant leaves. Explain to students that these leaves were collected outside.

Circulate throughout the room as students make their observations of the leaves. Encourage them to study the leaves up close, including measuring them. As students work on the questions at the bottom of the Activity Page, ask the following:

- How do traits vary among these leaves from the same population? (*size, shape, or color of the leaves*)

2. Encourage student questions.

5 MIN

Lead a discussion about the examples of similar and different traits that students recorded. Prompt students to think about the things that make the leaves look similar and the things that make the leaves look different. In other words, among leaves from the same species from the same population, ask students to share their responses to the questions at the end of the Activity Page to ensure understanding.

3. Read and discuss: “Traits Vary Within Populations and Species.” 25 MIN

Student Reader



Ch. 4

Read together, or have students read independently, “Traits Vary Within Populations and Species,” Chapter 4 in the Student Reader. The selection reinforces the idea of variation of traits among populations and species and how those traits vary. It introduces the meaning of the term *ecosystem* and differentiates populations and species. The reading also presents several examples of traits that vary within a population and discusses that certain traits can be beneficial to individual organisms.

Preview Core Vocabulary Terms

Before students read, write **population** on the board or chart paper. Have students write the term in the upper left corner of an index card and underline it. Encourage students to pay special attention to the word as they read.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

- Page 21** Discuss with students the meaning of the term *population*. Have a volunteer read the definition out loud from the vocabulary box on the page. Tell students that they may already be familiar with the term *population* from hearing it in day-to-day language.
- Have students come up with some examples of variations of penguin traits. Encourage students to think of traits that might be helpful to individual penguins (*larger beaks for catching bigger fish*).
- Page 22** Pause with students after reading the sentence about ecosystems. Focus on the term *ecosystem* before moving on to the rest of the reading on the page. Make sure students have a clear understanding of what an ecosystem is. Ask students to name examples of living and nonliving things that make up the ecosystem where you live. (*living things: plants, insects; nonliving things: air, water*)
- SUPPORT**—*Ecosystem* is not a Core Vocabulary word. The emphasis is on populations. However, it is important for students to understand that several populations can share the same space. When they do, they interact and affect each other.
- Page 23** After students have read the page, ask them to look carefully at the photo of the katydids. Ask the following:
- » Which trait is helping one katydid survive better than the other? (*body color*)
 - » What do you think will happen to the pink katydid? (*It will not survive as long as the green katydid.*) Why do you think that is? (*Because it cannot blend in with its environment and hide, it may be eaten quickly.*)
 - » What would happen if a new bird came into the meadow that could not see the color pink and yet loved to eat katydids? (*The bird might start eating the green katydids.*)
- Page 24** Ask students to come up with more examples of individual traits that can help animals. Use prompts if necessary, such as the following:
- » What would happen if a giraffe has a longer neck than another giraffe? (*Giraffes with longer necks will be more appealing to other giraffes, which may better help them to find a mate.*)
 - » What would happen if a zebra is born with more muscular legs and can therefore run faster than other zebras? (*Zebras that can run faster because they have more muscular legs can outrun predators and stay safer than other zebras.*)
- Page 25** Ask students what they notice about the different traits of the saguaros. Students should identify that one is taller than the others. After reading the page, have students tell whether these saguaros are the same species. (*yes*) Then have them tell whether the saguaros are in the same population. (*yes*). Ask students whether a tall or a short saguaro would be able to get more water. (*tall*) Ask if height is a trait that differs in saguaros. (*yes*) Elicit from students that this means taller saguaros are more likely to get more water to survive than saguaros that do not grow as tall.

Have students turn to their neighbor and discuss the following question prompts:

- » Are these frogs part of the same species? (*yes*)
- » Are the frogs all the same size? (*no*)
- » Are they all the same color? (*no*)
- » Do they all have the same color pattern? (*no*)

Reiterate for students that patterns in trait variations help identify and sort species.

4. Demonstrate examples and guide discussion.

5 MIN

Analyze with students 1) similar traits, 2) different traits, and 3) patterns that they observe within a large population or species. (See **Know the Science 1** and **2** for support with the analysis.)

- Sort colored marbles into families within a population on a table. Each family should be made up primarily of one color but with a couple of random color variations. Ask students to tell what they can observe in this demonstration.
 - » How can you tell which marbles belong to which family? (*Most of the marbles in a family are the same color.*)
 - » Are there variations among the families in this population of marbles? (*yes*)
 - » What do all the marbles in this population have in common? (*shape, size*)
- Show a video of a large herd of wild horses running. Ask what trait variations students can observe.
 - » Are these horses all part of the same population? (*yes*)
 - » Can you notice any trait variations in the horses? (*yes*)
 - » What traits are different? (*color, spots, size*)
 - » What traits are similar? (*shape, type of horse, physical features*)

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Know the Science

1. What are we doing with the marbles? *Looking for patterns!* Patterns in traits can be identified by looking for similarities and differences. Those similarities and differences can tell scientists about organisms and their traits.

2. Why are students watching a video about wild horses? *To show how variations in traits exist among populations!* These horses make up a population. In this video, students get to see how a trait within a population of horses can be similar and how it can vary. Color is the most obvious trait that students likely will recognize when watching wild horses.

- Prompt students to link details in this analysis discussion back to the leaf activity and the reading selection.
 - » What are some of the ways that individual plants or animals vary within a population? (*They can vary in size, color, or shape.*)
 - » Did you identify any variations or similarities among individuals of the same population in the leaf activity? (*Accept all correct answers.*)

1. Day 2: Focus student attention on the Big Question.

5 MIN

Online Resources



How do traits vary within groups of the same type of organism? To build on what students learned in Lesson 8, open this lesson by showing students an image of seashells. (See the Online Resources for a link to a suggested image.) Remind students that variation within individuals of a population is being shown. Discuss with students concepts of variation of traits among individuals of a population by using the following questions to prompt discussion:

- » What traits within this population are similar? (*size, shape, texture*)
- » What traits within this population are different? (*color, shape, patterns*)

2. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Card

Before students begin their investigations, write **population** on the board or chart paper. Have students write the term in the upper left corner of an index card and underline it.

Word Work

- **population:** (n. a group of a single type of organism living in the same place at the same time) Prompt students to think about ways that trait variations exist among populations. For example, sunflowers can grow in fields and have different parents, making a sunflower field a large population of sunflowers. Within this population, sunflowers can vary in traits such as height and number of flowers per stem. Have students write a short sentence that includes the word *population*.

3. Preview the investigation.

5 MIN

Activity Page



AP 8.2

Distribute and review Traits in a Population (AP 8.2). Remind students that in Lesson 7, they focused on the physical traits of cheetahs within a family (parents and siblings). Tell students that today they will continue their investigation of cheetahs as it relates to a population. (See **Know the Science 3.**)

Know the Science

3. What are students learning in this investigation? *That variations in traits exist among individuals of a population!* Understanding variation of a trait within a population can help scientists sort and study information about those traits that benefit or harm organisms within a population in an ecosystem.

Students will investigate this concept by doing the following:

- reading a scenario
- organizing data
- answering questions
- using data to make a graphical representation
- displaying the graphical representation to the class

Tell students they will get to use their Lesson 7 graphical displays as a reminder of the data they collected on the cheetahs within a family.

4. Facilitate the investigation.

20 MIN

Divide students into the same pairs they had for Lesson 7. (If any students are missing a partner from Lesson 7, group students with other pairs.) Ensure that all pairs of students have the following materials:

- poster board
- assorted colored markers
- Lesson 7 graphical display boards (for reference only)

Pass out the Lesson 7 graphical display boards to the correct groups. Explain to students that they will not have to add or change anything on their Lesson 7 boards, but that they can use them for reference for how to make a graphical representation.

As students work on their Activity Pages, circulate throughout the room to ensure that they are correctly completing the data table. The data table will help students organize the information from the scenario so that they can easily see patterns that they wish to display in their graphical representations. If students incorrectly fill out the data table, their data in the graphical representation will not be accurate.

SUPPORT—If needed, help students by showing them where certain data belongs within the data table. Point out the table's rows and columns, and make sure students understand how the data is to be identified in the scenario and then plugged into the table. Prompt students to mark up their Activity Pages to help them organize the information. You can use the following prompts:

- Circle all the data in the scenario that talks about fur color.
- Underline all the data in the scenario that talks about number of spots.
- Highlight all the data in the scenario that talks about size.

Give students time to complete the data tables based on the scenarios. When ten minutes have passed, prompt students to start working on their graphical representations. Remind students that for their graphical representations, they can choose either a pie chart or a bar graph.

Ensure students understand how they are to use the data from the table for their graphical representations. Guide students to focus on graphical representations and data that show variation of traits among the population of cheetahs.

Tell students that all four families of cheetahs should be represented.

5. Encourage discussion.

5 MIN

Once students have had time to complete their data tables and make their graphical representations, bring the class back together for a whole-class discussion to summarize what students discovered. Students should be able to explain their observations and support them with evidence from the data. Encourage student pairs to showcase their poster board graphical representations to the rest of the class.

Ask if any patterns could be found in the data. (yes)

- » What did the population of cheetahs have in common? (*Families 1 and 4 had cheetahs with more light tan fur.*)
- » How did the population of cheetahs differ? (*size, coloring, spots*)
- » Why is there variation among populations? (*Variations begin within families, and when many families make up a population, there are many different traits.*)

Elicit from students that populations have variations in traits.

Ask if students have any questions about the scenario, and address any misunderstandings.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 8.1 and 8.2) for correct answers and sample student responses.

- Collect the completed Looking at Leaves (AP 8.2). Scan the T-charts that students completed, and check for correct understanding. Then check the answers that students provided, and check for correct understanding of families and patterns among traits.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions, such as distinguishing between families and populations and between populations and species.
- Collect the completed Traits in a Population (AP 8.2). Scan the data tables that students completed and check for accurate numbers. Then check the graphical representations that students made, and make sure the numbers correlate. Data in the graphs should reflect data from the table and scenario. If the graphs contain missing labels, engage in further discussion, emphasizing the parts that are missing and why they are important to graphical representations.

PART C

The Environment Affects Traits

OVERVIEW

Lesson	Big Question	Advance Preparation
9. Investigating Plant Growth	How does the environment affect some traits of plants?	Gather materials for hands-on investigation. (See Materials and Equipment, page 13.)
10. Environments and Traits	How does the environment affect the traits of living things?	Read Student Reader, Chapter 5.
11. Environments and Traits—Investigation Results	How did the environment affect the traits of the plant in my investigation?	Gather materials for hands-on investigation. (See Materials and Equipment, page 13.)

Part C: What's the Story?

Students learned in Part B “Organisms Have Traits” (Lessons 5–8) that plants and animals have traits. They learned that these traits are inherited from parents and that the physical traits within a family and population can vary.

In Part C “The Environment Affects Traits” (Lessons 9–11), students take a closer look at the ways in which the environment affects the physical traits of plants and animals.

In Lesson 9, we start by revisiting the bean plants that were planted in Lesson 1. So far, the plants have been maintained in a controlled environment. Now, students will get to see what happens to their plants when some of those environmental controls change and vary. Students will implement changes to the amount of light and water that the plants receive and monitor the plants to observe any changes that suggest the environment can affect the traits of the plants.

In Lesson 10, students read and learn about the environment and its effect on traits. This lesson provides a general explanation of the relationship between traits and the environment through the use of specific examples. There is a cause-and-effect relationship between the environment and its various changes and the physical traits of organisms.

In Lesson 11, which concludes Part C, students get to conduct a hands-on investigation in which they will observe and record the results of their bean plant investigation. Students will use evidence to explain the cause-and-effect relationship between the environment and the physical traits of plants, and they will create a poster that highlights changes in physical traits.

So, to repeat, **the environment affects certain physical traits of organisms, and changes in the environment can negatively or positively influence how an organism grows.** Help your students grasp this concept, and you will lay the groundwork for meeting the NGSS expectations addressed in the rest of this unit.

LESSON 9

Investigating Plant Growth

Big Question: How does the environment affect some traits of plants?

AT A GLANCE

Learning Objectives

- ✓ Describe examples that indicate that the environment can affect some of an organism's traits.
- ✓ Analyze and interpret evidence that demonstrates how the environment can affect an individual's traits.
- ✓ Use evidence to explain the cause-and-effect relationship between the amount of light a plant receives and its growth.

Lesson Activities

- student investigation

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Constructing Explanations and Designing Solutions

Cause and Effect is important to this lesson because cause-and-effect relationships are used to explain changes when an organism lives and grows. In this lesson, students will make changes to the environment of their growing plants to find out (in Lesson 11) whether there is a relationship between those changes and the ability of the plants to grow.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

change
environment

individual
life cycle

trait
variation

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Activity Page



AP 9.1

Activity Page

Environmental Changes (AP 9.1)

Make sufficient copies for your students prior to conducting the lesson. Read the instructional steps on the Activity Page in advance to prepare to facilitate the student investigation.

Materials and Equipment

Collect or prepare the following items:

- cardboard boxes
- measuring cups/measuring tools
- water
- poster board
- timer
- individual cups of plants
- cell phone with camera
- OPTIONAL: printer to print photos of developing plants
- index cards for student vocabulary deck (1 per student)

Advance Preparation

In this lesson, some of the students in the classroom will completely deprive plants of light and water while others partially deprive plants of light and water. This will cause some of their plants to become weak and possibly die. For the remainder of the unit, those students whose plants have died will have to examine other students' plants to observe their growth and to continue the long-term investigation that began in Lesson 1. It may help to assign students to "share" a plant following this lesson.

Additionally, you may choose to use cell phone cameras in the classroom so that students can take pictures of their plants each time they observe them. This would serve as a way to visually record the changes to the plants that are deprived of water and light. Students could then use these pictures in the poster displays that they make in Lesson 11. If this option is available to students, remind them to record the dates the pictures were taken so that they can tell how the changes took place over time.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How does the environment affect some traits of plants? Ask students what kinds of things plants need to grow (*food, light, water, gases in the atmosphere*). Tell students that these are things found in the natural environment. If we change any of these, such as the amount of food or light a plant gets every day, it could affect how well the plant grows and survives. It could also affect the plant's traits.

Introduce the lesson to students by telling them that they will make environmental changes to some of the plants in the classroom to see what happens. Then they will look for evidence that these environmental changes either do or do not have an effect on plants and their traits.

Preview Core Vocabulary

Display the word **environment** on the board or chart paper. Have students write each term in the upper left corner of an index card and underline it. Instruct students to listen for the term during the investigation and discussion and to try to determine what it means through context. Students will do Word Work for the term in the next lesson.

2. Encourage student questions.

5 MIN

Activity Page



AP 9.1

Have students find their plants, and tell them to form groups of six. Distribute and review Environmental Changes (AP 9.1), emphasizing the following points:

- Two students in the group will completely deprive their plants of light and water.
- Two students in the group will deny their plants light most of each day, and they will give them only a fraction of the water the other plants receive.
- Two students in the group will continue to give their plants the same amount of light and water as before.
- Each student will fill out his or her own observation chart.

3. Facilitate the investigation.

20 MIN

Encourage students to use the materials available to them to come up with creative ways to control the changed environment. For example, students can put cardboard boxes over the plants so that the plants no longer receive light. Or students can simply move their plants to a dark area of the classroom. Make sure there are dark areas of the classroom, such as a cupboard, for students to keep their plants in if they are part of the group that has to deprive their plants of some amount of light.

