

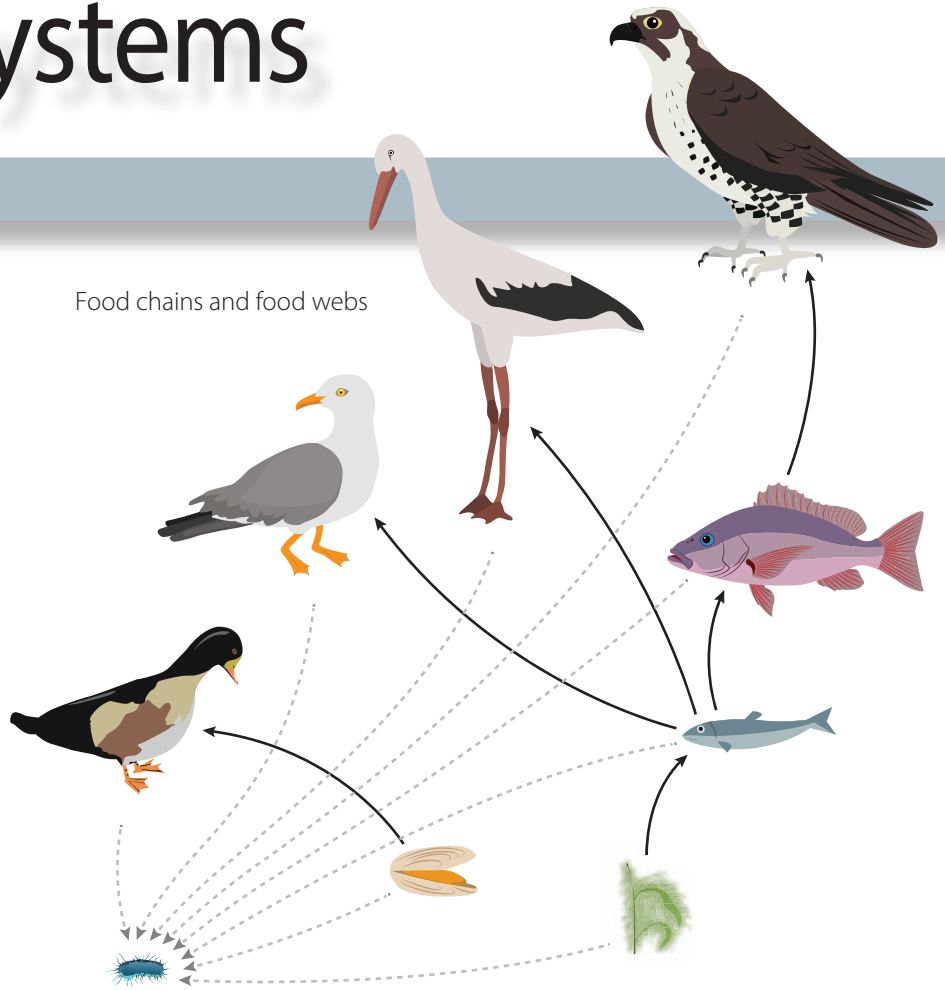
Energy and Matter in Ecosystems

Teacher Guide



Energy from sunlight

Food chains and food webs



Producers and consumers





Energy and Matter in Ecosystems

Teacher Guide



Core Knowledge®

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ISBN: 978-1-68380-539-7



Energy and Matter in Ecosystems

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Energy and Matter in Ecosystems

Teacher Guide

Core Knowledge Science™ 5

Introduction

ABOUT THIS UNIT

The Big Idea

This unit focuses on the scientific concept that energy and matter flow through an ecosystem to individual organisms and back to the ecosystem in a continuous cycle.

Students will learn that every organism on Earth needs energy to live. Both energy and matter cycle through an ecosystem. Life on Earth derives its energy from the sun. Plants and algae take in the energy of sunlight and transform it into the chemical energy of food. When animals eat plants, the chemical energy of food moves into the bodies of animals, so the energy that animals use originally came from the sun. The flow of energy and matter through ecosystems becomes clearer once students understand the following:

- Ecosystems consist of many interdependent relationships in which matter and energy cycle.
- Plants use energy from the sun to start the movement of energy and matter in an ecosystem.
- Producers, consumers, and decomposers interact in food chains, which make up food webs.
- Ecosystems can be easily disrupted by changes in the physical environment, by changes in the animals or plants living there, or by human actions.

Notes to Teachers and Curriculum Planners

This unit introduces Grade 5 students to real-world examples and fundamental concepts that will be explored in greater depth in later grades. Students will learn about the needs and usages of energy that organisms have, how plants and animals obtain energy and matter, and how energy and matter are cycled through an ecosystem.

- This unit introduces specific examples and models of ecosystems and discusses the causal relationships that occur when organisms interact to meet their needs. It does not assess students on their comprehensive understanding of the flow of energy between organisms.
- Living things need chemical energy from food for all life processes, and this energy originates from the sun and moves through producers, consumers, and decomposers.
- As producers, plants need sufficient sunlight and water to grow. As consumers, animals get their energy by eating other organisms. This process transfers the energy from producers to consumers.
- Ecosystems are the living and nonliving things in an area. As matter cycles through an ecosystem, the interactions of producers, consumers, and decomposers meet the needs of those living things in the ecosystem.

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 the following:

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

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
Ecology (Grade 3) • The food chain: producers, consumers, decomposers • Ecosystems: how they can be affected by changes in environment (for example, rainfall, food supply, etc.), and by man-made changes Plant Structures and Processes (Grade 5) • Photosynthesis is an important life process that occurs in plant cells (<i>photo</i> = light; <i>synthesis</i> = putting together). Unlike animals, plants make their own food, through the process of photosynthesis.	Organisms Need and Use Energy • Living things need chemical energy from food for all life processes. • Producers, consumers, and decomposers Plants and Animals • Plants need sufficient sunlight, warmth, soil, water, and air to grow. • Photosynthesis: Plants use air, water, and the energy of sunlight to make food. • The energy in animals’ food originated as energy from the sun.
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 addresses the following Grade 5 Performance Expectations for the NGSS topics *Organisms Need and Use Energy; From Molecules to Organisms; Structures and Processes*; and *Ecosystems: Interactions, Energy, and Dynamics*. Students who demonstrate understanding can

5-PS3-1 Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.