Circulate throughout the room as groups work together to decide on the types of changes to make to their environment and ways to monitor the variables. Ask prompting questions (see **Know the Science** for support), such as these:

Know the Science

What will happen to the plants? One of three things will happen! The plants that continue to receive enough light and water will continue to grow and develop. The plants that receive less light and water may continue to grow, or they become wilted and brown. However, the plants that are completely deprived of light and water will show signs that they are not thriving, such as not growing as tall, having weakened stems, falling over, and probably dying. Each organism interacts in a specific way with the environment, and when environments change, so do the traits of those organisms. In this lesson, students should focus on comparing traits to see cause-and-effect relationships.

- What do you think will happen to the plants that do not get any or enough light? *(They will not grow as well and may die.)*
- What do you think will happen to the plants that do not get any or enough water? *(They will shrivel and likely die.)*
- Which plants do you think will be stronger? Weaker? *(The plants that get the same amount of light and water as before will be stronger; those that get less will be weaker; those that don't get any will die.)*
- What do you think will happen to specific plant traits? For example, what will happen to the leaves, stems, and possibly even the roots? *(The traits of the plants that get the same amount of light and water as before will be strong and green; the traits of the plants that get less will be weaker and less green, possibly even turn brown; the traits of the plants that get no light or water at all will be weakest and will turn brown and die.)*

As students answer the questions on the first page of the Activity Pages, provide guidance by telling them the following:

- The amount of light can be recorded in seconds, minutes, or hours.
- The amount of water must be a measurable unit, such as a teaspoon, a tablespoon, or a cup. Students can use their measuring cups or measuring tools to ensure that the plants get the same amount of water each time.

Put the plants in Group A back in the light (or wherever they had been before).

4. Summarize and discuss.

5 MIN

Lead a discussion about the different ways that groups chose to change their plants' environment. Invite volunteers to share their ideas for monitoring the amount of light and water the plants get. Draw attention to examples with similarities, such as measuring and recording how much water the plant receives each week and measuring and recording how many minutes or hours of light it receives during that same time.

5. Provide ongoing monitoring.

5 MIN

For students to track the growth of their plants, they will need to spend a few minutes every two or three days tending to their plants. This includes doing the following:

- watering the plants
- exposing the plants to light
- recording how the plants are doing

Be sure to schedule time during the class period to allow students to monitor their plants.

Refer to the **Observation Schedule for Teacher Use** on the following page to help organize or plan the dates for student monitoring.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 9.1) for correct answers and sample student responses.

- Scan the completed Activity Pages. Ensure that they are completed, and check for understanding.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions. These questions may include the following:
How did the traits in your plants change? What caused the traits to change?

Observation Schedule for Teacher Use

Write the dates on the lines for when you plan to have students observe their plants, water their plants, and give their plants exposure to light. It is best to spread these dates out so that students make their observations every few days. This activity should be spread out over a couple of weeks.

Observation Day 1 _____

Observation Day 2 _____

Observation Day 3 _____

Observation Day 4 _____

Observation Day 5 _____

Environments and Traits

Big Question: How does the environment affect the traits of living things?

AT A GLANCE

Learning Objectives

- ✓ Describe examples that indicate that the environment can affect an organism's physical and behavioral traits.
- ✓ Use evidence to explain the cause-and-effect relationship between the amount of food an animal eats and its growth.

Lesson Activities

- student observation
- reading, discussion, writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Cause and Effect

Science and Engineering Practices:
Constructing Explanations and Designing Solutions

Cause and Effect is important to the topic of the environment's influence on traits because it can be used to explain why certain physical or behavioral trait changes occur. Students begin this lesson by observing examples of things they find in their environment and discussing what would happen if things in the environment changed. Then they read about the ways in which the environment can affect the traits of animals and plants.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

environment

trait

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 5

Student Reader, Chapter 5
"Environments and Traits"

Activity Page

What Is All Around Me?
(AP 10.1)

Activity Page



AP 10.1

Make sufficient copies for your students prior to conducting the lesson. Read the instructional steps on the Activity Page in advance to prepare to facilitate the student investigation.

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 45 MIN

1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 10.1

How does the environment affect the traits of living things? Remind students that as part of Lesson 9, they made changes to certain factors (water, light) in the environment of their bean plants to track what kinds of changes come as a result.

Distribute and review What Is All Around Me? (AP 10.1). Tell students that they will make observations of their environment—what is all around them. Then they will use their observations to think about what would happen to physical or behavioral traits if one of the things in the environment changed. Tell students there are no right or wrong answers to the Activity Page. They should record what they notice about their surroundings.

As students work on their Activity Pages, remind them that they are not limited to writing down only what is in the classroom. Tell them that they should think about their environment at home, in their neighborhood, outside, etc. As students work on the questions on the second page of the Activity Page, tell them that their environmental changes do not have to be realistic. Use the following prompts:

- An example of a change to the environment could be getting rid of all the water at the lake. What would happen if all of the water in the lake disappeared? (*It would affect all the fish and animals that live there.*)
- Another example of a change to the environment could be cutting down the trees at school to make more room for playground equipment. What would happen if the trees were cut down at school? (*Students would no longer have shade outside.*)
- Changing amounts of rain or sunlight can also be an example. What would happen if an area got too much sunlight and not enough rain or got too much rain and not enough sunlight? (*How well plants grow may change, resulting in some plants turning brown or dying.*)

The goal of this exercise is for students to understand that there is a cause-and-effect relationship between the environment and the physical and behavioral traits of the organisms that live there.

2. Encourage student questions.

5 MIN

Lead a discussion about the examples of things found in the environment that students recorded. Draw attention to similarities. Ask students to share their responses to the questions at the end of the Activity Page, and ensure understanding of cause-and-effect relationships with regard to traits. Use prompting questions based on student examples to further stimulate discussion or enhance awareness. For example, if students wrote that the environment changed as a result of a flood, ask them how the flood would affect the specific things that live there, such as trees, people, and animals.

3. Read and discuss: “Environments and Traits.”

15 MIN

Student Reader



Ch. 5

Read together, or have students read independently, “Environments and Traits,” Chapter 5 in the Student Reader. The selection reinforces the idea that environments have an affect on the organisms that live in them. The Student Reader introduces the meaning of the term *environment* and makes comparisons so that students can see how one kind of environment influences an organism one way while another kind of environment influences it differently. The reading presents several examples of physical and behavioral traits to help make the cause-and-effect relationship between environmental factors and traits clearer.

Preview Core Vocabulary Terms

Before students read, write **environment** on the board or chart paper. Encourage students to pay special attention to this term as they read.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 27

Discuss with students the meaning of the term *environment*. Have a volunteer read aloud the definition from the vocabulary box on the page. Tell students that they may already be familiar with the term *environment* from hearing it in day-to-day language.

SUPPORT—If necessary, have students name examples of nonliving things in an environment. Draw connections between the examples that students recorded in their Activity Pages and the examples that students name now.

When students read the paragraph that says that some environments contain more shrimp than others, take a moment to explain why this is so. Tell students that flamingos living in the wild, which feed on shrimp, are often brighter in color than the flamingos living at a zoo. This is because zoo flamingos are fed food pellets instead of actual shrimp. The pellets do not contain the same nutrients that the wild flamingos get from the shrimp they eat. Therefore, the zoo flamingos are often lighter in color.

Make sure students understand that there are some inherited traits of an animal that do not change based on the food they eat. For example, most animals have eyes. Changing their diet would not cause their eyes to go away, though it may affect how well they see. Use the following question prompt to ensure understanding:

- What are some physical traits that do not change based on a flamingo's environment? (*long legs, beak shape*)

Pages 28–29

Be sensitive in the classroom when talking about issues involving weight.

After reading the spread, ask students if any of them have animals they or their families take care of. If so, ask the following questions:

- » How often does your animal get exercise?
- » How many meals a day does your animal eat?
- » Do you ever feed your animal people food as a treat?

Draw attention to the fact that the two environments being discussed are very different. The cat's environment is indoors, and the urban monkeys' environment is outdoors. However, both environments have caused the animals to become overweight. The similarity here is not about indoor environments or outdoor environments; it is more about the factors within those environments themselves.

SUPPORT—If necessary, explain to students that monkeys naturally live outdoors. But wild monkeys that live in the jungle have different diets from the monkeys that have moved into cities. The city monkeys eat people food, and the jungle monkeys eat wild foods. This is the main difference. One environment—the city—is designed for people. The other environment—the jungle—is where monkeys are used to living. The city environment offers monkeys things that they are not used to, and this causes changes to the monkeys' physical traits.

Pages 30–31

Pause after the first paragraph on the page. Review the concept of learned behaviors with students. Have students name some examples of learned behaviors of animals. Be sure they know the term *behavioral traits*. Students may confuse learned behaviors with inherited behaviors, but this is okay as long as you explain that sometimes animals inherit certain behaviors that they later learn how to carry out.

As you read these pages, pause to make a list on the board or chart paper of the behavioral traits that the meerkats and prairie dogs learn from monitoring their environments. Make sure students understand that certain characteristics result from the animals' interactions with their environments, such as the meerkat learning how to stand guard for others by watching other meerkats carrying out this task.

Page 32

Students should be familiar with the concept of limiting the amount of resources—such as water and light—a plant gets and seeing how the plant responds. By now, students may have already observed changes in their plants that do not receive as much water or light as the other plants. However, the concept of too much water may be new for some students.

SUPPORT—Students may have a difficult time understanding how something that is necessary for life (water) can be harmful to plants. If plants need water to live and grow, why is it that too much water is bad for them? Explain to students that too much water can kill plants by preventing oxygen from getting to the roots. Plants have parts in place that allow them to use certain amounts of water and no more. When plants take in too much water, their roots can become damaged and drown out the rest of the plant.

NOTE—If further explanation is needed on this concept, see the link on the following page for a video that you can watch in class.

4. Demonstrate examples and guide discussion.

5 MIN

Choose one or more of the following examples to stimulate further discussion. Analyze with students 1) the physical traits of the organism and 2) how those traits change based on the environment. (See **Know the Science 1** and **2** for support with the analysis.)

Know the Science

1. Why are students watching a video about a flooded field? To show that too much water can be harmful to plants! Water is a resource that helps sustain life. But too much water can be detrimental to plants. When heavy rains or floods occur, plants can be destroyed or even die from too much water. This video and the discussion centered on it help students understand what can happen to plants because of floods. The goal is for students to understand and see that too much water is an environmental factor that may not be good for plants.

2. Why are students watching a video about city monkeys? To show how these monkeys are eating people food in their urban environments! Monkeys have moved into cities and adapted to eating people food. Monkeys like to eat as much as they can, and they even store food for later. The video shows monkeys breaking into people's homes to gain access to food. With this level of consumption, monkeys can become unhealthy and overweight. Their risk of becoming overweight is a product of their new environment.



- Show a video of farmland that has been flooded. (See the Online Resources for a link to a suggested video.) Ask what traits students can observe in the plants.
 - » Do you think these plants will survive the flood? (*yes, if the waters recede quickly; no, if the waters do not recede quickly*)
 - » What kinds of changes to the plants' physical traits might the flood cause? (*The leaves might fall off; the stems might bend over.*)
 - » If these things happen, what will be the cause? (*Too much water will have drowned the plants.*)
- Show a video of urban monkeys rummaging for human food. (See the Online Resources for a link to a suggested video.) Ask what traits and behaviors students can observe.
 - » What are the monkeys doing? (*stealing people food and eating it*)
 - » What are the monkeys eating? (*bananas, peanuts*)
 - » What do you think will happen to the monkeys after eating too much people food? (*They will become overweight.*)

Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

- Prompt students to link details in this discussion back to the reading selection.
 - » What are some of the ways that plants or animals are influenced by their environment? (*Environments can cause animals to become overweight. Diet may change the color of an animal's fur or feathers.*)
 - » What happens when environments change? (*The living things in the environment, such as plants and animals, can undergo trait changes, too.*)

5. Teach Core Vocabulary.

5 MIN

Word Work

Have students complete the Core Vocabulary card for the word **environment** that they began as a preview in the previous lesson.

environment: (n. a surrounding area that contains living and nonliving things)

Challenge students to write a short sentence that defines *environment* and also uses the word *traits*. (*Sample answer: An animal's environment is the place that surrounds it, and it can affect some of the animal's traits.*)

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 10.1) for correct answers and sample student responses. Collect the completed Activity Pages. Scan the tables that students completed, and check for understanding, even though there are no right or wrong answers.

Choose one or two questions based on what you see in the Activity Pages to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and to correct misconceptions, such as distinguishing physical traits and behavioral traits.

LESSON 11

Environments and Traits— Investigation Results

Big Question: How did the environment affect the traits of the plant in my investigation?

AT A GLANCE

Learning Objectives

- ✓ Describe observations that indicate that the environment can affect an organism's traits.
- ✓ Use evidence to explain the cause-and-effect relationship between the environment and traits.

Lesson Activities

- student observation
- data analysis
- discussion and writing

NGSS References

Disciplinary Core Idea LS3.A: Inheritance of Traits

Disciplinary Core Idea LS3.B: Variation of Traits

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Constructing Explanations and Designing Solutions

Cause and Effect is important to the topic of trait variation because identifying causes clarifies that certain changes in the environment bring about effects to the organisms that live there. These changes may include altered physical or behavioral traits.

This lesson serves as a continuation or extension of Lesson 9. Students will study the data they collected from Lesson 9 and look for evidence to explain the cause-and-effect relationship between the environment and their bean plants. They will make a poster that represents this relationship.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced during this lesson.

change
environment
individual

life cycle
physical trait

trait
variation

Instructional Resources

Activity Page



AP 11.1

Activity Page

Evidence of Changes (AP 11.1)

Make sufficient copies for your students prior to conducting the lesson. Read the instructional steps on the Activity Page in advance to prepare to facilitate the student investigation.

Materials and Equipment

Collect or prepare the following items:

- Activity Page 9.1
- poster board
- markers, assorted colors
- OPTIONAL: printer to print photos of developing plants

Advance Preparation

Students will refer to the Environmental Changes (AP 9.1) data table as they work on this lesson. Have these pages available and ready to distribute. Students will not need to refer to the actual plants in this lesson, as they have already collected data on the plants' changes as part of the ongoing monitoring for Lesson 9.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How did the environment affect the traits of the plant in my investigation?

Remind students that in Lesson 9, they made changes to the amount of water and light that their plants received and kept track of their observations in a data table. They had opportunities over several days to track and record their plants' progress, including watering the plants and giving them light. Review with students the fact that water and light are examples of variables that can change in a natural environment.

Ask students some prompting questions about their process:

- What parts of the plants did you observe when you studied them in Groups A and B? (*leaves, stems, color*)
- What are these physical features of each plant examples of? (*physical traits*)

Tell students that today they will study the data they collected and put together posters to present the changes in their plants. Get students to think about the connection between environmental changes and changes to plants' physical traits in preparation for their presentation.

2. Encourage student questions.

5 MIN

Lead a discussion about the effects of the environment on traits. Prompt students to think about whether some environmental changes affect organisms more than others. Use examples to help students make a connection between their investigations and real-world scenarios. Ask: Do you think having more rain in an environment would affect the organisms that live there? What if an environment became hotter or colder? (*Yes, those kinds of changes could affect the organisms. Too much rain may drown plants or animals. An environment that becomes hotter or colder may make it harder for plants or animals to live there.*)

3. Preview the analysis.

5 MIN

Activity Pages



AP 9.1
AP 11.1

Have students form the same groups that they were in for Lesson 9. Distribute Evidence of Changes (AP 11.1) along with Environmental Changes (AP 9.1). Remind students that they already used and filled out the data tables from Activity Page 9.1. Now they will use their tables for reference in this lesson to analyze the data that was collected.

Review Activity Page 11.1 with students. Tell students that they will analyze the data from their Lesson 9 data tables and answer questions to come up with a conclusion about the cause-and-effect relationship between the environment and the plants' traits. (See **Know the Standard.**) Students will complete this investigation by doing the following:

- comparing Group A, Group B, and Group C data
- looking for evidence

Know the Standard

How will students identify a cause-and-effect relationship? The Crosscutting Concept of Cause and Effect for 3-LS3-2 specifies that students at this level should recognize that cause-and-effect relationships can be identified and used to explain changes. Students should be able to study the data and look for patterns or similarities that point to the fact that changes to the environment (cause) lead to changes in the organisms (effect). Students do not need to formulate ideas or an understanding about why certain changes in the environment occur, such as why some environments lack light or water. Rather, they only need to understand how these factors influence the physical traits of organisms in the environment.

- writing explanations
- forming conclusions
- making a poster for display

Explain that students will be guided to create a poster that shows the way the environment affected the physical traits of the plants. Tell students that the Activity Pages will be completed individually but that the poster presentation will be done as a group.

Show students the materials they can use for their poster displays. Give each group time to collect their materials.

TEACHER NOTE—If you allowed students to use a cell phone camera in Lesson 9, tell them that they can use their pictures to serve as a “before and after” visual of the plants. Students can use glue or tape to stick the printed pictures to their poster boards.

4. Facilitate the analysis.

20 MIN

Circulate throughout the room to provide assistance as students work on their individual analyses and group posters. Remind students to work on their group posters after they have completed the analyses and formed a conclusion about their findings. This is important because the poster board displays must reflect the evidence collected in the data analysis.

SUPPORT—If students are unclear about how to find evidence, refer them to the data in the Lesson 9 Activity Pages. Tell students that data can be used as evidence, especially if they can identify patterns. Help students identify patterns between the Group A plants, the Group B plants, and the Group C plants. Students should be able to see that the Group A plants maintained their traits while the Group B and Group C plants experienced negative changes to their traits due to changes in the environment (light and water resources).

Make sure students are designing posters that illustrate differences between the plants in Groups A, B, and C and the changes they experienced.

5. Summarize and discuss.

5 MIN

Invite each group of students to briefly present their posters. Students should do the following:

- Describe what they did to change the environment for Group B. (*We gave them less light and water.*)
- Explain what happened to the plants in Group B. (*They did not grow; they lost their color; they started to topple to the side.*)
- Explain what happened to the plants in Group C. (*They died.*)
- Explain what happened to the plants in Group A. (*They continued to grow.*)

- Talk about what evidence they have that environments cause changes to plants. Evidence should be based on the amounts of light and water that students gave their plants over the days or weeks. (*Group A plants did not have any changes to the amount of water and light they received, and they continued to grow. Group B plants looked worse after not having as much water and light. Group C plants wilted and died. Therefore, plants that do not receive as much water and light do not survive as well.*)

Each group should have two to three minutes to present. Draw attention to similarities (such as whether all the plants in Group B look wilted or dry) so that students can see patterns and make connections.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 11.1) for correct answers and sample student responses.

- Scan the completed Evidence of Changes (AP 11.1). Ensure that the sheet is completed, and check for understanding. Students should show that there is a cause-and-effect relationship between the environment and traits.
- Review the poster displays, and look for correct understanding of how the environment influences organisms' traits.

PART D

Advantages of Specific Variations

OVERVIEW

Lesson	Big Question	Advance Preparation
12. Helpful Traits	Which traits are helpful to organisms, and which traits are not?	Read Student Reader, Chapter 6.
13. Traits, Survival, and Differing Environments	Why are traits important when environments change?	Read Student Reader, Chapter 7.
14. Traits and Advantage	How can variation of a trait be an advantage or disadvantage?	Gather materials for hands-on activity. (See Materials and Equipment, page 13.)

Part D: What's the Story?

Students learned in Part C “The Environment Affects Traits” (Lessons 9–11) that the environment has the ability to impact an organism’s physical traits for better or for worse. Through hands-on investigations and observations, they learned that things such as the availability of water and light affect how plants grow or survive in their environment.

In Part D “Advantages of Specific Variations” (Lessons 12–14), students study how certain traits are helpful or harmful to organisms and how such traits can matter when environments change.

In Lesson 12, we start by having students read and learn about how different kinds of traits can help or harm organisms depending on their surroundings. Students will also complete a short observation of living things around the school to identify traits and propose how they are helpful to the organism.

In Lesson 13, students read and learn about the relationship between the environment and traits. As environments change, organisms with particular traits may be able to survive and reproduce in greater numbers than other organisms that do not possess the same traits. Over time, some organisms may survive the changes in their environments, but many others may not survive.

In Lesson 14, which concludes Part D, students conduct a hands-on activity in which they construct an explanation that shows how some individuals within a population have traits that give them a greater advantage for survival and reproduction over other organisms within the same population. Students will read a story and then answer prompts, providing illustrations as part of their answer. In doing so, they make a connection between traits and advantages/disadvantages within populations.

So, to repeat, **certain physical traits can help organisms survive and reproduce in their environments, whereas other traits may be harmful to organisms or less likely to help them survive and reproduce.** Help your students grasp this concept, and you will have met the standards for the Performance Expectation.

LESSON 12

Helpful Traits

Big Question: Which traits are helpful to organisms, and which traits are not?

AT A GLANCE

Learning Objectives

- ✓ Distinguish between traits that are helpful to an organism and traits that are not helpful.
- ✓ Compare advantageous and disadvantageous traits.

Lesson Activities

- student observation
- reading, discussion, writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS4.B: Natural Selection

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Constructing Explanations and Designing Solutions

Cause and Effect is important to the topic of helpful and harmful traits because it can be used to explain why certain changes occur through natural selection. Students begin this lesson by observing living things around the school to identify traits. They then think about how those traits might be helpful to the living organisms. Next, they read about the ways in which certain traits can help be helpful or harmful to organisms and how these determine how they will survive in their environment.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

advantage	individual	survive
change	population	trait
disadvantage	reproduce	variation

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 6

Student Reader, Chapter 6
“Helpful Traits”

Activity Page



AP 12.1

Activity Page
Helpful Traits Scavenger Hunt
(AP 12.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- front board or chart paper (make sure there is enough space for drawing)
- front board markers or chalk or, if an interactive board is being used, the proper drawing tools
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (2 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 12.1

Which traits are helpful to organisms, and which traits are not? Distribute and review the directions for Helpful Traits Scavenger Hunt (AP 12.1). Tell students that they will go outside and observe living things such as plants, birds, and insects. They will focus on the traits of those living things and then try to tell how those traits help the organism survive. Remind students that they have been studying physical traits throughout all the lessons in this unit and that now they will be identifying the traits that help (or do not help) organisms. As students conduct this activity, prompt them to ask themselves, “How can this trait help the organism?”

Review the sample provided on the Activity Page. Tell students that organisms have many different traits and that students should try to focus on identifying traits that could help the organism survive in some way.

SUPPORT—Help students understand that as they observe the organisms, they will notice many different physical traits. Not all traits are helpful to animals, but most are. Most individuals are fit to live in their environment. If necessary, give students examples of a trait on an animal or plant they see outside that could be helpful to that organism. You can also use the example on the Activity Page and elaborate on why large wings are helpful to birds.

In answering the question “Why do you think living things have helpful traits?” prompt students to think about the word *trait*. Explain that traits not only allow people to identify organisms, but also help tell scientists how an organism survives.

Continuously stress the terms *survival* and *reproduction*—the benefits of advantageous traits.

While students are outside, give them time to complete the table on the Activity Page. When you return to the classroom, give them a few more minutes to answer the questions at the end.

2. Encourage student questions.

5 MIN

Lead a discussion about the examples of traits that students observed. Discuss how those traits are helpful to the plants or animals described. Draw student attention to similarities that have been identified. Ask students to share their responses to the questions at the end of the Activity Page, and ensure that they understand how each trait is helpful or harmful to organisms. Use prompting questions to further stimulate discussion or enhance awareness. For example, ask the following:

- » Could the trait that is harmful to this organism be helpful to another of the same species?
- » How do you think the trait fits the environment in which the organism lives?

3. Read and discuss: “Helpful Traits.”

15 MIN

Student Reader



Ch. 6

Read together, or have students read independently, “Helpful Traits,” Chapter 6 in the Student Reader. The selection reinforces the idea that whether a trait serves as an advantage or a disadvantage depends on how it aligns with the environment in which the organism lives. The reader presents several examples of ways in which traits serve as an advantage or disadvantage.

Preview Core Vocabulary Terms

Before students read, write the following terms on the board or chart paper. Encourage students to pay special attention to these terms as they read.

advantage **survive**

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 33

Draw student attention to the picture of the foxes. Ask which fox they think will have a better chance of catching prey and surviving the snowy winter. (*the white fox*) Then have students tell why they chose this fox. (*It blends in with the snow and is harder for other animals to see.*)

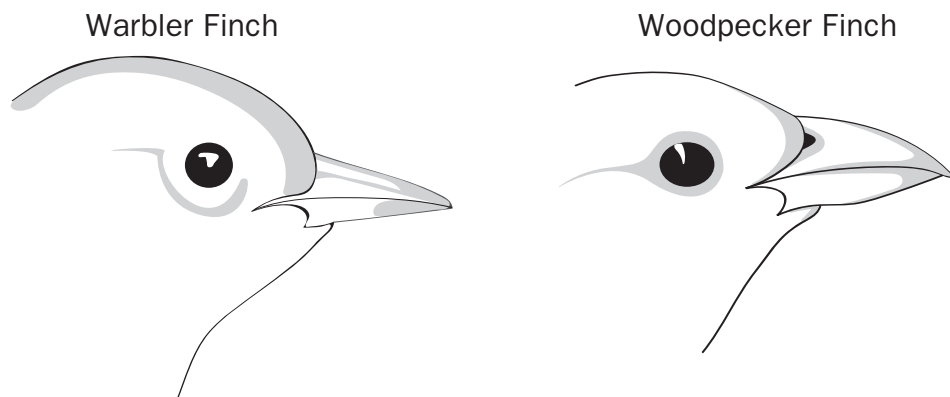
SUPPORT—Make sure students are focused on the correct physical trait of the foxes in the pictures. The focus of this page is related to the trait of color rather than other traits that students might notice, such as ear size or length of legs.

Make sure students understand that traits are helpful in certain environments. For instance, the fox's white fur is helpful in a snowy environment. Ask, "Would the white fox be able to blend in well to a brown desert environment without snow?" (*no*) Then ask students to tell you whether the brown fox would be able to survive better in a brown desert environment. (*yes*) Reiterate that each color of a fox's fur can be a helpful trait in certain environments and a harmful trait in others.

Page 34

After reading, emphasize to students that the large beak of the large ground finch is a physical trait that helps the bird survive in its environment. Without these beaks, the birds might not be able to eat the hard seeds common in the environment and survive.

SUPPORT—If necessary, draw the three types of beaks mentioned in the page on the front board or chart paper so that students can compare them side by side. Draw the large ground finch's beak first. Then draw the smaller pointed beak of the warbler finch and the long beak of the woodpecker finch. (Use the images below for reference.) Discuss with students how the birds use their beaks and why their beaks are well suited to their environments and the things that they eat.



Page 35

Introduce students to the term *disadvantage*. As a class, define this term using what students already know about the meaning of *advantage*. Explain that when a trait is harmful, the organism is at a disadvantage.

As you read the paragraph about the prairie dogs, have students explain why long legs on a prairie dog are both helpful and harmful. (*Long legs can help them run faster but also stop them from fitting in their burrows.*) See if students can come up with other examples of physical traits on animals that are helpful for one reason but harmful for another reason. You can use the following examples to help prompt students:

- large size of elephants (*helpful for protecting themselves against other animals; not helpful for hiding from predators or blending into the environment*)
- small size of mice (*helpful for hiding, but because they are so light in weight, allows them to be easily picked up by birds*)

Page 36

After students read this page, discuss the importance of reproduction as a means to survival for a species. Tell students that if a species cannot reproduce, it will eventually die off. Explain that there are many examples of animals' special traits that attract mates, such as the peacock's colorful feathers and large deer antlers. Both are traits that males use to attract females of the same species.

Page 37

After students read this page, ask them why the spines of the cactus are a trait that gives the plant protection. (*Animals will stay away from the cactus so that they do not get pricked.*) Have students consider why a cactus with fewer spines would not survive as well in the desert. (*because more animals would be able to eat them for water*)

CHALLENGE—Challenge students to use reasoning to explain why most cacti in a population have very dense spines. Prompt them to think back to the concept of inheritance that they learned about earlier in the unit and how traits that help organisms survive are most likely the ones that are passed down from parents to offspring.

See whether students can think of other helpful traits that plants have to protect themselves. One example is being poisonous. Being poisonous is a trait that helps protect a plant from being picked or eaten by other organisms.

Page 38

Be sure students know that albinism is not always harmful. In many situations it can be neutral or even advantageous. Be sensitive to albinism with regard to people.

Have students tell why an albino alligator would have a hard time finding food. (*It would easily be seen by its prey and would not be able to sneak up on potential meals.*) Ask students whether being an albino alligator is an advantage or a disadvantage. (*It's a disadvantage.*) Prompt students to think about what traits would help this alligator survive better in its environment. (*If the alligator were green or greenish-brown, it would better fit into its environment, where it could more easily hunt for and catch prey.*)

See whether students can name other harmful traits that organisms have that can serve as a disadvantage to them.

4. Demonstrate examples and guide discussion.

5 MIN

Choose one or more of the following examples to stimulate further discussion. Analyze with students 1) the physical traits of the organism, 2) whether the trait helps or harms the organism, and 3) how the environment determines whether the trait is an advantage or disadvantage (see **Know the Science 1** and **2** for support with the analysis).

Activity 1: Use the front board or chart paper for this activity. As a class, have students help draw a new type of animal with specific traits that will help it survive in its environment. Select an environment for the animal, such as a desert or a rain forest. Ask students to help you design this new animal by focusing on specific traits that will help it survive in this environment. Use the following prompts:

- » How many legs should the animal have? How will the number of legs help the animal survive?
- » Think about what the animal eats in this environment. Based on what it eats, what kind of teeth should the animal have?
- » Does the animal need to be able to hide in its environment? Should it have stripes or spots or be able to change colors?
- » How large should the ears of the animal be? Does it need to be able to hear danger coming from far away?

Know the Science

1. Why are we drawing a new animal? To show the relationship between the environment and traits! Traits can serve as an advantage or disadvantage to living things. Certain traits can be helpful to organisms in one environment but harmful to those same organisms in another environment. Traits are advantageous when they can help an organism survive, find mates, and reproduce in its environment. Normally, these types of traits are passed on through inheritance while the traits that are not advantageous eventually phase out. However, as environments change, traits can, too, over time. This is known as adaptation, and it is an important part of natural selection. By having students make up a new animal, they can see how many helpful traits depend on the conditions of the animal's environment, including what the animal eats, who its predators are, and what the weather is like.

2. Why are students watching a video about polar bears? To learn about their helpful traits for living in cold, isolated environments! Polar bears are unique animals with physical traits that are specifically adapted to their environment. The video shows students that many of the polar bears' physical traits help them survive. For example, the polar bear has paws that are flatter than other bears', which helps the polar bear swim better. If polar bears' paws were more rounded and smaller, polar bears might not be able to swim as well and thus would not survive as well in their environment.

CHALLENGE—For an extra challenge, have students add some traits that would be helpful in one environment but harmful in another. You can explain that the imaginary animal lives in two environments; some of the animals live in a desert while others live in a rain forest. You could still draw one animal but include traits on the animal that would serve as an advantage or disadvantage depending on the animal's environment. (Think back to the images of the foxes in the Student Reader.) Then have students tell in which environment the animal would survive the best.

There are no wrong answers for students in this activity, but be sure to gauge student understanding of how certain traits are helpful to animals in certain environments.