5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

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:

PS2.A: Energy

- Grades K–2**
- Sunlight warms Earth’s surface.

LS1.C: Organization for Matter and Energy Flow in Organisms

- Grades K–2**
- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

LS2.A: Interdependent Relationships in Ecosystems

- Grades K–2**
- Animals depend on their surroundings to get what they need, including food, water, shelter, and a favorable temperature. Animals depend on plants or other animals for food. They use their senses to find food and water, and they use their body parts to gather, catch, eat, and chew the food. Plants depend on air, water, minerals (in the soil), and light to grow. Animals can move around, but plants cannot, and they often depend on animals for pollination or to move their seeds around. Different plants survive better in different settings because they have varied needs for water, minerals, and sunlight.

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Grades K–2**
- Organisms obtain the materials they need to grow and survive from the environment. Many of these materials come from organisms and are used again by other organisms.

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Grades K–2

- The places where plants and animals live often change, sometimes slowly and sometimes rapidly. When animals and plants get too hot or too cold, they may die. If they cannot find enough food, water, or air, they may die.

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 Need and Use Energy

LESSONS 1–4

- Explain how the energy in animals' food originated as energy from the sun.
- Identify the basic function in an ecosystem of producers, consumers, and decomposers.
- Create a model that shows the relationships among sunlight, producers, consumers, and decomposers.

B. Plants and Animals

LESSONS 5–9

- Explain that experiments have shown that the increase in matter during plant growth does not come from the soil.
- Use evidence to support an argument that plants mainly get the materials they need for growth from air and water.
- Develop a model to show the basic idea of photosynthesis, that air and water use sunlight to produce food (a sugar called glucose).
- Create a presentation that explains the energy relationship between the sun, plants, herbivores, omnivores, and carnivores.

C. Matter Cycles Through Ecosystems

LESSONS 10–15

- Define the term *ecosystem*, and describe at least four examples.
- Compare a food chain to a food web.
- Create and use a model to show the cycling of matter and energy from producers to consumers to decomposers and to show how the interactions of producers, consumers, and decomposers meet the needs of the living things in an ecosystem.
- Describe specific ways that an ecosystem and its food webs can be disrupted and protected.
- Gather evidence to show how a specific ecosystem can be disrupted by changes in the environment and by human activities.

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 *Energy and Matter in Ecosystems* Student Reader has eight 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 aloud and engagement with the text. The Teacher Guide provides Guided Reading Supports to prompt discussion, clarify misconceptions, and promote understanding in relation to the Big Questions.

Pacing

The *Energy and Matter in Ecosystems* unit is one of five units in the Grade 5 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-one days teaching the *Energy and Matter in Ecosystems* unit so that you have time to teach the other units in the Grade 5 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 Need and Use Energy (5-PS3-1)	1. Living Things Grow and Change	What makes living things alive?
	2. Producers, Consumers, and Decomposers	Where do organisms get the energy they need for living?
	3. Living Things Use Energy	How do organisms use energy that originally comes from the sun?
	4. Modeling the Flow of Energy	How can I model the flow of energy through living things?
B. Plants and Animals (5-LS1-1)	5. Growing Plants Without Soil	Can I grow a plant without soil?
	6. What Plants Need	Where do plants get the materials they need for growth?
	7. Modeling Photosynthesis	How can I model photosynthesis?
	8. Energy Relationships Among Plants and Animals	Where do different organisms get their energy?
	9. Explaining Energy Relationships Among Plants and Animals (three class sessions)	Where do different organisms get their energy?
C. Matter Cycles Through Ecosystems (5-LS2-1)	10. Ecosystems	What is an ecosystem, and what are some different types of ecosystems?
	11. A Local Ecosystem	What lives where I live?
	12. Food Chains and Food Webs	What are food chains and food webs?
	13. Modeling the Cycle of Matter in an Ecosystem (two class sessions)	How can I show cycles of matter in an ecosystem?
	14. Changes in Ecosystems	What happens when ecosystems are disrupted?
	15. People and the Environment (two class sessions)	What happens when human activity disrupts an ecosystem?
Unit Review and Assessment	Energy and Matter Review Game	What have I learned about ecosystems?
	Unit Assessment	What have I learned about ecosystems?

Activity Pages and Unit Assessment

Activity Pages



AP 1.1

AP 1.2

AP 2.1

AP 3.1

AP 4.1

AP 4.2

AP 6.1

AP 7.1

AP 8.1

AP 9.1

AP 10.1

AP 11.1

AP 12.1

AP 13.1

AP 14.1

AP 15.1

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 127–164. 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—Library Scavenger Hunt (AP 1.1)

Lesson 1—Plant Data Sheet (AP 1.2)

Lesson 2—Organisms and Chemical Energy (AP 2.1)

Lesson 3—Photosynthesis Model (AP 3.1)

Lesson 4—Model Checklist (AP 4.1)

Lesson 4—Energy's Path Through Living Things (AP 4.2)

Lesson 6—A Needy Plant in the Neighborhood (AP 6.1)

Lesson 7—A Rough Draft of Your Model (AP 7.1)

Lesson 8—Energy from the Sun to You (AP 8.1)

Lesson 9—Research Guide (AP 9.1)

Lesson 10—Ecosystem: Yes or No (AP 10.1)

Lesson 11—Ecosystem Investigation (AP 11.1)

Lesson 12—Chains and Webs (AP 12.1)

Lesson 13—Modeling the Cycling of Matter and Energy (AP 13.1)

Lesson 14—Things That Disrupt Ecosystems (AP 14.1)

Lesson 15—Research and Writing Guide (AP 15.1)

Unit Review—Energy and Matter Review Game (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 165–166.