Activity 2: Use a T-chart to compare advantageous and disadvantageous traits. Draw a T-chart on the front board or chart paper, and discuss specific plant or animal traits, such as color or size. Have students tell whether the trait is helpful or harmful to the specific organism. Use the following prompts:

- » Can this trait help the organism survive? If so, how?
- » Can this trait harm the organism? If so, how?

Show a video of polar bears. (See the Online Resources for a link to a suggested video.) Ask what traits and behaviors students can observe.

- » Are the polar bear's skin and fur helpful or harmful traits? (*helpful*)
- » How are the polar bear's skin and fur helpful? (*The skin is dark and can help the sun keep the polar bear warm. The fur is transparent to let the sun shine onto the skin.*)
- » Which physical traits help the polar bear be an excellent swimmer? (*large paws that act as paddles, shape of face and snout, layers of fat*)
- » How is being an excellent swimmer a helpful trait for a polar bear? (*Swimming helps polar bears find food so they can eat and stay alive.*)
- » How is being large in size an advantage to the polar bear? (*It can hunt other large animals, such as walruses, for food.*)

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Prompt students to link details in this analysis discussion back to the reading selection.

- » Are all plant and animal traits helpful? (*no*)
- » What is an example of a harmful trait? (*A plant that has soft stems and leaves may be more likely to be eaten than plants with thorns.*)

5. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Have them write each term in the upper left corner of an index card and underline it (one term per card).

advantage **survive**

Word Work

- **advantage:** (n. a factor that helps an organism) Point out that *advantage* is a noun because it is something (a condition or circumstance) that puts one in a better position. It is also the opposite of *disadvantage*. This means that the two terms are antonyms. Have students tell what *disadvantage* means based on your discussion. The term *disadvantage* has the term *advantage* in it but uses the prefix *dis-*. Discuss with students what happens when the prefix *dis-* is added to the front of a word.

Ask volunteers to use both terms in a sentence. Encourage sentences that use the terms in relation to traits. Write two sentences on the board or chart paper (one using *advantage* and one using *disadvantage*). (*An advantage is something that helps an organism. A disadvantage is something that harms an organism.*) Have students copy the sentences on their cards and underline the words *advantage* and *disadvantage*.

- **survive:** (v. to stay alive) Challenge students to write a sentence that defines the word *survive* and also includes the word *trait(s)*. (*Sample answer: Survive means to keep living, and animals have traits that help them survive.*)

Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add to the deck in later lessons.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 12.1) for correct answers and sample student responses.

- Collect the completed Helpful Traits Scavenger Hunt (AP 12.1). Scan the tables that students completed, and check for understanding, ensuring that students are listing traits that are helpful (not harmful) to the animal and that their explanations support the traits.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions, such as distinguishing between traits that are advantageous and those that are disadvantageous for an organism.

LESSON 13

Traits, Survival, and Differing Environments

Big Question: Why are traits important when environments change?

AT A GLANCE

Learning Objective

- ✓ Describe how changes in the environment may allow individuals with certain traits to survive and reproduce in greater numbers than individuals without those traits.

Lesson Activities

- reading, discussion, writing

NGSS References

Disciplinary Core Idea LS4.B: Natural Selection

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Constructing Explanations and Designing Solutions

Cause and Effect is important to the topic of helpful and harmful traits because cause-and-effect relationships can be used to explain why changes in the environment cause certain individuals with certain traits to survive more often than others.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 166–167 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

camouflage

change

extinct

rare

seasonal

survive

trait

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 7

Activity Page



AP 13.1

Student Reader, Chapter 7
“Traits, Survival, and Differing Environments”

Activity Page
Whales (AP 13.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- index cards (enough for half of the students)
- sticky notes (enough for half of the students)
- water
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (3 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 13.1

Why are traits important when environments change? Remind students that in Lesson 12, they learned that organisms’ traits can be helpful or harmful and that the determination of whether a trait is helpful or harmful usually depends on the environment in which the organism lives.

Distribute and review Whales (AP 13.1). Tell students that they will be prompted to read a scenario about whales and answer questions that follow.

As students work on answering the questions, prompt them to think about how traits are helpful in certain environments. For example, a whale with more blubber has a better chance of surviving icy cold ocean water. But other whales that are smaller and lighter and have larger fins can swim faster and thereby have a better chance of surviving in warm shark-infested waters. Make sure students understand that these are examples of how changes in the environment may allow certain individuals with certain traits to survive better than individuals without those traits.

SUPPORT—If necessary, have students write down or underline the traits of each whale. Explain that both organisms are whales—perhaps different species of whales, but they have different traits. Students must be able to see the different traits and how those traits are helpful or harmful to the whale to answer the questions correctly.

As students conduct this activity, prompt them to ask themselves, “How do changes in the environment affect how organisms survive?” In answering this question, tell students to think about what they know so far about traits and inheritance. Remind them that traits are inherited, or passed down, from parents to offspring. Traits that are helpful to organisms will allow more organisms with these traits to survive. Thus, those traits will be passed down in greater numbers than traits that are harmful. This is how living things that fit well into certain environments survive to pass on their traits to their offspring.

2. Encourage student questions.

5 MIN

Lead a discussion about the types of traits students read about with the whales. Discuss which traits were helpful in the icy cold waters and which traits were helpful in the shark-infested warmer waters. Have students share their answers about which whale would survive better in which environment, and draw attention to similar answers. Ask students to share their responses to the questions at the end of the Activity Page. Ensure understanding of traits as being helpful or harmful depending on the environment.

3. Read and discuss: “Traits, Survival, and Differing Environments.” 15 MIN

Student Reader



Ch. 7

Read together, or have students read independently, “Traits, Survival, and Differing Environments,” Chapter 7 in the Student Reader. The selection reinforces the idea that environments can differ and change. When an environment changes, either gradually or suddenly, an organism might struggle to survive and reproduce. Sometimes organisms have to adapt to survive. Other times, they might leave the environment and relocate to a neighboring location with better living conditions.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Have students write each term in the upper left corner of an index card and underline it. Instruct students to add definitions to their cards for these terms as they read.

camouflage **extinct** **rare**

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 39

Discuss with students the meaning of the term *change*. Tell students that they are already familiar with the term *change* from hearing it in day-to-day language. Have students name some changes that can occur in an environment. Examples may include the weather getting hotter or colder, an area getting more or less rain, and trees in a forest being cut down.

SUPPORT—If necessary, explain that environmental changes can be big or small, fast or slow. Sometimes changes are massive and sudden. An example of this is a forest fire that burns thousands of acres of trees. A forest fire suddenly changes an environment. Other times, changes occur gradually over time. These changes take longer to notice, and organisms have more time to adapt to them.

SUPPORT—Make sure students are clear on the connection between the long necks of giraffes and how that same trait can either help or harm the giraffe, depending on the environment. Use the following question prompts to ensure understanding:

- » Which trait helps the giraffes survive in the grasslands? (*long necks*)
- » Which trait would make it hard for giraffes to survive in a thick, tropical forest? (*long necks*)
- » How can the same trait be helpful and harmful at the same time? (*The trait helps giraffes in one environment but harms them in another.*)

Pages 40–41

As students read about camouflage, address any misconceptions that camouflage is the same thing as being able to change colors. Color-changing traits allow some animals to become camouflaged, but animals can camouflage without changing colors just by using their natural colors against a similarly colored background.

Use this opportunity to make sure students understand what coal is when they read about it. Refer students to the picture of soot on the page. Point out the soot in the picture so they can easily see what it is and how it covers things around it. Check for understanding by using the following prompts:

- » How did the environment change for the peppered moths? (*Soot covered the trees.*)
- » Why did this affect the moths' ability to survive? (*It changed which moths could blend in with the trees.*)
- » Why did the white moths suddenly not survive as well as the black moths? (*They could not blend in as well as the black moths against the soot-covered trees.*)

CHALLENGE—If time permits, challenge students to come up with other examples of animals that use camouflage as a helpful trait to survive. Examples can include animals that change color, such as octopuses and chameleons, and animals that do not change color, such as owls, snakes, and grasshoppers.

Page 42

After reading the page, ask students if they know what might have caused woolly mammoths to go extinct. Discuss with them that at the end of a long period known as the Ice Age, the environment began to change. Earth grew warmer, and huge glaciers melted. Because this happened quickly over time, most woolly mammoths could not adapt and died off.

Page 43

Pause after reading the first paragraph, and emphasize the concept of a species being extinct. It means that there are no surviving individuals within that species that can reproduce, so the life cycle ends at the death stage.

After reading the rest of the page, ask: "Why didn't the dodo birds survive on the island?" (*The conditions of the island changed when humans settled there and ate the bird eggs; the birds did not have traits that allowed them to survive in the newly changed environment.*)

SUPPORT—If students are confused by the idea of extinction, ask them about specific dinosaurs. Most students will have heard about, read about, or seen TV programs or movies about dinosaurs. Ask them if they have ever seen a live *Tyrannosaurus rex*, *Triceratops*, or *Velociraptor*. (*no*) Explain that they have never seen one living anywhere because all that's left of most dinosaurs are fossils. All the dinosaurs other than birds died off millions of years ago and today are considered extinct.

CHALLENGE—If time permits, challenge students to think of another scenario in which an animal could become extinct if its environment changed. You can do this as a whole-class discussion or have students work with a partner to come up with scenarios and share their samples.

Page 44

After reading the page, ask students: “If the ice sheets are melting, what could explain that?” (*Earth’s climate is getting warmer.*) Point out that a warming climate is an example of environmental change. Have students explain why the polar bear cannot move to a new area. (*The polar bear spends most of its time on ice sheets, and the ice sheets are not shifting to a new location.*)

CHALLENGE—Have students tell what kinds of traits allow the polar bear to survive and how those same traits might be a disadvantage in a changing environment. This could be a whole-class discussion, or you could have students draw pictures of what the polar bear’s adaptations would look like. If necessary, use prompts to encourage creative thinking:

- » What adaptation helps the polar bear swim farther to find seals?
- » What adaptation helps the polar bear survive warmer weather?

Be sure students understand that polar bears cannot change their physical traits to meet their needs in a new environment. Physical traits are determined by what they inherit from their parents. It takes many generations for organisms to develop new traits to survive in changing environments. If environments change too drastically, the organisms may not change fast enough and will likely die off. Some may even go extinct, as happened with the woolly mammoths.

4. Demonstrate examples and guide discussion.

5 MIN

Choose one or more of the following examples to stimulate further discussion. Analyze with students 1) changes in the environment, 2) how environmental changes affect organisms, and 3) how an organism’s traits can help it survive changes in an environment. (See **Know the Science 1** and **2** on the next page for support with the analysis.)

- Make elephant ears out of index cards and sticky notes.
- Give half the class index cards.
- Give the other half sticky notes.
- Explain that elephants have large ears not just for hearing but also to help keep them cool. Tell students that as elephants flap their ears, they can cool down their bodies, especially after taking a bath in a lake or some mud. Blood vessels in the ears carry heat. By fanning their ears in the breeze, elephants can lose some of that heat and cool down. However, not all elephants have the same size ears. Some ears are bigger, and some are smaller.
- Explain that the index cards represent larger elephant ears. The sticky notes represent smaller elephant ears.
- Next, go around the room, and place a drop of water on the back of each student’s nondominant hand.

- Tell students to fan off the drop of water using their “elephant ear.”
- Use the following prompts:
 - » Which ears took longer to fan off the drop of water? (*smaller ears/sticky notes*)
 - » Which ears do you think are better for helping the elephant survive in hot environments? (*larger ears*)
 - » Does having larger ears help if the environment changes and becomes hotter? (*yes*)
 - » Does having larger ears help if the environment gets very cold? (*no*)
- Show a video of snowshoe hares. (See the Online Resources for a link to a suggested video.) Ask what traits students can observe as the environment changes for the hares.
 - » Is the color-changing fur a helpful or harmful trait for the hare? (*helpful*)
 - » Which hare, brown or white, do you think would be able to better survive in areas that are very snowy? (*white*) Why? (*It helps them camouflage themselves in the environment.*)
 - » If the environment is not snowy, how can this color-changing trait be helpful to the hare? (*The hare does not have to turn white; it stays brown because its fur color is a genetically inherited trait.*)

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Know the Science

1. Why are we making elephant ears? To show how certain traits can help some animals survive in certain environments better than others! Certain traits can be helpful to organisms in a specific environment, but when that environment changes, those traits can either help organisms survive or make it more difficult for them. In this activity, students get to see that having larger ears is a trait that can help some elephants survive. Not all elephants have the same ear size. Some have smaller ears than others. Those with smaller ears may have a harder time cooling off in warm temperatures than elephants with large ears. The reason is that elephants’ ears contain many blood vessels. These vessels carry heat. When the ears are fanned in the breeze, they lose heat. Therefore, larger ears become a superior trait that can help with the survival of elephants if an environment becomes warmer.

2. Why are students watching a video about snowshoe hares? To learn about how traits change with changing environments! Some individuals have traits that can help them survive and reproduce in changing environments. Other organisms might not have those traits. The snowshoe hare is an example of an organism that has a color-changing trait that can be helpful when the environment itself changes. Better camouflage coloration gives the hare a better chance of survival because predators will not be able to spot it as easily against the backdrop of the environment. As a result, these hares may be more likely to survive than other kinds of hares that do not have the trait of color change.

- Prompt students to link details in this analysis discussion back to the reading selection.
 - » Why do some organisms survive better when environments change? (*Organisms survive better when they have traits that enable them to survive changed conditions of the environment.*)
 - » What did you read about in the reading selection that is similar to these activities? (*The peppered moths are similar to the snowshoe hares because they both have traits to help them blend into the environment.*)

5. Teach Core Vocabulary.

5 MIN

Word Work

Guide students to consider the definitions they added to their Core Vocabulary cards as they read and make adjustments based on the follow-up discussion. Have students write or draw an example for each term.

- **camouflage** (n. a color or pattern that helps an organism blend in with its surroundings) For examples that students offer of camouflage, prompt them to describe both the trait of the organism and the corresponding details about the environment into which the organism blends.
- **rare** (adj. not found in large numbers) Help students consider organisms that may be rare, endangered, or threatened in your region.
- **extinct** (adj. having no remaining living members) Students will likely mention dinosaurs as commonly known to be extinct. Remind them that every living species on Earth today has extinct relatives—closely related species that no longer survive.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 13.1) for correct answers and sample student responses. Collect the completed Whales (AP 13.1). Scan the answers that students wrote, checking for understanding of how the traits can be helpful when changes occur in the environment.

Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions, such as explaining the cause-and-effect relationship between the environment and traits.

Traits and Advantage

Big Question: How can variation of a trait be an advantage or disadvantage?

AT A GLANCE

Learning Objective

- ✓ Construct an explanation to show that, within a population, some individuals have traits that give them a greater advantage than others for survival and reproduction.

Lesson Activities

- discussion and writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS4.B: Natural Selection

Crosscutting Concept: Cause and Effect

Science and Engineering Practices:

Constructing Explanations and Designing Solutions

Constructing Explanations and Designing Solutions is important to the topic of traits that offer organisms advantages. By learning how to construct explanations, students can understand the importance of gathering and using evidence (through observations and patterns) to describe phenomena. In this lesson, students develop a learning artifact to demonstrate that they can meet the Performance Expectation based on what they have learned throughout the unit.

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

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced during this lesson.

advantage

change

disadvantage

individual

population

reproduce

survive

trait

variation

Instructional Resources

Activity Page



AP 14.1

Activity Page

A Prickly Tale (AP 14.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- writing paper
- assortment of colored pencils

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Activity Page



AP 14.1

How can variation of a trait be an advantage or disadvantage? Distribute and review A Prickly Tale (AP 14.1). Tell students that they will read a short story and use the information in the story to write a report. The report should explain the phenomenon being described in the story and be supported with two or three illustrations that students must draw. The story is about the variation of traits in blackberry bushes that lead to an advantage for one individual and a disadvantage (or less of an advantage) for the other individual. (See **Know the Standards 1.**)

Review the different sections of the Activity Page with students. Show them that the first part of the Activity Page is the story. The next part has the guidelines for writing the report. Review the guidelines with students, and encourage them to read the guidelines again carefully on their own when they are ready to write the report. Emphasize that they will have to refer back to the story to find what they need to write their reports. Make sure students understand what they are writing about for each paragraph.

If students show concern about having to draw illustrations, emphasize that they will not be scored based on artistic ability but on being able to show understanding of how variations in traits can be helpful or harmful to individual organisms, depending on the environment.

Know the Standards

1. What is the purpose of having students read the story? In this lesson, students understand that variations in traits among individuals of the same population may provide advantages when it comes to reproducing, finding mates, and surviving. These helpful traits are most often passed on through inheritance from parents to offspring to help offspring have better chances of survival. Students do not need to discuss or understand the role of genetics in trait variation, so their report and illustrations will be limited to focusing on how the variation in thorn length is helpful or harmful to the blackberry bush.

2. Facilitate the activity.

25 MIN

Provide each student with the following materials:

- writing paper
- assorted colored pencils

Remind students that they will be working independently on this activity.

As students work on their reports and illustrations, circulate throughout the room to ensure that they are following the guidelines of the Activity Page:

- writing on separate paper
- writing in complete sentences
- writing complete paragraphs
- using two or three illustrations to support the text

Help guide the writing of the report by using the following prompts:

- What trait variation is described in the story? (*the length of the blackberry thorns*)
- What is the evidence that Daniel collects? (*There are more and more blackberry bushes with longer thorns and fewer blackberry bushes with short thorns.*)
- Why do you think there are more blackberry bushes with longer thorns? (*The bushes with longer thorns survive better than the bushes with shorter thorns. Since this trait helps them survive, it is passed down so that more plants have longer thorns.*)

SUPPORT—If necessary, help students identify the evidence in the story. Prompt them to underline or circle the text in the story that shows an observation or a pattern. Explain that these can be used as evidence they can discuss in their reports. (See **Know the Standards 2.**)

Remind students that they have been studying helpful and harmful traits in the past couple of lessons. They have also been studying variations of traits within families and populations.

SUPPORT—If necessary, review with students how if a trait helps an individual reproduce, find a mate, or survive, then the trait is considered an advantage. If a trait harms an individual and does not help the chances of reproduction or survival, then the trait is considered a disadvantage.

Know the Standards

2. What role does evidence play in this activity? There are many types of evidence that can be used in science. These range from data and measurements to observations and patterns. For this lesson, students are only required to gather evidence based on observations and patterns that they recognize in the story. Evidence can include a given trait of a species, patterns of variation of that trait among individuals in a population or species, and the potential benefits of the given variation of the trait. In this case, the trait is the length of the blackberry bush thorns.

Make sure students understand the purpose of the illustrations. Explain that the illustrations must show the variation of traits being described to help tell how they matter in this story. Tell students that they can include the illustrations anywhere in the report that makes the most sense. Encourage students to have fun with the illustrations and to use their colored pencils.

Encourage students to use vocabulary terms in their reports, including *trait*, *variation*, *vary*, *advantage*, *disadvantage*, *individual*, *population*, *reproduce*, and *survive*. If necessary, write terms on the board or chart paper that you want students to use in their reports.

Give students time to complete their reports.

3. Summarize and discuss.

10 MIN

Once students have had time to complete their reports, bring the class back together for a whole-class discussion to summarize what students wrote and drew. Invite volunteers to share their reports with the class. Students should be able to use reasoning to connect the evidence from the story to support their explanation for why the length of the thorns becomes advantageous or disadvantageous to the individual blackberry bushes.

Elicit from students that there can be a cause-and-effect relationship between a specific variation of a trait and its effect on an individual organism's ability to survive and reproduce.

Ask if students have any questions about the activity, and address any misunderstandings.

4. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 14.1) for sample student responses.

- Students do not write on the Activity Page, so you do not have to collect them.
- Collect the completed reports that students wrote on separate pieces of paper. Scan the reports to ensure that students wrote in complete sentences, have three complete paragraphs, and included two or three supportive illustrations (students are not scored on artistic ability).
- In paragraph 1, check for understanding of the phenomenon (variation of traits) and the inclusion of evidence to support the observations being made in the story.
- In paragraph 2, look to see whether students gathered evidence to support the explanation for the phenomenon.
- In paragraph 3, students should use a chain of reasoning that includes the fact that certain variations in traits (length of thorns) make it harder or easier for the blackberry bushes to survive and reproduce, that these traits give the individual

an advantage over other individuals within the species or population, and that there can be a cause-and-effect relationship between the length of the thorns and the plant's ability to survive and reproduce due to protecting itself from being picked or eaten.

- Check to see whether students used some Core Vocabulary words in their report.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions, such as distinguishing between traits that give organisms advantages and those that give organisms disadvantages.

Science Categories Review Game

Big Question: What have I learned about life cycles, traits, and variations?

AT A GLANCE

Learning Objective

- ✓ Fluently discuss life cycles, traits, and variations.

Lesson Activities

- discussion
- vocabulary game

NGSS References

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

3-LS4-2 Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

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

www.coreknowledge.org/cksci-online-resources

The Big Idea

Living things go through cycles of growth and change from their initial development through death. Throughout their lives, organisms exhibit traits that may be similar within families, populations, and species but vary for individuals. Many traits are biologically inherited, but some traits are influenced by an organism's environment. Variations of traits can result in advantages or disadvantages for the survival of individuals, in turn affecting the likelihood that traits get passed on through successful reproduction.

Core Vocabulary

Language of Instruction: During the review, remind students of their prior exposure to the following terms.

adolescence
advantage
camouflage
environment
extinct
flowering plant
germination

identical
individual
inherit
life cycle
metamorphosis
offspring
organism

physical trait
plant
pollination
population
rare
reproduction

seed
siblings
species
spore
survive
vary/variation

Core Vocabulary Deck: Students should refer to their full set of Core Vocabulary cards during the review activity.

Instructional Resources

Activity Pages



AP UR.1
AP UR.2
AP UR.3

Activity Pages

Science Categories (AP UR.1)

Vocabulary Crossword Puzzle
(AP UR.2)

Vocabulary Review (AP UR.3)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- poster board
- sticky notes (variety of colors)
- markers
- question and answer cards/sheet
- timer

Advance Preparation

Create the game board on poster board. Draw a giant table with the following column categories for which students will answer questions:

- Plant Life Cycles
- Animal Life Cycles
- Traits and Variations
- Environments and Traits
- Helpful or Harmful Traits

Place five sticky notes under each category. It works best if you can use different color sticky notes for each category, but this is not mandatory. Use your marker to write the number of points on each sticky note. For example:

Life Cycles, Traits, and Variations Game Board

Plant Life Cycles	Animal Life Cycles	Traits and Variations	Environment and Traits	Helpful or Harmful Traits
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Write your questions and answers for the game. Assign each question to a specific category and number of points. As the points get higher, the questions become more difficult. Use the following examples as a guide:

- An example of a low-level question is *What does it mean to reproduce?*
- An example of a higher-level question is *Describe the life cycle of a nonflowering plant.*

Keep your questions and answers on cards or on a sheet, and have them ready to read when you play the game with the class. Students will not get to see the questions in advance. Questions should be a variety of vocabulary-based and concepts-based questions from information covered in the unit.

Sample Review Game Questions

Plant Life Cycles

100 points—True or False: All plants make flowers as part of their life cycle. (*false*)

200 points—A young plant is protected by a _____ until conditions are right for it to grow. (*seed*)

300 points—Describe germination. (*when a seed starts to grow*)

400 points—What three things does a plant need to germinate? (*light, water, and heat*)

500 points—What are the stages in a plant life cycle? (*germination, growth, reproduction, death*)

Animal Life Cycles

100 points—What is the series of stages in an organism's life called? (*a life cycle*)

200 points—What is the name of a series of steps that frogs and butterflies go through to change form? (*metamorphosis*)

300 points—What stage occurs between being young and an adult? (*adolescence*)

400 points—How is a chicken egg like a plant seed? (*Both the eggshell and seed protect the young organism until it is ready to grow.*)

500 points—How does the life cycle of a frog differ from the life cycle of a chicken or mouse? (*A young frog [tadpole] develops legs after it is born and loses a tail. The other two animals have all their body parts when they are born.*)

Traits and Variations

100 points—What is the term used to describe a young organism from a parent? (*offspring*)

200 points—What is an example of something a young oak tree inherits from its parent tree? (*Possible answers: brown bark, roots that grow down, green leaves*)

300 points—True or False: Traits are only physical features of an organism. (*False, traits can also be behavioral.*)

400 points—What did Gregor Mendel notice when he studied a lot of pea plants? (*Sample answer: He noticed that the plants had different traits and had patterns of inheritance that could be documented.*)

500 points—How would you describe how two sibling ducks could have two different patterns of feather color? (*Each sibling inherits some different traits from its parents.*)

Environment and Traits

100 points—True or False: The living things in an ecosystem interact with the nonliving things. (*true*)

200 points—What term describes a group of a single type of organism living in the same place at the same time? (*population*)

300 points—How does a cactus survive in a desert with little water? (*The cactus stores water inside for when there is little water in the desert.*)

400 points—What is the difference between an ecosystem and an environment? (*An ecosystem is all the living and nonliving things in the same place. An environment is only the area where something lives.*)

500 points—How is it an advantage for the fur on some foxes to change to white when winter comes? (*because with white fur they can blend in with the snow to hunt for food and to hide from animals that would eat them*)

Helpful or Harmful Traits

100 points—What term describes something that helps to make an organism better or more likely to succeed? (*advantage*)

200 points—Are the spines on a cactus in a desert a helpful or harmful trait? Explain. (*They are a helpful trait. The spines help protect the cactus from animals seeking water and food.*)

300 points—What is the ultimate reason organisms have helpful traits? (*to survive*)

400 points—What term describes a color or pattern that helps an organism survive in its environment? (*camouflage*)

500 points—What might happen to an organism if its environment changes? (*The animal could become extinct if it cannot respond quickly enough to the changes in the environment. The animal could change enough to survive, and over generations it could become fit to live in the new habitat.*)

1. Focus student attention on the Big Question.

5 MIN

What have I learned about life cycles, traits, and variations?

Review with students what they learned throughout this unit:

- life cycle of animals
- life cycle of flowering and nonflowering plants
- plant and animal traits
- inheritance of traits
- trait variation within families
- trait variation within populations
- environmental impacts on traits
- helpful and harmful traits

2. Prepare to review.

5 MIN

Activity Page



AP UR.1

Tell students that you will play a game as a class using the Core Vocabulary cards they made throughout the unit. Have students take out their Core Vocabulary decks. Place students in small groups, and explain that each group will perform as a team. Distribute and review Science Categories (AP UR.1).

3. Review together.

30 MIN

Assign each team a number, and write the team numbers on the front board or chart paper. This is where you will keep score of the game points.

Review the game rules with students while they follow along on their Activity Pages.

Decide which team will go first.

To play, the team will select the category and the number of points for the question they wish to answer. Read the corresponding question, and use your timer (or phone) to give the class thirty seconds to answer. Call on the team that raises a hand first, and give the team a chance to answer the question. If the team gets the answer wrong, give the class one more chance to answer it correctly. If neither team answers correctly, nobody gets the point, and the second team gets to choose the next question.

As teams pick the questions, remove the sticky notes from the poster board so that teams can no longer pick the same questions.

Assign points to the appropriate teams by marking the front board or chart paper. The team with the most points at the end of the game wins.

SUPPORT—Make sure students understand that the team that picks the question category and number does not get to answer the question first. All questions are asked for all teams, and it is a race among the teams to raise their hands first to answer each question.

4. Provide additional take-home support.

5 MIN

Activity Pages



AP UR.2

AP UR.3

After the game, distribute and review Vocabulary Crossword Puzzle (AP UR.2) and Vocabulary Review (AP UR.3). Tell students that they will take these Activity Pages home to complete independently. Students may use their Core Vocabulary cards to help them solve the puzzle's clues and fill in the blanks.

For Vocabulary Crossword Puzzle (AP UR.2), review with students how to complete the crossword puzzle by drawing their attention to the word bank, the clues, and the puzzle itself. Make sure students understand how to fill in a crossword puzzle according to the numbers of the clues and using only the words from the word bank.

SUPPORT—If necessary, tell students that they can help keep track of the words they use by crossing them out in the word bank after they use them. This can help keep students on track and organized as they select the correct terms.

For Vocabulary Review (AP UR.3), explain to students that they are being asked to fill in the blank with the correct word from the word bank at the top of the page. Only words from the word bank can be used to fill in the blanks.

SUPPORT—If necessary, tell students that they can help keep track of the words they use by crossing them out in the word bank after they use them. This can help keep students on track and organized as they select the correct terms.

Life Cycles, Traits, and Variations

Activity Pages

• The Life of a Plant (AP 1.1)	125–126
• Modeling a Life Cycle (AP 2.1)	127
• Modeling Plant Life Cycles (AP 3.1)	128
• Model Checklist (AP 4.1)	129
• Comparing Life Cycles (AP 4.2)	130
• Take-Home Modeling Activity (AP 4.3)	131–132
• Plant and Animal Traits (AP 5.1)	133
• Box and T-Chart (AP 6.1)	134
• Cheetah Traits (AP 7.1)	135–138
• Looking at Leaves (AP 8.1)	139
• Traits in a Population (AP 8.2)	140–141
• Environmental Changes (AP 9.1)	142–143
• What Is All Around Me? (AP 10.1)	144–145
• Evidence of Changes (AP 11.1)	146–147
• Helpful Traits Scavenger Hunt (AP 12.1)	148
• Whales (AP 13.1)	149
• A Prickly Tale (AP 14.1)	150
• Unit Review: Science Categories (UR.1)	151
• Vocabulary Crossword Puzzle (UR.2)	152–153
• Vocabulary Review (UR.3)	154

Unit Assessment: *What Have I Learned About Life Cycles, Traits, and Variation?*

155–159

Activity Pages Answer Key: *Life Cycles, Traits, and Variations*

160–162

Unit Assessment: Teacher Evaluation Guide

163–165

Appendix A: Glossary	166–167
Appendix B: Classroom Safety for Activities and Demonstrations	168–169
Appendix C: Strategies for Acquiring Materials	170
Appendix D: Advance Preparation for Activities and Demonstrations	171
Appendix E: What to Do When Activities Don't Give Expected Results	172

Name _____

Date _____

Activity Page 1.1 (Page 1 of 2)

Use with Lesson 1.

The Life of a Plant

Plants grow from seeds! In this activity, you will plant seeds in cups and watch them grow into plants over time.

What materials will you use to plant your seeds?

Describe how you will plant your seeds.

Plant your seeds into the cups using the materials you listed above.

What steps did you use to plant your seeds?

What do you think will happen to the plants as they grow?

How to Care for Your Plant

How often will you check on your plant?

How much water will you give your plant each time you check on it?

Why is it important to not disturb the soil or try to find your seed in the cup?

Observation Chart

Use these prompts to record what you see:

- Did the soil change?
- Do you see anything sprouting through the soil?
- What color is the sprout?
- How big is the sprout?
- Are there any leaves?
- Do you see any flowers?

Date	What do you see?

Name _____

Date _____

Activity Page 2.1

Use with Lesson 2.