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 152–158) 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

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 167–171, 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

Online Resources



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 Need and Use Energy

Lesson 1

- rock
- access to the school's library during class time when no other classes will be there
- plant cuttings
- containers
- water
- rulers
- scales
- markers

Lesson 2

- assorted pictures of green plants
- reference books and other research materials
- index cards for student vocabulary deck (5 per student)

Lesson 3

- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (4 per student)

Lesson 4

- poster board (assorted colors)
- construction paper (assorted colors)
- markers
- scissors
- glue bottles/glue sticks
- shoeboxes (or small boxes or containers)
- colored pencils
- crayons

Lesson 4, continued

- craft pom-poms
- yarn
- stapler
- hole punch/three-hole punch
- craft clay
- old magazines with pictures of animals and plants
- computer/internet access
- index cards for student vocabulary deck (2 per student)

Part B: Plant and Animals

Lesson 5

- plants in containers of water (that students started in Lesson 1)
- scales
- rulers
- water
- water pitchers
- Activity Page 1.2 (from Lesson 1)

Lesson 6

- reference books and other research materials
- computer/internet access
- (optional) plastic sandwich baggies (1 per student)
- index cards for student vocabulary deck (2 per student)

Lesson 7

- poster board
- foam/closed-cell extruded polystyrene foam board

Lesson 7, continued

- paint (assorted colors)
- paintbrushes
- construction paper (assorted colors)
- felt (assorted colors)
- chenille craft wires (assorted colors)
- markers (assorted colors)
- cardboard paper towel rolls
- scissors
- glue
- toothpicks
- clear tape
- real plant or tree leaves

Lesson 8

- reference books and other research materials
- index cards for student vocabulary deck (3 per student)

Lesson 9

- library or computer (internet) access
- printer or copy machine
- library books
- Core Vocabulary cards for the following words: *energy, photosynthesis, herbivore, omnivore, carnivore, producer, consumer, scavenger*
- timer
- Activity Page 1.2 (from Lesson 1)

Part C: Matter Cycles Through Ecosystems

Lesson 10

- 6 assorted pictures of ecosystems and non-ecosystems
- drawing paper
- colored pencils or crayons
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

Lesson 11

- bright-colored cones or flags

Lesson 12

- assorted pictures of organisms that belong to a food chain
- index cards
- tape or glue
- internet access and the means to project images/videos for whole-class viewing
- index cards for student vocabulary deck (2 per student)

Lesson 13

- poster board
- markers (assorted colors)
- heavy paper or index cards
- tape
- internet access and the means to project images/video for whole-class viewing

Lesson 14

- drawing paper
- ruler
- crayons or colored pencils (assorted colors)
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

Lesson 15

- library or computer (internet) access

SAMPLE PACING GUIDE

The sample Pacing Guide suggests use of the unit's resources across a period of twenty-one days. 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.

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™*.

Online Resources



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>Living Things Grow and Change</i> TG Lesson 1 AP 1.1, 1.2	<i>Producers, Consumers, and Decomposers</i> TG Lesson 2 SR Chapter 1 AP 2.1	<i>Living Things Use Energy</i> TG Lesson 3 SR Chapter 2 AP 3.1	<i>Modeling the Flow of Energy</i> TG Lesson 4 AP 4.1, 4.2	<i>Growing Plants Without Soil</i> TG Lesson 5 AP 1.2

Week 2

Day 6	Day 7	Day 8	Day 9	Day 10
<i>What Plants Need</i> TG Lesson 6 SR Chapter 3 AP 6.1	<i>Modeling Photosynthesis</i> TG Lesson 7 AP 7.1	<i>Energy Relationships Among Plants and Animals</i> TG Lesson 8 SR Chapter 4 AP 8.1	<i>Explaining Energy Relationships Among Plants and Animals DAY 1</i> TG Lesson 9 AP 1.2, 9.1	<i>Explaining Energy Relationships Among Plants and Animals DAY 2</i> TG Lesson 9 AP 9.1

Week 3

Day 11	Day 12	Day 13	Day 14	Day 15
<i>Explaining Energy Relationships Among Plants and Animals DAY 3</i> TG Lesson 9 AP 9.1	<i>Ecosystems</i> TG Lesson 10 SR Chapter 5 AP 10.1	<i>A Local Ecosystem</i> TG Lesson 11 AP 11.1	<i>Food Chains and Food Webs</i> TG Lesson 12 SR Chapter 6 AP 12.1	<i>Modeling the Cycle of Matter in an Ecosystem DAY 1</i> TG Lesson 13 SR Chapter 7 AP 13.1

Weeks 4 and 5

Day 16	Day 17	Day 18	Day 19	Days 20 and 21
<i>Modeling the Cycle of Matter in an Ecosystem DAY 2</i> TG Lesson 13	<i>Changes in Ecosystems</i> TG Lesson 14 SR Chapter 8 AP 14.1	<i>People and the Environment DAY 1</i> TG Lesson 15 AP 15.1	<i>People and the Environment DAY 2</i> TG Lesson 15 AP 15.1	TG Unit Review AP UR.1, UR.2, UR.3 Unit Assessment AP Unit Assessment

PACING GUIDE

Twenty-one days have been allocated to the *Energy and Matter in Ecosystems* unit to complete all Grade 5 science units in the *Core Knowledge Curriculum Series™*. If you cannot complete the unit in twenty-one 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

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Week 6

Day 26

Day 27

Day 28

Day 29

Day 30

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Week 7

Day 31

Day 32

Day 33

Day 34

Day 35

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Week 8

Day 36

Day 37

Day 38

Day 39

Day 40

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PART A

Organisms Need and Use Energy

OVERVIEW

Lesson	Big Question	Advance Preparation
1. Living Things Grow and Change	What makes living things alive?	Gather materials for student investigations. (See Materials and Equipment page 12.)
2. Producers, Consumers, and Decomposers	Where do organisms get the energy they need for living?	Read Student Reader, Chapter 1.
3. Living Things Use Energy	How do organisms use energy that originally comes from the sun?	Read Student Reader, Chapter 2.
4. Modeling the Flow of Energy	How can I model the flow of energy through living things?	Gather materials for student investigations. (See Materials and Equipment page 12.)