Modeling a Life Cycle

All animals go through similar life cycles. You may choose any animal you wish if it hasn't been used in class already. Be sure your drawing has the following labels: birth, growth, reproduction, death.

Write the name of your animal here: _____

Draw your animal's life cycle from birth to death in the box below. Label each part.

Name _____

Date _____

Activity Page 3.1

Use with Lesson 3.

Modeling Plant Life Cycles

All plants go through similar life cycles. You may choose any plant you wish if it hasn't been used in class already. Be sure your drawing has the following labels: germination, growth, reproduction, death.

Write the name of your plant here: _____

Draw a plant's life cycle from germination to death in the box below. Label each part.

Model Checklist

Build your model. Choose from one of the following types below:

- four-sided box
- flip-book
- diorama
- pinwheel

Use the information below as you build your models.

- **Four-sided box**
 - Draw one part of the life cycle on each side of the box.
 - Use arrows in your drawings to show how the box should be turned in the order of the life cycle stages, from birth to death.
 - Use labels to show important parts of the life cycle.
 - Only include one plant or animal.
- **Flip-book**
 - Use a separate piece of paper for each stage of the life cycle.
 - Draw life cycles in order from birth to death.
 - Use labels to show important parts of the life cycle.
 - When you put the pages together, put the Death page on the bottom. Put the Reproduction page on top of the Death page. Put the Growth page on top of the Reproduction page. Put the Birth page on the very top.
 - Fasten the pages together in this order to make a book.
 - Only include one plant or animal.
- **Diorama**
 - Show the progression of the life cycle from birth to death.
 - Put the birth stage on the left side of the diorama, leading to death on the right side of the diorama.
 - Only include one plant or animal.
- **Pinwheel**
 - Draw one part of the life cycle on each part of the pinwheel.
 - Place the parts of the life cycle in order from birth to death.
 - Place the parts of the life cycle so they move clockwise on the pinwheel.
 - Only include one plant or animal.

Activity Page 4.2

Use with Lesson 4.

Comparing Life Cycles

All plants and animals have a life cycle! In this activity, you will compare the stages in the life cycles.

Fill out the table below as you look at other models in the classroom. As you work on the table, keep these questions in mind:

- How are the life cycle stages similar to the other ones I studied?
- How are these life cycle stages different from the other ones I studied?

Organism Model	How did the student model birth?	How did the student model growth?	How did the student model reproduction?	How did the student model death?
<i>Bird</i>	<i>A craft pom-pom was used as an egg.</i>	<i>There was a drawing of a baby chick and an adult chicken.</i>	<i>An arrow pointed from the adult chicken to a new egg.</i>	<i>There was an exit ramp at the death stage that led out of the circle.</i>

Take-Home Modeling Activity

Dear Family Members,

Over the last few days, your child has been building models that show plant and animal life cycles. He or she reviewed the order of the life cycle stages, including birth, growth, reproduction, and death, and developed a three-dimensional model that shows these stages in the correct order in which they occur. He or she has learned that there are similarities and patterns among the life cycles of plants, as well as similarities and patterns among the life cycles of animals. There are even parallels between the life cycles of plants and animals. He or she has also learned that reproduction is an important factor in ensuring that the life cycle of a plant or animal species continues even after individual organisms die. (The life cycle of humans is not discussed or covered in these lessons.)

Below are some suggestions for activities that you may do at home to reinforce what your child is learning about plant and animal life cycles.

1. Media Search

Your child has focused on a specific plant organism and a specific animal organism. He or she made a three-dimensional model of the life cycle for that plant and animal. You may wish to reinforce your child's knowledge of the organism's life cycle by working with him or her to find kid-friendly media sources that provide information about specific parts of that organism's life cycle. Media sources could include online websites, images, or videos, as well as magazines or journals. You may wish to encourage your child to take notes on the specific parts of the plant and/or animal's life cycle in order for him or her to enhance understanding about the three-dimensional model made in class.

2. Words to Use

Below are several of the words that your child has been learning about and using. Try to use these words as they come up in everyday speech with your child.

- *Organism*—any living thing, such as an animal or a plant
- *Life cycle*—a series of changes, often grouped into stages, in an organism's life
- *Birth*—when animals are born
- *Adolescence*—a stage of the life cycle when a young animal is growing and developing into an adult
- *Reproduction*—the process of making a new living thing
- *Flowering plant*—any plant that makes a flower
- *Seed*—the small part of a plant that grows into a new plant under the right conditions
- *Pollination*—the transfer of pollen to make a seed
- *Germination*—when a seed starts to grow
- *Metamorphosis*—a series of steps that some animals go through to become adults

3. Vocabulary in a Flash!

Your child has been learning a variety of new vocabulary terms that describe the life cycle of plants and animals. You may wish to reinforce your child's knowledge of the terms by putting together flash cards that ask your child to define a particular part of the life cycle. Alternatively, you may wish to use the flash cards such that your child identifies the part of the life cycle based on a definition that you read from the card.

4. Real-Life Examples

Your child has been studying the life cycles of plants and animals. Plants and animals can be found in most environments, including homes and neighborhoods. You may wish to reinforce your child's comprehension of the stages of the life cycles by having him or her tell you about the life cycle of a favorite animal, a plant that is in your house or in your yard, or an animal and/or plant that you come across in your neighborhood. Encourage your child to practice using the correct vocabulary terms when describing the life cycle stages of each plant or animal you come across.

Name _____

Date _____

Activity Page 5.1

Use with Lesson 5.

Plant and Animal Traits

All plants and animals have traits!

Write down what you notice about plants and animals.

Type of Animal or Plant	Traits

Complete the chart below based on the traits you observed. Use the sentence starters in the second column to help you write your responses.

What traits do the plants have in common?	All four plants have ...
How are the traits of the plants different?	Some of the plants have ... but other plants have ...
What traits do the animals have in common?	All of the animals have ...
How are the traits of the animals different?	Some of the animals have ... but other animals have ...

Name _____

Date _____

Activity Page 6.1

Use with Lesson 6.

Box and T-Chart

As you watch the video, fill in the T-chart to analyze your traits. Pay attention to similarities and differences. Then write a summary of your observations in the bottom box.

--	--

Summary:

--

Name _____

Date _____

Activity Page 7.1 (Page 1 of 4)

Use with Lesson 7.

Cheetah Traits**Read the scenario below.**

A scientist has been studying a pair of male and female cheetahs at a research zoo. Over several years, these parents had three litters of offspring, or groups of cubs. In her first litter, the mom had 6 cubs. In her second litter, she had 7 cubs. In her third litter, she had 5 cubs. That's a total of 18 young, or offspring.

The scientist wanted to study the cubs more closely to answer a question:

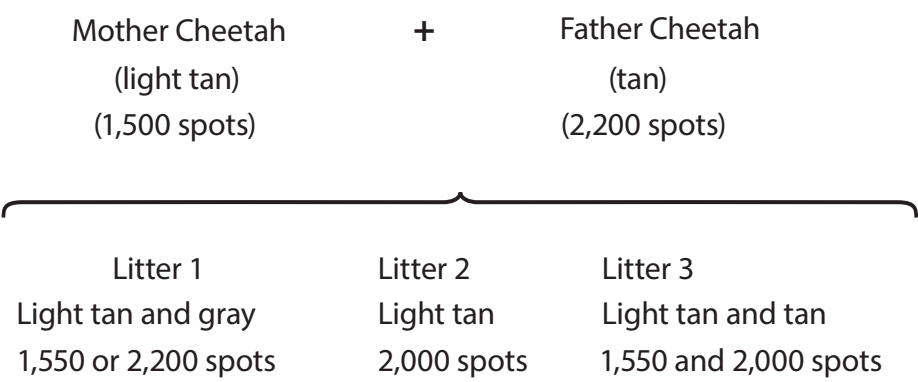
How do the traits of one cub compare to those of its parents and siblings?

She collected the following information:

Mother Cheetah	Father Cheetah
Fur color—light tan	Fur color—tan
Number of spots—1,500	Number of spots—2,200

Litter 1	Number of Cubs	Fur Color	Number of Spots
Males	5	Light tan	2,200
Females	1	Gray	1,550
Litter 2			
Males	4	Light tan	2,000
Females	3	Light tan	2,000
Litter 3			
Males	3	Light tan	2,000
Females	2	Tan	1,550

Size Observations
The cubs in Litter 1 were the largest out of all the litters.
The cubs in Litter 2 were the smallest out of all the litters.
The cubs in Litter 3 were average size.



Summary of traits shared by all members of the family:

All of the cheetah cubs in the three litters, including the mother and father cheetahs, have four legs, two eyes, and two ears. They all share the same color eyes (yellow-brown) and have short rounded ears. All of the cheetahs in the family also have white fur on the underside of their stomachs.



Complete the tables based on the data collected by this scientist.

Parent Cheetahs	Fur Color	Number of Spots
Mother		
Father		

Cubs	Light Tan Fur	Tan Fur	Gray Fur
Litter 1—males			
Litter 1—female			
Litter 2—males			
Litter 2—females			
Litter 3—males			
Litter 3—females			

Cubs	2,200 Spots	2,000 Spots	1,550 Spots
Litter 1—males			
Litter 1—female			
Litter 2—males			
Litter 2—females			
Litter 3—males			
Litter 3—females			

Cub Size	Number of Cubs	Litter Number
Large		
Average		
Small		

Look for patterns in the data. Specifically, compare and contrast the traits of the parents and siblings. Do you see any similarities and/or variations between the offspring and the parents? What about similarities and/or variations between the brothers and sisters?

Answer the following questions.

What is a pattern that you see from the data?

What kind of graph will you use to show variation in a family? Circle one.

pie chart

bar graph

What data will you use from the table in your graphical representation?

Now it's time to put your data together!

Make a pie chart or a bar graph on your poster board to show similarities and variations of traits among the cub siblings.

- **Apply the data from the table.**
- **Use different colored markers to emphasize different data.**
- **Label your graph and your data.**

SUPPORT—Indicate what each piece of data represents in your graph by making a legend. A legend shows the color that corresponds to each set of data. Make a legend by drawing a box in the corner of your graph. Identify the color that will be used for each data set. Then write a description of the data, such as “Fur color” or “Number of spots.”

Before drawing on your poster board, you can use the drawing box below to make a rough draft of your graphical representation.



Name _____

Date _____

Activity Page 8.1

Use with Lesson 8.

Looking at Leaves

All living things have traits. From colors to shapes to sizes, you can always spot some traits on plants, animals, and people, too.

All of these leaves come from different individuals of the same species and from the same population.

Study the leaves. Record the traits that you find in the chart below.

Looking at Leaves	How does this trait vary?
(Answers will vary but may include color, size, shape, texture.)	(Answers will vary but may include color, size, shape, texture.)

Answer the question that follows.

Can you notice any patterns in the leaves? If so, what are they?

Traits in a Population

Read the scenario below.

Breaking news! The zoo has rescued four families of cheetahs from bad conditions in their homeland. All of the cheetahs are from the same population in a grassland ecosystem in the African country of Botswana.

The scientist who studies cheetahs noticed that not all of the cheetahs look the same. Some of them look very different. Below are her findings:

- Family 1 has twenty cheetahs. Seventeen of these cheetahs are light tan and have many spots. Three of these cheetahs have dark tan fur and many spots. These cheetahs are of average size.
- Family 2 has sixteen cheetahs. All of these cheetahs are gray and have many spots. They are smaller than the rest of the families.
- Family 3 has seventeen cheetahs. All of these cheetahs are dark tan and have few spots. They are the largest-sized cheetahs out of all of the families.
- Family 4 has nineteen cheetahs. Sixteen of these cheetahs are light tan and have very few spots. Three of these cheetahs are gray and have very few spots. The cheetahs are average size.

Complete the data table below about this population of cheetahs.

Question	Number of Cheetahs
How many cheetahs are light tan?	
How many cheetahs are gray?	
How many cheetahs are dark tan?	
How many cheetahs are average size?	
How many cheetahs are small?	
How many cheetahs are large?	
How many cheetahs have many spots?	
How many cheetahs have few spots?	
How many cheetahs have very few spots?	

Answer the questions that follow.

What kind of graphical representation will you use to show your data?

What data will you include in your graphical representation?

How does this data show variations of traits among individuals in a population?

Now it's time to make your graphical representation!

Make a pie chart or a bar graph on your poster board to show variation of traits among the population of cheetahs.

- **Use the data from the table.**
- **Be sure to represent all four families in your graph.**
- **Use different colored markers to show different data.**
- **Label your data.**

You can use the drawing box below to make a rough draft of your graphical representation before drawing it on the poster board.



Name _____

Date _____

Activity Page 9.1 (Page 1 of 2)

Use with Lesson 9.

Environmental Changes

Your plants have been getting light and water so far. But what happens when the environment changes? Find out by completing the activity steps below.

STEP 1: **Select** two plants that will continue to get the same amount of light and water that they have been getting so far. These plants will be Group A.

STEP 2: **Select** two plants that will get less light and water. These plants will be Group B.

STEP 3: **Select** two plants that will receive no water or light whatsoever. These plants will be Group C.

STEP 4: **Observe** the traits that you can see for the plants in Group A, Group B, and Group C. Record your observations below.

Group	Starting Traits
Group A	
Group B	
Group C	

Answer the following questions to explain your plan for changing the environment for the plants in Group B.

How will you change the environment of the plants in Group B?

How much light will the plants in Group B get each week?

How much water will the plants in Group B get each week?

How will you keep the plants in Group C from getting light and water?

You will expose your plants to light and water every few days. In the table below, record the following things:

- the date that the plant got light and water
- how much light the plant got
- how much water the plant got
- how the plant looks (traits)

Group	Date	Amount of Light	Amount of Water	Traits
Group A				
Group B				
Group C				
Group A				
Group B				
Group C				
Group A				
Group B				
Group C				
Group A				
Group B				
Group C				
Group A				
Group B				
Group C				

Name _____

Date _____

Activity Page 10.1 (Page 1 of 2)

Use with Lesson 10.

What Is All Around Me?

There are many things that make up your environment. How many can you name?

Think about your school, home, and neighborhood environment. Write down the things that make up your environment. List as many things as you can. List both living and nonliving parts of your environment.

The first example has been done for you.

What is part of your environment?

Air

Answer the questions that follow.

1. Name one way the living things could change in your environment.

2. Name one way the nonliving things could change in your environment.

3. What would happen if that change occurred? What kind of effect would it have on the environment?

4. How might such a change affect the way you are physically? How might such a change affect your behavior?

Name _____

Date _____

Activity Page 11.1 (Page 1 of 2)

Use with Lesson 11.

Evidence of Changes

Study the Lesson 9 table where you recorded the light, water, and traits for your plants.

Answer the questions that follow.

What happened to the plants in Group A?

What happened to the plants in Group B?

What happened to the plants in Group C?

Why do the plants in Group B and Group C look different from the plants in Group A?

Do changes in the environment cause changes to plant growth? Use evidence to support your explanation.

Write a paragraph that summarizes the cause-and-effect relationship between the environment and the traits of the plants in Groups B and C.

Make a poster to display your findings.

- Work with your group.
- Show what the Group B plants looked like before the changes to their environment.
- Show what the Group B plants looked like after the changes to their environment.
- Show what the Group C plants looked like before the changes to their environment.
- Show what the Group C plants looked like after the changes to their environment.
- Compare the Group A, Group B, and Group C plants.
- Describe the final cause-and-effect relationship between environment and traits.

Name _____

Date _____

Activity Page 12.1

Use with Lesson 12.

Helpful Traits Scavenger Hunt

All living things have physical traits. Which of those traits help the organisms survive?

Complete the table below:

- **Write down three organisms that you see outside.**
- **Write down a trait that each organism has.**
- **Explain how the trait is helpful to the organism.**

The first example has been done for you.

Organism	Trait	How it helps
Bird	large wings	Large wings help the bird soar longer distances.

Answer the questions that follow.

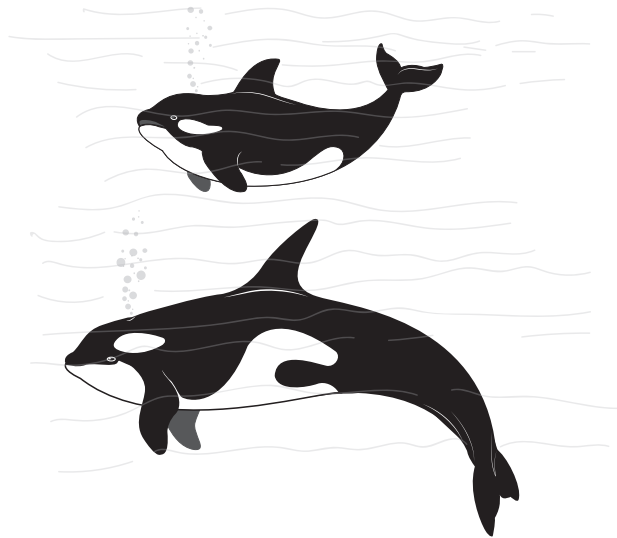
1. Why do you think it is important for living things to have helpful traits?

2. Do you think organisms have traits that are harmful? Give an example.

Whales

Organisms, such as whales, have traits that help them survive in certain environments better than other organisms.

Read the scenario below. Then answer the questions.



These two types of whales like to swim together.

- Whale A is larger and heavier. It also has more blubber. The blubber helps keep the whale warm.
- Whale B is smaller and lighter. It has less blubber but larger fins. This lets the whale swim faster.

If the whales spend most of their time in icy cold ocean water, which whale will most likely survive the best?

Which trait helps that whale survive better than the other whale?

Imagine the ocean water changes and becomes very warm. Now, the warm water attracts sharks! Sharks like to eat whales. Whales need to swim fast to get away from sharks.

Which whale will most likely survive the best in this new environment?

Which trait helps that whale survive better than the other whale?

A Prickly Tale

Read the story below.

Daniel is a boy who lives on a farm. For several years, he had fun playing in the fields and picking blackberries from the bushes on the property. At first there weren't too many deer on the farm. As time went by, Daniel noticed lots more deer had moved into the area.

As a few years went by, Daniel also noticed that it got harder to pick the blackberries because of the sharp thorns that would prick his fingers when he picked them. Daniel did not remember this many bushes having long thorns. He thought that the thorns used to be a lot shorter.

Daniel started to pay more attention to the blackberry bushes. He noticed that some bushes had short thorns and other bushes had long thorns. He also noticed that the deer preferred to eat the blackberry leaves from the bushes with the short thorns. The deer never touched the leaves on the bushes with the long thorns. When the bushes had few leaves, they did not survive very well because they could not photosynthesize.

As more seasons passed, Daniel noticed that more and more bushes with longer thorns were growing and producing blackberry fruits and seeds and that there were fewer and fewer bushes with short thorns.

Now it's time to write your report. Follow these guidelines below:

1. Take out a separate sheet of paper.
2. In paragraph 1, write about what is happening to the blackberry bushes in the story.
3. In paragraph 2, tell what evidence Daniel has for explaining what is happening to the blackberry bushes.
4. In paragraph 3, use the evidence to explain why this is happening to the blackberry bushes.
5. Include two or three drawings in your report.
 - The drawings must show the variation in the traits of the blackberry bushes.
 - The drawings must support how this variation matters in the story.
 - You can add the drawings to any paragraph.

Science Categories

Game Rules

In this game, you will work with your team to answer the most questions and score the most points.

- The teacher reads each question out loud to the class.
- Teams must raise their hands if they know the answer.
- Teammates can discuss the answers with each other before raising their hands.
- Do not shout out the correct answer. Wait to be called on by the teacher.
- The teacher will call on the team that raises its hands first.
- Teams get thirty seconds to answer the question.
- If a team gets the answer correct, that team gets to pick the next question.
- If a team gets the answer wrong, another team can try to answer the question and win the point.
- Teams can use their Core Vocabulary cards to search for the answers.

You can use the scorecard below to keep track of your team’s points.

My Team’s Points	
------------------	--

Name _____

Date _____

Activity Page UR.2 (Page 1 of 2)

Use with Unit Review.

Vocabulary Crossword Puzzle

Review the cards in your Core Vocabulary deck before you begin.

Use all the words in the word bank to complete the crossword puzzle.

organism	life cycle*	birth	adolescence	reproduction	flowering plant*
pollination	germination	metamorphosis	inherit	offspring	population
seed	siblings	trait	variation	environment	survive
advantage	disadvantage				

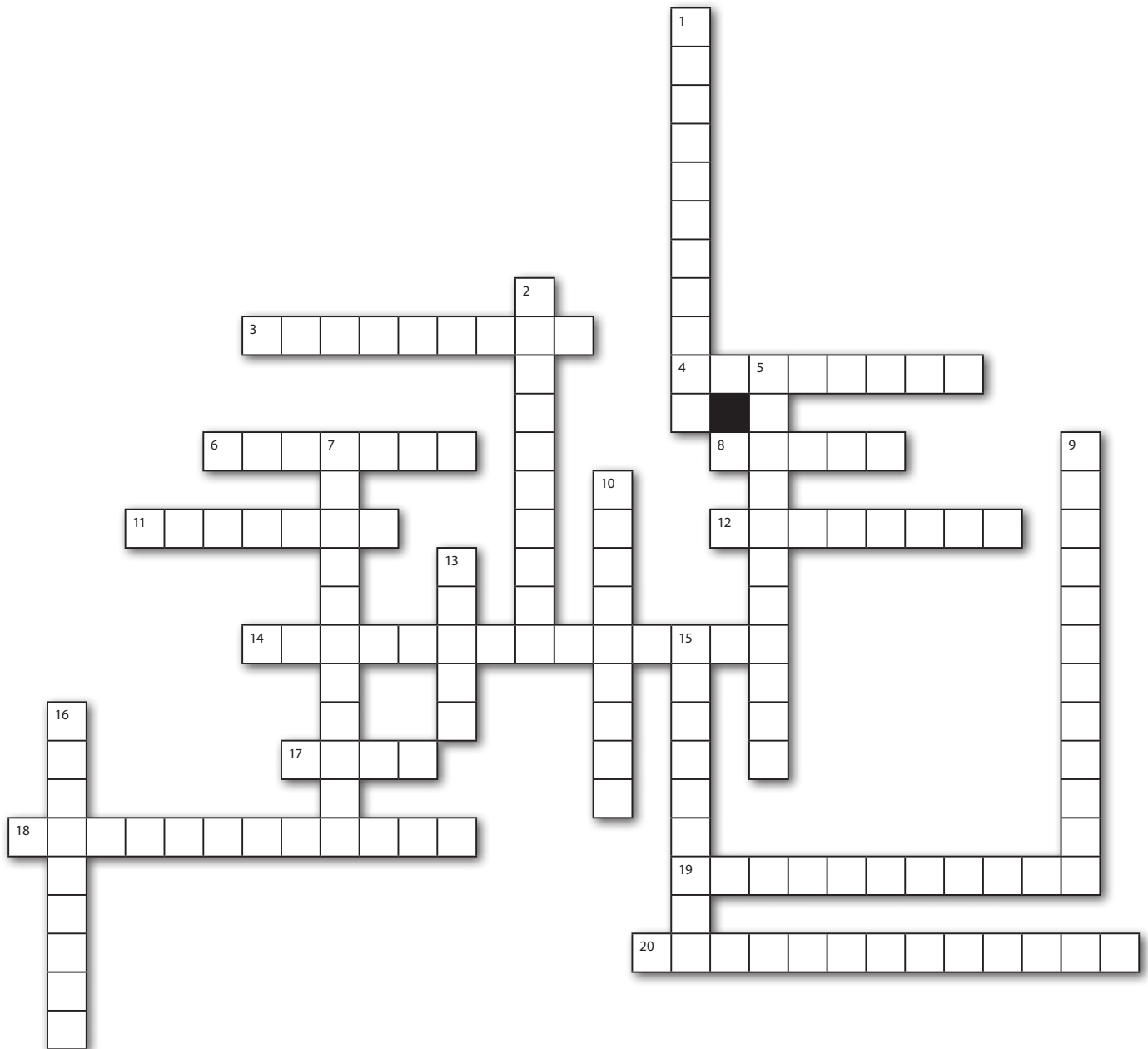
*No spaces between words are included in the puzzle.

Across

3. a change or difference in something, such as a trait
4. any living thing, such as an animal or a plant
6. to receive a trait from a parent
8. a distinguishing physical feature
11. to continue to live
12. two or more offspring from the same parents
14. any plant that makes a flower
17. the small part of a plant that grows into a new plant under the right conditions
18. the process of making a new living thing
19. a stage of the life cycle when a young animal is growing and developing into an adult
20. a series of steps that some animals go through to become adults

Down

1. the transfer of pollen to make a seed
2. the number of living things that live together in the same area
5. when a seed starts to grow
7. the surroundings where an animal or plant lives
9. something that puts a plant or animal in a bad position
10. an organism's young
13. when animals are born
15. something that puts a plant or animal in a good position
16. a series of changes, often grouped into stages, in an organism's life

Vocabulary Crossword Puzzle, *continued*

Vocabulary Review

Complete each sentence with the correct Core Vocabulary term or phrase. Not every word in the word bank will be used. Review the cards in your Core Vocabulary deck before you begin.

environment	life cycle	reproduction	nonflowering	flowering		
pollination	metamorphosis	offspring	seed	spore	inherits	
survive	die	traits	advantage	disadvantage	siblings	family
population	species	cousins	germination			

1. Birth, growth, reproduction, and death are part of a plant or animal's _____.
2. When an animal makes a new living animal, this is known as _____.
3. A fern is an example of a _____ plant.
4. _____ is the transfer of pollen to make a seed.
5. Butterflies and frogs are examples of organisms that go through a process called _____.
6. An organism's young is called its _____.
7. The _____ is the small part of a plant that grows into a new plant under the right conditions.
8. A baby goat _____ its traits from its parents.
9. Animals need to reproduce in order to _____.
10. If you see an orange growing on a tree, you are looking at a _____ plant.
11. Siblings can have similar _____ as one another.
12. A trait that is helpful to an organism gives that organism a(n) _____.
13. Two or more offspring from the same parents are called _____.
14. A(n) _____ refers to parents, offspring, and siblings. A(n) _____ refers to the living things that live together in the same area.
15. When seeds start to grow, this process is known as _____.

Name _____

Date _____

Unit Assessment: What Have I Learned About Life Cycles, Traits, and Variations?

Answer the items below to show what you have learned.



1. This plant started out as a seed. What changes has it gone through up to this point? Predict other changes that it will go through after this point.

2. Describe each type of organism's life cycle by writing the correct words from the word bank under that organism in the table. You may use some words more than once.

adolescence	flower	pollination
adulthood	fruit	pupa
birth	germination	reproduction
death	growth	spores
egg	larvae	

Mouse	Butterfly	Flowering Plant	Fern

3. Which of the following stages are common to all organisms' life cycles? Circle all the correct answers.

- a) pollination
- b) germination
- c) birth
- d) growth
- e) flower/fruit
- f) death
- g) spores
- h) reproduction
- i) larvae
- j) pupa
- k) adulthood

4. Complete the sentence.

A characteristic that is passed down from parent to offspring is called a(n) _____ .
Be sure to use the Core Vocabulary that you have learned in this unit in your answer.

5. Look at the picture closely. These kittens are part of one litter. They all have the same mother. What are some of the traits you see in the picture? Describe each trait. Organize your data in the table below.



Cat 1	Cat 2	Cat 3

6. Why do the offspring look different from each other?

7. Give four examples of traits that can vary within a population.

8. Which of the following are examples of the environment affecting an organism's physical traits? Circle all the correct answers.
- a) A flamingo's diet makes its feathers bright pink.
 - b) A house cat sleeps more than it would if it lived outside.
 - c) Cold air causes people to put on heavier clothes.
 - d) A drought results in foxes moving to new habitats.
 - e) Heavier rains cause plants to get much bigger.
9. The two plants described in the table below are the same kind of plant. Using evidence from the table, explain what will happen to each plant.

Plant 1	Plant 2
Receives direct sunlight during the day	Receives little to no sunlight during the day
Receives water once a day	Receives water once a month
Receives air at all times	Receives air for only half the day each day

10. Considering the example of the plants in the table above, make a similar argument for animals. How might the amount of food an animal gets affect its growth?

- 11.** Read the following paragraph. Then underline every cause and circle every effect between the environment and traits.

Animals have traits that help them survive in specific environments. For example, in a snowy landscape, a white rabbit can be hidden from predators. Animals that live in tall grasses may have long legs to be able to see over the grasses. This might help them look for prey or escape from predators.

- 12.** Complete the sentence.

Traits that are helpful to an organism are a(n) _____. Traits that are harmful to an organism are a(n) _____.

Be sure to use the Core Vocabulary that you have learned in this unit in your answer.

- 13.** Which of the following are most likely helpful traits in the environment it lives in? Circle all the correct answers.
- a)** large horns on a deer that lives in a thick, wooded area
 - b)** dark brown or black fur on a hare in a snowy environment
 - c)** white fur on a fox, coyote, or wolf in a snowy environment
 - d)** long legs on a predator that hunts in tall grass
 - e)** a predator with a poor sense of sight or smell
 - f)** long arms on an animal that lives in the tops of trees
- 14.** Which animal is better able to survive the change in the environment brought by the drought? Use evidence from the paragraph below in your answer.

Organism A can store a great deal of water for later use. Organism B can travel fast to hunt down the prey that it eats. A drought, or a period without rain, strikes the environment in which the two organisms live. Ponds and lakes dry up. Rivers become dry beds.

Activity Pages Answer Key: Life Cycles, Traits, and Variations

AP 1.1 The Life of a Plant (Pages 125–126)

- Accept all plausible materials and methods for planting seeds.
- Review and accept all reasonable student steps for planting seeds. Accept all reasonable predictions for what will happen to the plants as they grow.
- Accept all reasonable student responses for the care of their plant.
- Student observations on the chart should show constant changes to the plant from one observation date to the next once the seed germinates in the soil.

AP 2.1 Modeling a Life Cycle (Page 127)

Students should identify the life cycle of an animal and have a life cycle with birth, growth, reproduction, and death clearly labeled.

AP 3.1 Modeling Plant Life Cycles (Page 128)

Students should identify the life cycle of a plant and have a life cycle with germination, growth, reproduction, and death clearly labeled.

AP 4.2 Comparing Life Cycles (Page 130)

Students should complete their tables with the name of an organism in each row with a brief description of how each phase of the life cycle was modeled.

AP 5.1 Plant and Animal Traits (Page 133)

- Students should have the name of a plant or animal in each row with physical and behavioral traits noted. Accept any traits they note, but be alert for misconceptions about traits.
- Students should note the similarities and differences between the plants and between the animals they observed.

AP 6.1 Box and T-Chart (Page 134)

Students should use one side of the T-chart to identify traits of the black puppy and the other side of the T-chart to identify traits of the siblings. Students should then consider the similarities and differences based on their observations and write a summary in the box at the bottom of the page.

AP 7.1 Cheetah Traits (Pages 135–138)

- Students should find that light tan fur is the predominant color of the cheetah cubs, with very few having tan or gray fur. Students should also find that 2,000 spots is the most common number of spots regardless of the litter. They should also find that cub size can be different from litter to litter but that each litter is about the same number of cubs (an average of six in this scenario).
- Verify that student pie charts or bar graphs match the data students were given and that each data set is correctly labeled.