Part A: What's the Story?

Living things are defined by certain processes, such as acquiring energy for life, releasing waste, growing, reproducing, and monitoring the environment. This section helps students learn about how living organisms do all of these things, as well as how energy gets from the sun into living things and makes its way through a food chain.

In Lesson 1, we start by setting the foundation for the remainder of the unit. Students first learn about the various processes that determine whether something is or is not alive. These processes are reinforced for students when they research a specific plant or animal of their choice and explain how the organism incorporates each process.

In Lesson 2, students read and learn about how and where organisms get the food they need for energy, beginning with plants that take in energy from sunlight, turn it into food (in the form of glucose), and store it for later energy needs. This lesson addresses the differences between producers (organisms that make their own food), consumers (organisms that get their food—and therefore meet their energy needs—by eating other organisms), and decomposers (organisms that get their food by consuming dead or decaying plant and animal matter).

In Lesson 3, students read and learn more about the process of photosynthesis, which is how plants take energy from the sun and convert it into glucose to meet their energy needs. Plants transform light energy into chemical energy, the sugar glucose. Students learn that chemical energy moves through a food chain and that chemical energy—called food—is used for movement, growth, reproduction, and body repair.

In Lesson 4, students conduct a hands-on activity in which they build a physical model showing the flow of energy from the sun to producers, then into consumers, and finally into the students (who are consumers themselves). The goal of the lesson is for students to understand the flow of energy in the food chain.

So, to repeat, **all organisms need and use energy**. Help your students grasp this concept through the use of models, and you will lay the groundwork for the idea that plants get the materials they need to grow primarily from air and water, as well as help your students later model how energy moves from the sun to producers and then consumers, all of which are NGSS expectations addressed in the rest of this unit.

LESSON 1

Living Things Grow and Change

Big Question: What makes living things alive?

AT A GLANCE

Learning Objective

- ✓ Explore living things, how they grow and change, and how they meet their energy needs.

Lesson Activities

- student investigation
- discussion and writing

NGSS References

Disciplinary Core Idea PS3.D: Energy in Chemical Processes and Everyday Life

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Developing and Using Models

Energy and Matter are important to the topic of living things and their growth because all living things are made up of matter and they all need energy to grow. In this lesson, students learn about the seven life processes that scientists use to determine whether matter is living or nonliving.

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.

food
energy

energy transfer
energy transformation

living

Instructional Resources

Activity Pages



AP 1.1

AP 1.2

Activity Pages

Library Scavenger Hunt (AP 1.1)

Plant Data Sheet (AP 1.2)

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

Materials and Equipment

Collect or prepare the following items:

- rock
- access to the school's library during class time when no other classes will be there
- plant cuttings
- containers
- water
- rulers
- scales
- markers

Advance Preparation

It may be best to conduct most of the class session in the library. Taking students to the library during the activity portion of the session may cause a loss of time that will be needed for students to conduct their research.

For Activity Page 1.2, you may wish to prepare the plant cuttings in advance. Choose one of the following plants: geranium, begonia, coleus, mint, philodendron, Swedish ivy, rosemary, basil, oregano, sweet potato vine, or snapdragon. Cut one part of the stem for each student group. Make sure there are no leaves or flowers on any of the cuttings.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What makes living things alive? In Unit 1, students learned that all matter has properties and that different types of matter can combine to make new matter. In this unit, they will learn that some matter is alive and other matter is not. Students will also learn how to differentiate between living and nonliving matter, or things. In doing so, they will come to understand that living things need energy to stay alive and will discover how some living things get their energy.

Begin the discussion by having students look around the classroom. Ask the following:

- What things in this classroom are not alive? (*Students may point to books, desks, chairs, computers, or other inanimate objects as not being alive.*)
- What things in this classroom are alive? (*Students may say that other students, the teacher, and any plants or animals in the classroom are alive.*)

SUPPORT—Place a rock on your desk, and ask, “Is it alive?” If necessary, prompt students to think about things that make something alive through questions such as *Does it breathe? Does it move? Does it eat?*

Ask students how they know which things are alive and which things are not alive in the classroom. Answers may vary but should include some of the following: the ability to move, breathe/respire, sense changes in the environment, grow, reproduce, get rid of waste, and take in nutrients. After students answer, be sure they consider both plants and animals.

NOTE—Students may not use the same terminology as listed above. For example, they may say “have children” instead of “reproduce,” or they may say “eat” instead of “take in nutrients.” Also, they will likely not name all of these processes. This is okay. The important thing is that students understand the concepts, or ideas, that scientists use to determine whether something is living or not living. Virtually all living things go through the seven processes described above, and most of these will be covered throughout this section and unit.

CHALLENGE—Students should be aware that all living things are made up of one or more cells. (Most multicellular organisms are made up of considerably more than one.) Students themselves can actually see these cells by looking at them under a microscope. For example, a part of a plant may be placed under a microscope and magnified so that its cells are visible. Only living things have cells; nonliving things do not. If there is a microscope in the classroom, have students look at a plant part under it and describe what they see.