AP 8.1 Looking at Leaves (Page 139)

- Accept all student observations and all reasonable explanations of how the traits vary based on what students write in their T-chart.
- Accept all defensible patterns students have noted. In cases where students note a pattern not supported by their observations, ask them to support their recognition of a pattern with evidence.

AP 8.2 Traits in a Population

(Pages 140–141)

- Students should generate the following data from the scenario:
How many cheetahs are light tan? 33
How many cheetahs are gray? 19
How many cheetahs are dark tan? 20
How many cheetahs are average size? 39
How many cheetahs are small? 16
How many cheetahs are large? 17
How many cheetahs have many spots? 36
How many cheetahs have few spots? 17
How many cheetahs have very few spots? 19
- Accept all plausible student graphical representations and data inclusion. Students should explain how the data shows variation among individuals in a population.

AP 9.1 Environmental Changes

(Pages 142–143)

- Student observations of the starting traits of the plants should accurately reflect what they are seeing.
- Students should note how the environment of the plant will be changed for Group B, the amount of light and water the plants will receive, and how students will manipulate those needs.
- Student charts should indicate the date, amount of light and water, and traits of the plants over five observation days.

AP 10.1 What Is All Around Me?

(Pages 144–145)

Accept all student responses for both living and nonliving parts of the environment.

- Students should identify one living and one nonliving thing that could change in the environment.
- Students should note the effect the change would have on the environment as well as how the change in their environment would affect the student.

AP 11.1 Evidence of Changes

(Pages 146–147)

Students should have their Lesson 9 table to reference the changes for this activity.

AP 11.1, continued

- Students should have observations on what effect the changes had on the plants in each group.
- Students should suggest reasons why the plants in the groups appeared to be different, including individual traits as well as the effect the changes had on the plant.
- Students should summarize how changes in the environment affect plant growth, using evidence from the activity to support their argument.
- Students should be able to draw a clear cause-and-effect relationship between the changes in the plants' environment and the results of their activity.
- Student posters should show the plants before and after the changes as well as a comparison of the plants in each group. Finally student posters should summarize their cause-and-effect relationships between the environment and traits generally.

AP 12.1 Helpful Traits Scavenger Hunt

(Page 148)

- Students should note organisms, the trait, and an explanation of how the trait helps the organism.
- Accept all plausible student explanations of why it is important for living things to have helpful traits. Students should note that organisms can have harmful traits, such as spines on a cactus or spider venom, which do not harm the organism but can harm organisms that prey on the organism.

AP 13.1 Whales

(Page 149)

- Students should note that the whale with more blubber will likely survive the colder water better.
- Students should note the smaller, lighter whale with larger fins should be able to adapt and survive in warmer water with sharks because it can move faster in that water when sharks are present.

AP 14.1 A Prickly Tale

(Page 150)

Student reports should note what is happening to the blackberry bushes, the evidence that Daniel has for explaining what is happening, and the evidence from the story that explains what is happening over time.

AP UR.2 Vocabulary Crossword Puzzle
(Pages 152–153)

ACROSS:

- 3.** variation
- 4.** organism
- 6.** inherit
- 8.** trait
- 11.** survive
- 12.** siblings
- 14.** flowering plant
- 17.** seed
- 18.** reproduction
- 19.** adolescence
- 20.** metamorphosis

DOWN:

- 1.** pollination
- 2.** population
- 5.** germination
- 7.** environment
- 9.** disadvantage
- 10.** offspring
- 13.** birth
- 15.** advantage
- 16.** life cycle

AP UR.3 Vocabulary Review
(Page 154)

- 1.** life cycle; **2.** reproduction; **3.** nonflowering;
4. pollination; **5.** metamorphosis; **6.** offspring;
7. seed; **8.** inherits; **9.** survive; **10.** flowering; **11.** traits;
12. advantage; **13.** siblings; **14.** family, population;
15. germination

Unit Assessment: Teacher Evaluation Guide

Teacher Directions: The Unit Assessment is designed as a fifty-point test. Through this assessment, students demonstrate their overall learning of the unit's Learning Objectives. CKSci Unit Assessments typically range from ten to fifteen questions in the upper elementary grades, which can be answered in a single classroom session.

Items with simpler answers that assess knowledge but not the deeper understandings of the content, such as multiple choice or short answers, are weighted differently and are worth fewer points. Assessment items that require more complex thinking and a deeper understanding of the content, such as writing explanations or identifying multiple relationships, are worth more points. Items that require synthesis of content and other student knowledge are weighted with more points as well. Some test items encourage students to use their Core Vocabulary decks as a reference source for terminology and concepts related to the test item.

Expected Answers and Model Responses

1. Sample answer: Before this point, the seed sprouted into a plant. It developed a stem, branches, and leaves. After this point, as the plant grows, its stem will get bigger and wider. There will be more branches with leaves. If it is a flowering plant, it will develop a flower and may produce fruit. (5 points)
2.

Mouse	Butterfly	Flowering Plant	Fern
birth, adolescence (growth), adulthood, reproduction, death	egg, larvae, pupa, adulthood (reproduction), death	pollination, germination, growth, flower, fruit (reproduction), death	spores, growth, reproduction, death

(5 points)
3. c, d, f, h, k (5 points)
4. trait (1 point)
5. Students will identify such traits as eye color, fur color, size of ears, size of paws, and so on. They should describe each to the best of their ability. (5 points)
6. Sample response should indicate that the kittens all look different from each other because they inherited different things from their mother and father. (2 points)
7. Students may list hair color, eye color, height, weight, length of arms or legs, fur color, etc. (4 points)
8. a, e (2 points)

- 9.
- | | |
|----------------------|---|
| Above Average | Student response shows an understanding that Plant 1 receives the sunlight, water, and air it needs to live and, as a result, will grow larger and stronger over time. It shows an understanding that Plant 2 receives little of the sunlight, water, and air it needs to live. Student understands that the plant will not grow and likely will turn brown, wilt, and die. |
| Average | Student correctly identifies what each plant is or is not getting to aid in survival but does not include the correct outcomes. |
| Adequate | Student correctly identifies what one of the plants is or is not getting to aid in survival but does not include the correct outcomes. |
| Inadequate | Student does not understand which plant is receiving what it needs and which is not, nor does he or she include the correct outcomes. |
- (5 points)
- 10.
- | | |
|----------------------|---|
| Above Average | Student response shows an understanding that if an animal gets enough food, it will continue to grow. If the animal does not get enough food, it might stop growing and eventually die. If the animal gets too much food, it might grow too large and suffer as a result. |
| Average | Student response indicates two of the following: If an animal gets enough food, it will continue to grow. If the animal does not get enough food, it might stop growing and eventually die. If the animal gets too much food, it might grow too large and suffer as a result. |
| Adequate | Student response indicates one of the following: If an animal gets enough food, it will continue to grow. If the animal does not get enough food, it might stop growing and eventually die. If the animal gets too much food, it might grow too large and suffer as a result. |
| Inadequate | Student response shows little to no understanding of the question. |
- (4 points)
11. *causes*: a snowy landscape; tall grasses; *effects*: help a white rabbit hide from predators; grow taller over time to see prey and escape predators (3 points)
12. advantage, disadvantage (2 points)
13. c, d, f (3 points)

14.

Above Average	Student response shows an understanding that Organism A is better able to survive the change in the environment. The change to the environment has been caused by a drought, which means that there is less water. Organism A can store a great deal of water to help it survive until the drought is over.
Average	Student response shows an understanding that Organism A is better able to survive the change in the environment and that the change has been caused by a drought. The student does not explain what Organism A does that helps it survive the drought.
Adequate	Student response shows an understanding that Organism A is better able to survive the change in the environment but goes no further in answering the question.
Inadequate	Student response shows little to no understanding of the question.

(4 points)

Glossary

Green words and phrases are Core Vocabulary for the unit, and Student Reader page numbers are listed in parentheses. **Bold-faced words and phrases** are additional vocabulary terms related to the unit that you should model for students during instruction and that are often used within the Student Reader, and these latter terms do not have specific page numbers listed. Vocabulary words are not intended for use in isolated drill or memorization.

A

- adolescence, n.** a stage of the life cycle when a young animal is developing into an adult (2)
- advantage, n.** a factor that helps an organism (33)
- animal, n.** a living organism that eats and responds to senses

B

- birth, n.** the first stage of an animal's life cycle

C

- camouflage, n.** a color or pattern that helps an organism blend in with its surroundings (40)
- change, v.** to make an object, a living thing, or an environment different from what it was previously
- characteristic, n.** a particular action or physical appearance of an organism

D

- death, n.** the final stage of an animal's life cycle
- disadvantage, n.** a trait that makes an organism less likely to survive or succeed

E

- ecosystem, n.** all the living and nonliving things that interact in the same place
- environment, n.** a surrounding area that contains living and nonliving things (27)
- extinct, adj.** having no remaining living members (43)

F

- family, n.** a group of animals that have the same ancestry and share similar traits
- flowering plant, n.** a plant that produces flowers during its life cycle (7)

G

- germination, n.** the beginning of the growth process when a plant sprout comes out of a seed (9)
- growth, n.** the process of a living organism maturing or becoming larger

I

- identical, adj.** exactly the same (19)
- individual, n.** a single living organism (14)
- inherit, v.** to receive from parents (15)

L

- life cycle, n.** a series of stages in an organism's life (1)

M

- metamorphosis, n.** a change of form during the life cycle of some animals (5)
- multiples, n.** the birth of more than one offspring at the same time

O

- offspring, n.** a young organism produced by parents (15)
- organism, n.** any living thing (1)

P

- parent, n.** the adult members of a group of animals that produce offspring
- pattern, n.** the predictable stages of growth or any predictable repetition
- physical trait, n.** a feature of a living thing's body (14)
- plant, n.** a living thing which often grows in soil and has structures such as roots, leaves, and stems
- pollination, n.** the transfer of pollen that causes flowering plants to reproduce (9)
- population, n.** a group of a single type of organism living in the same place at the same time (21)

R

rare, adj. not found in large numbers (41)

reproduction, n. the process of making new organisms (3)

S

seasonal, adj. the particular parts of a year that are related to temperature and weather conditions (summer, winter, fall, spring)

seed, n. the part of a plant that protects the material that sprouts into a new plant (9)

siblings, n. organisms that come from the same parents (18)

species, n. a group of similar individuals that can reproduce together (20)

spore, n. a tiny structure on some nonflowering plants that can grow into a new plant (11)

stages, n. the steps involved in a plant's or animal's growth

survive, v. to stay alive (33)

V

variation, n. a difference between things or in one thing over time (20)

vary, v. to change or differ (20)

Classroom Safety for Activities and Demonstrations

In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily-available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- 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 engage with an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances, such as vinegar and baking soda.

Copy and distribute the Student Safety Form, found on the next page, for students to read and agree to prior to the start of the first unit, so students are aware of the expectations when engaged in science activities.

Online Resources



For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

When doing science activities, I will do the following:

- Report spills, breakages, or injuries to the teacher right away.
- Listen to the teacher for special instructions and safety directions. If I have questions I will ask the teacher.
- Avoid eating or drinking anything during the activity unless told to by my teacher.
- Review the steps of the activity before I begin. If I have questions I will ask the teacher.
- Wear safety goggles when working with liquids or things that can fly into my eyes.
- Be careful around electric appliances and unplug them by pulling on the plug when it is time to unplug an electric appliance.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ / ____ / ____ /

Student signature and date

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your daughter or son and sign this contract. If you have any questions, please feel free to contact me.

_____ / ____ / ____ /

Parent or guardian signature and date

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles, but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned and will last more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science as well as reducing 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 list 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.

Advance Preparation for Activities and Demonstrations

Being properly prepared for classroom activities and demonstrations is the first step to having successful and enriching activities and demonstrations. Advanced preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class:

- Familiarize yourself with the activity by performing the activity yourself or with a team and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will pre-assemble the materials to be distributed to the students and/or groups.
- Identify safety issues that could occur during an activity or demonstration and plan and prepare how to address them.
- Review the Teacher's Guide before teaching and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for post-activity collection and disposal of materials/equipment.

While engaged in the activity or demonstration:

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate among the students and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration:

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices, such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

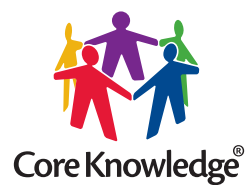
What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and X-rays are just some of the discoveries made when people were practicing science and something did NOT go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity didn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence or they missed a step when performing the activity. Review and provide feedback on the students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson's big question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly, a measurement was made in error such as a wrong unit of measure or quantity, or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but guiding them through the problem and figuring out the *why* something happened will help them to develop a better sense of how to do science.



CKSci™
Core Knowledge **SCIENCE™**

Series Editor-in-Chief

E.D. Hirsch Jr.

Editorial Directors

Daniel H. Franck and Richard B. Talbot

Subject Matter Expert

Joyce Latimer, PhD

Professor

Department of Horticulture

Virginia Tech

Blacksburg, VA

Illustrations and Photo Credits

Age fotostock / Alamy Stock Photo: Cover C

Elena Elisseeva / Alamy Stock Photo: Cover A

Ferrero-Labat / Pantheon / SuperStock: 136

Moodboard / SuperStock: Cover D

NaturePL / SuperStock: i, iii

Westend61 / SuperStock: 157

Within this publication, the Core Knowledge Foundation has provided hyperlinks to independently owned and operated sites whose content we have determined to be of possible interest to you. At the time of publication, all links were valid and operational, and the content accessed by the links provided additional information that supported the Core Knowledge curricular content and/or lessons. Please note that we do not monitor the links or the content of such sites on an ongoing basis and both may be constantly changing. We have no control over the links, the content, or the policies, information-gathering or otherwise, of such linked sites.

By accessing these third-party sites and the content provided therein, you acknowledge and agree that the Core Knowledge Foundation makes no claims, promises, or guarantees about the accuracy, completeness, or adequacy of the content of such third-party websites and expressly disclaims liability for errors and omissions in either the links themselves or the contents of such sites. If you experience any difficulties when attempting to access one of the linked resources found within these materials, please contact the Core Knowledge Foundation:

www.coreknowledge.org/contact-us/

Core Knowledge Foundation

801 E. High St.

Charlottesville, VA 22902

Core Knowledge Curriculum Series™

Series Editor-in-Chief

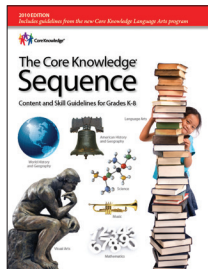
E.D. Hirsch Jr.

CKSci™

Core Knowledge **SCIENCE**™

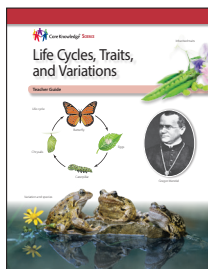
Life Cycles, Traits, and Variations

Core Knowledge Science 3



What is the Core Knowledge Sequence?

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



For which grade levels is this book intended?

In general, the content and presentation are appropriate for readers in the middle-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.

CKSci™
Core Knowledge SCIENCE™

A comprehensive program in science, integrating topics from Earth and Space, Life, and Physical Sciences with concepts specified in the **Core Knowledge Sequence** (content and skill guidelines for Grades K–8).

Core Knowledge SCIENCE™
units at this level include:

Investigating Forces
Life Cycles, Traits, and Variations
Habitats and Change
Weather and Climate

www.coreknowledge.org

Core Knowledge Curriculum Series™
Series Editor-in-Chief
E.D. Hirsch Jr.