2. Encourage student questions.

5 MIN

On the board or chart paper, list the following life processes: **movement** (the ability to move), **respiration** (the ability to breathe or respire), **sensitivity** (the ability to sense changes in the environment), **growth** (the ability to grow and change physically), **reproduction** (the ability to have offspring), **excretion** (the ability to get rid of waste), and **nutrition** (the ability to take in nutrients, or energy in the form of food). Ask students which of the processes are for plants and which are for animals. (All of them apply to both.) (See **Know the Science 1–7**.)

Know the Science

1. What is movement? *Movement of living things is the ability to go from one place to another at will or to physically react to stimuli in an environment!* Most animals have limbs that help them to move from place to place, usually in search of food for energy. Some animals are quadrupedal, which means they use their arms and their legs to move; others are bipedal, which means they use only their two hind legs to move. Some animals have many legs that help them get from place to place, and others (such as worms and snakes) do not have any legs at all. Instead, they use their bodies to propel them forward. Plants can also move, though not in the same way as animals. Instead, they may follow the sun, from which they get their energy. This means that though they may be rooted to one spot, plants’ bodies can shift throughout the day to ensure that the parts that take in energy from the sun are always facing the sun. Most animals and some plants can also react to stimuli in their environments. They may draw back from an object that is too warm or too cold, for example. Many plant leaves close up during a rain shower.

Know the Science

2. What is respiration? *Respiration is a chemical process that takes place in the body!* Respiration has two meanings. Students may know this word can refer to breathing, drawing oxygen into their mouths or nostrils when they breathe in and releasing carbon dioxide when they breathe out. However, not all animals breathe through mouths or nostrils. Fish, for instance, respire through gills, and whales breathe through blowholes. Plants respire by drawing in carbon dioxide and releasing oxygen. The second use of the word is one students may not be used to. Respiration also can refer to the chemical reactions that occur when organisms break down sugars to release useable energy in the form of ATP.

3. What is sensitivity? *Sensitivity is the ability to monitor an environment!* Living things usually have ways of sensing the temperature of their environments, which enable them to move if the environment grows too hot or too cold for them. Or they may have traits that help them sense light or food. They may also be able to detect other aspects of the environment that are friendly (helpful) or unfriendly (harmful) to them, which may enable them to move to a new environment that better meets their needs.

4. What is growth? *Growth refers to the physical enlargement and changing forms that living things go through in their lives!* All living things are born, they grow, they reproduce, and then they die. Different types of living things have different types of growth patterns and life stages, though all individual organisms begin with birth and end in death. (Plants germinate, a process we don't refer to as birth but certainly is similar in a way.) Animals and plants have similar life stages, though they are not exactly the same. Students will learn more about growth through this unit.

5. What is reproduction? *Reproduction is the ability to reproduce, or create offspring, and to pass on genetic information to those offspring!* All living things reproduce. Single-celled organisms do it by splitting into two cells. Some living things do it sexually, which occurs when a male and a female of the species mate. Other organisms reproduce asexually, which occurs when a single parent has offspring without the help of a mate. Asexual reproduction is more common in plants than it is in animals.

6. What is excretion? *Excretion is the ability to get rid of waste!* All living things must take in food to meet their energy needs, but they do not need every particle of the food they ingest. The remains of that food are excreted as waste. Waste products can include oxygen and carbon dioxide, as well as the physical remnants of food (urine and fecal matter). Waste is the product of chemical reactions that take place in the body of a plant, animal, or other living thing. The body breaks down the food it takes in, uses some parts by transforming them into energy, and gets rid of the parts it does not need by transforming them into urine and feces.

7. What is nutrition? *Nutrition is the process of a living thing obtaining the energy it needs to grow!* All living things grow, but they cannot grow without energy. They get the nutrients they need to make energy from food, which is one form of chemical energy. Different types of living things can have very different processes for getting the nutrients they need. Plants get it directly from sunlight; some animals get it directly from plants; some animals get it directly from other animals that get it from plants; some animals can get it from either plants or animals. Students will learn more about how plants get their nutrients in Lessons 2, 7, and 8; how animals get their nutrients in Lessons 2, 9, and 10; and how the food chain works in Lessons 13 and 14.

Invite students to write down any questions they have about each process. Explain that they will learn about some of the processes in this lesson and about others over the course of this unit. Have students turn in their questions. Explain that they will not be graded on these questions but that you will select a few to cover at the end of this session. Point out that these seven life processes are also criteria or traits scientists use to determine if something is a living thing.

3. Preview the investigation.

5 MIN

Activity Page



AP 1.1

Distribute and review Library Scavenger Hunt (AP 1.1). Tell students that they will choose a living thing to investigate. This living thing can be a plant or an animal.

CHALLENGE—An enterprising student may choose bacteria, unicellular organisms, though this will be rare. In such cases, the processes listed on the Activity Page still apply, though how they occur may be radically different from the way they occur in plants and animals.

Remind students of the seven processes scientists use to determine whether something is living or nonliving. Students can refer to these processes as they do their research. Explain that they will use the library's resources to find out how their living thing engages in these processes.

4. Facilitate the investigation.

10 MIN

As students work on their Activity Pages, circulate around 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 better tell whether something is living or nonliving. Encourage students to focus on two aspects of the data table in particular: growth and nutrition. Explain that these will be important in upcoming lessons in this unit. If students incorrectly fill out the data table, their interpretation of what is living and what is not living may be skewed or incorrect.

SUPPORT—Some students may struggle with researching their living thing. If they have chosen a living thing for which there is little information—or for which information is difficult to find—allow them to select another living thing to research. However, make sure that they are aware of the time constraints for the activity. If they need help with research, provide help yourself or request the help of a librarian or library assistant to show the student how research is done. By fifth grade, most students should understand the basics of library and online research, but they may still need an occasional refresher or help with a difficult subject.

5. Summarize and present.

5 MIN

Once students have had time to complete their data tables, bring the class back together, and hold 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. Have students use the Core Vocabulary Terms for the lesson when they discuss their findings. Encourage volunteers to showcase their living thing and how it conducts each life process, presenting their information to the rest of the class.

SUPPORT—If necessary, address the following misconceptions:

- Some living things may become paralyzed; they are not moving, yet they are still alive. How can this be true? Point out that even living things that do not appear to be moving still have parts that are moving, such as blood flowing through their bloodstream, hearts that are beating, or brains that are thinking. Just because the parts we see cannot move doesn't mean that other parts we cannot see are not moving. (Be sensitive to any students who may have a loved one who is paralyzed in some way or are themselves paralyzed.)
- Some students may believe that only things with mouths can eat. Point out that eating is the act of taking in nutrients. Different living things have different kinds of structures for taking in nutrients and gaining energy. Plants take in nutrients very differently from animals. Some animals take in nutrients differently from other animals. Though this may not appear on the surface to be "eating," it achieves the same results.
- In rare cases, physical problems with an individual organism may prevent that individual from reproducing. However, the species to which that individual belongs can reproduce on the whole, and therefore the individual itself is still living. In many species, the ability to reproduce may end in a later stage of the life cycle that comes after the maturity stage but before the death stage.

Ask whether students have any questions about what makes something alive, and address any additional misunderstandings.

6. Preview the investigation.

10 MIN

Activity Page



AP 1.2

After students have completed their presentations, distribute and review Plant Data Sheet (AP 1.2), along with one plant cutting and one container per student. Go over the directions for the Activity Page. Explain that students will engage in an experiment to see what plants need most to grow. What students are doing today is just the first part of the activity; they will return to it throughout this unit to see how their plant cuttings are growing in just a container of water. Then allow students to carry out the activity described on the first page of the Activity Page.

SUPPORT—Circulate throughout the room as students complete their Activity Page. Observe closely to ensure they are following the directions, and answer any questions they may have.

7. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 1.1 and 1.2) for correct answers and sample student responses.

- Collect the completed Library Scavenger Hunt Activity Pages. Scan the data tables that students completed, and check for accuracy and understanding of the life processes and how they work for the specific organism that was selected.
- Review the questions about life processes that students turned in for Section 2. As time permits, select several that students struggled with throughout this class session, and go over them. Allow volunteers to try to answer the questions, and provide constructive feedback to affirm correct answers.
- Collect the Plant Data Sheet Activity Pages from students, and store them in a safe place. Students will return to them throughout the unit.

LESSON 2

Producers, Consumers, and Decomposers

Big Question: Where do organisms get the energy they need for living?

AT A GLANCE

Learning Objectives

- ✓ Identify the basic function in an ecosystem of producers and consumers.
- ✓ Identify food as the source of chemical energy needed for survival.

Lesson Activities

- reading, discussion, writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea PS3.D: Energy in Chemical Processes and Everyday Life

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Developing and Using Models

Energy and Matter are important to the topic of living things and their growth because all living things need chemical energy to live. Students learn about uses for chemical energy (food) such as keeping warm.

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 purple 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 165–166 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.

consumer	food	living	producer
decomposer	glucose	organism	scavenger
energy			

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 purple above.

Instructional Resources

Student Reader



Ch. 1

Activity Page



AP 2.1

Student Reader, Chapter 1
“Producers, Consumers, and Decomposers”

Activity Page
Organisms and Chemical Energy (AP 2.1)

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

Materials and Equipment

Collect or prepare the following items:

- assorted pictures of green plants
- reference books and other research materials
- index cards for student vocabulary deck (5 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Where do organisms get the energy they need for living? Remind students that in the last lesson, they learned about the criteria scientists use to determine whether something is living or not living. In this lesson, they will build on some of that criteria. Begin by asking students how they know when something is alive. They should cite the criteria they learned about in the previous lesson, such as taking in or making food, growing, and reproducing.

SUPPORT—If necessary, write the list of seven (life processes) criteria from Lesson 1 on the front board to refresh students’ memories.

Explain that in today’s lesson, they will learn more about how organisms get the food they need to grow and what that food is used for.

2. Read and discuss: “Producers, Consumers, and Decomposers.” 15 MIN

Student Reader



Ch. 1

Read together or have students read independently “Producers, Consumers, and Decomposers,” Chapter 1 in the Student Reader. The selection helps reinforce the idea that all living organisms can be divided into two categories: producers (organisms that produce their own food) and consumers (organisms that get their food from other organisms).

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.

consumer
decomposer

producer
organism

scavenger

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, provide the following prompts, but do not allow students to answer any question with an answer they have already used.

- » Name an organism that needs food. What kind of food does it consume, or eat? (*Sample answer: A giraffe eats leaves.*)
- » Name an organism that grows. How does it grow, or change, throughout its life? (*Sample answer: A tadpole changes into a frog as it grows into an adult.*)
- » Name an organism that reproduces. How does it make new life? (*Sample answer: A bird lays eggs, and the eggs can hatch into baby chicks.*)
- » Name an organism that is made of cells. Does it have only one cell, or does it have many cells? (*Sample answer: A tree has many cells and many kinds of cells.*)

SUPPORT—Some students may be confused by such questions as “How does it make new life?” If so, offer them guidance by reminding them about the different types of reproduction they learned about in Grade 3, Unit 2 (*Life Cycles, Traits, and Variations*). For instance, plants reproduce using seeds or spores, whereas animals reproduce when they find mates. Be aware that some students may not have taken this course and that the unit would have been covered two years before.

It is very important to clarify for students the relationship between food, chemical energy, and glucose. Food is a general term for any nutrition a living thing needs to live. A hamburger is food, and a peach is food. All uses of the term *food* imply that food is some form of chemical energy. Glucose, the chemical made during photosynthesis, is one form of chemical energy—a key one, since it is necessary for nearly all forms of cellular respiration.

Page 2

After reading the page, have students name more examples of producers. Write on the front board or chart paper a list of the examples students come up with. Draw attention to similarities, such as examples being plants.

SUPPORT—If necessary, check for understanding by asking students about whether certain animals are producers. For instance, ask: What does a bear eat? (*fish*) Does that mean it makes its own food, or does it find its own food? (*It finds its own food; it does not make its own food.*) Is a bear a producer? (*no*)

Page 3

Show students images of different types of plants, and ask them where they believe each plant makes its food. They should point to the areas of the plant that are the greenest. For example, a cactus makes food in its body. A maple tree makes food in its leaves. Have students explain their answers. Encourage students to use terminology from the page, including *chlorophyll*.

NOTE—Avoid discussing the word *photosynthesis*, as students will learn more about the word and what it means in the next lesson.

Page 4

Before students read the page, pause and ask, “If a producer makes its own food, what do you think a consumer does?” Students may be able to guess that a consumer eats food and does not make its own food. The word *consume* is an everyday word that students may already be familiar with in the context of eating.

After students have finished reading the page, ask them questions such as the following:

- » Where do you get your food? (*from producers or other consumers*)
- » Do you make it through the process that plants use? (*no*)
- » Do you get it from other living things? (*yes*)
- » Are you a producer or a consumer? (*a consumer*)

SUPPORT—For the first question, some students may answer, “From my parents (or guardians) or my school.” Explain that what this question really asks is where their food comes from. Does it come from producers or other consumers? You can break these questions down even further to mention specific foods, such as “Is the apple that you eat for lunch a consumer or a producer?”

Explain to students that animals are consumers. Animals cannot make their own food, and so they must rely on eating other organisms (either producers or other consumers) in order to get their nutrients.

NOTE—Make sure to not introduce any misconceptions about the color green and its association with producers. Not all green organisms contain chlorophyll or make their own food. For instance, many birds have green feathers, but they do not contain chlorophyll and are not producers.

Page 5

The images on the page show ways that organisms move to get food. Have students name other ways that organisms move to get food, such as walking on two legs, running on four legs, moving on many legs, flying, and swimming with fins. Emphasize the point that consumers must move in order to get their food. Have students come up with animals that do not or cannot move, and ask them how these animals get the energy they need to live.

CHALLENGE—Challenge students to think about why producers do not need to move in order to get their food. (*because they make their own food and they do not have to catch it*)

Pages 6–7

Scavengers and decomposers play a vital role in the health of ecosystems beyond completing the journey of energy and matter through the cycle and back into the ecosystem. Ask the following:

- » What would happen to a banana peel if it never turned brown and was broken down? (*Nothing; it would just be wherever it ended up.*)
- » What would happen if all the leaves in a tree fell on the ground but never broke down? (*There would be piles of leaves covering everything over time.*)
- » What would happen to the remaining nutrients in living things after they died? (*The nutrients would go nowhere.*)
- » If the nutrients never went anywhere, how would they get back into the ecosystem? (*The nutrients would not be returned to the ecosystem where living things needed the nutrients.*)

Page 8

Ask students to describe some of the things they do in a day that involve physical activity. Have them tell where they get the energy to do these things. (*from the food they eat*) Ask them what they think would happen if an organism did not take in chemical energy like that described on the page. (*The organism would be unable to move or do anything else, and eventually it would die.*)

Page 9

Ask students about ways they get warmer when they are cold. Some will say that they put on extra clothes, get under blankets, or move around more. Have students tell whether they are warm-blooded or cold-blooded and why they think so. (*Humans are warm-blooded because their bodies have the ability to regulate their internal body temperature.*) If students do not know the correct answer, provide a series of prompts to help them:

- » When you run, jump, or play, do you get hotter or colder? (*hotter*)
- » After your head lies on a pillow for a while, is the pillow still cold, or has it gotten warmer? (*gotten warmer*)

Explain that all organisms generate some heat from the chemical energy they take in. Some organisms can generate more heat than others, but they also need to take in more chemical energy to do so. For example, warm-blooded animals such as mammals usually eat more often than cold-blooded animals such as reptiles. (See **Know the Science** for support with this analysis.)

SUPPORT—Give students more examples of animals that are cold-blooded, such as amphibians, fish, and other reptiles.

Page 10

Have student volunteers describe any broken bones, cuts, or bruises they have had in their lives. (Be sensitive when discussing the issue of students being hurt, and do not force any student to describe any situation that may have been traumatic for him or her.) Ask them what happened to the broken bones, cuts, or bruises. (*They healed over time.*) Explain that when wounds on our bodies heal over time, it's because of energy. We eat food, our bodies have chemical energy, and one of the functions of that energy is to heal any wounds we may have received.

SUPPORT—Ask students to name other functions of energy in our bodies. Students should identify the fact that energy helps us grow. Have students state how tall they are. Ask them if their height is different now from a year ago, from three years ago, and from when they were born. They should recognize that they will continue to grow taller at least for a few years.

Point out to students that growth isn't only about height. Ask them to name other ways that animal bodies can grow or change.

3. Encourage discussion.

10 MIN

Activity Page



AP 2.1

Distribute and review Organisms and Chemical Energy (AP 2.1). Explain to students that they will come up with a list of plants and animals and complete the table with information that they know about an organism. Encourage students to select plants and animals that have not been used in the lesson so far. Allow students to draw on information and Core Vocabulary terms they learned in the previous lesson as well as in "Producers, Consumers, and Decomposers," Chapter 1 in the Student Reader.

Know the Science

Do cold-blooded animals produce heat? Yes! All living organisms generate some heat when they take in chemical energy, but some generate more than others. Mammals and birds are the only two kinds of organisms that are known as warm-blooded. This means that they then internally regulate their body temperatures. Other organisms do not do this. They generate some heat, but not necessarily enough to keep them alive. They rely on the temperature outside their bodies to help them live. For example, many reptiles bask in the sun in the morning; this is to help them warm their bodies so that they can move less lethargically. Other organisms, such as moths and butterflies, vibrate their wings to generate heat. Organisms that internally regulate their body temperatures, usually must take in chemical energy more often than those that do not.

SUPPORT—Students may have to do additional research to complete the Activity Page. If so, allow them to use classroom research materials or the internet.

Students may become confused about how to answer the question about warmth if the organism they chose is a plant. Tell students that it is okay to leave this box blank in the table for plants.

Lead a discussion about the examples that students named in their Activity Pages. Ask volunteers to share their organisms. Draw attention to similar examples that different students have identified. Have them identify ways in which the organisms are similar. Use additional guiding questions to help students link details in this discussion back to the Activity Page and Student Reader selection.

- Are there any similarities in the organisms that produce their own food? (*Sample answer: Trees are not all the same type, but they all make their own food in their leaves.*)
- Are there any similarities in the organisms that gain their energy from producers and consumers? (*Sample answer: The fruit of an apple tree can provide energy to many organisms, such as people, animals, birds, and worms.*)
- Are there any similarities in the organisms that gain their energy only from other consumers? (*Sample answer: Snakes eat small animals, and mountain lions eat larger animals.*)
- How are warm-blooded animals similar? (*Many jungle animals and farm animals are warm-blooded mammals that have four legs.*) How are cold-blooded animals similar? (*Snakes, lizards, and frogs have to live in warm places or stay underground when the outside temperature is too cold.*)

4. Teach Core Vocabulary

10 MIN

Prepare Core Vocabulary Cards

Have students write each Core Vocabulary term on the upper left corner of an index card. Instruct students to refer back to the Student Reader chapter as they complete the Word Work.

consumer
decomposer

organism
producer

scavenger

Word Work

Have students define each term in their own words and write an example of each. Ask for volunteers to share their definitions and examples.

- **organism:** (n. a single living thing) (*Examples could include any plant or animal. Students might also offer fungi as examples.*)

- **producer:** (n. a living thing that makes its own food) (*Students are likely to suggest plants as examples of producers, though they may also be familiar with algae.*)
- **consumer:** (n. an organism that gets energy by eating other organisms for food) Ask students to name some familiar consumers. Remind students that consumers are not only animals that eat other animals, but also include animals that eat plants. Challenge students to think of an animal that is not a consumer. (*There are none.*)
- **scavenger:** (n. an animal that eats organisms that have already died) Students might have heard the word *scavenge* used to mean hunting for whatever useful things one might find. Point out that, where ecosystems are concerned, *scavengers* specifically refers to animals that eat other animals that are already dead. (*Vultures are common scavengers.*)
- **decomposer:** (n. an organism that breaks down dead plant and animal matter and returns nutrients to the soil) Ask students to explain what it means to rot. Point out that, while decay is associated with dead organisms, decay is actually evidence of a life process for different organisms. What we observe as decay is the breakdown of plant or animal material occurring when decomposers consume that material, take energy from it, and release waste. (*Sample answer: mold on an apple*)

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

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 Organisms and Chemical Energy Activity Pages. Scan the examples that students came up with and the answers they wrote. If the tables contain inaccurate information, go through them with students, allowing volunteers to answer the questions. Engage in a discussion to help students remember through repetition the basics of how organisms get and use energy.

LESSON 3

Living Things Use Energy

Big Question: How do organisms use energy that originally comes from the sun?

AT A GLANCE

Learning Objectives

- ✓ Create a model that shows the relationship between sunlight, producers, and consumers.
- ✓ Explain how the energy in animals' food originated as energy from the sun.

Lesson Activities

- reading, discussion, writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea PS3.D: Energy in Chemical Processes and Everyday Life

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to this lesson because students see models of photosynthesis and the metabolic processes that drive the body's breakdown of glucose into useful energy. This is important because, in the next lesson, students will make their own models to show how energy gets from the sun to humans. The model that students see of the process of photosynthesis in Student Reader Chapters 1 and 2 shows them the first step in energy's movement from the sun to them.

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 purple 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 165–166 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.

chemical
chemical reaction

glucose
metabolism

photosynthesis
sugar

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 purple above.

Instructional Resources

Student Reader



Ch. 2

Student Reader, Chapter 2
“Living Things Use Energy”

Activity Page
Photosynthesis Model (AP 3.1)

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

Activity Page



AP 3.1

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project image/video for whole-class viewing.
- index cards for student vocabulary deck (4 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Online Resources



How do organisms use energy that originally comes from the sun? Open the lesson with a video that shows the process of photosynthesis. (See the Online Resources for a link to a suggested video.) Ask what students can observe in the video.

- » What are the three things that plants need to produce food? (*sunlight, carbon dioxide, water*)
- » What type of food (chemical energy) does the plant produce for energy? (*the sugar glucose*)
- » What does the plant release back into the air after the process is finished? (*oxygen*)

Have students keep the video in mind as they go through the remainder of the lesson. They will be asked to use what they have learned in the video, as well as what they will learn from their Student Reader, to develop a model of photosynthesis.

2. Read and discuss: “Living Things Use Energy.”

20 MIN

Student Reader



Ch. 2

Read together or have students read independently “Living Things Use Energy,” Chapter 2 in the Student Reader. The selection reinforces the idea that the source of all food is sunlight, which is used by plants—also known as producers—to produce glucose. From glucose, producers and all other life gain energy.

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 Vocabulary terms so that students begin to become familiar with them. As students encounter each one, have them make a vocabulary card for each. Each card should contain a sentence using the word correctly.

metabolism **photosynthesis** **sugar** **glucose**

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 11

Ask students to explain what sugar is in their own words. Some students may say a source of energy; others may identify sugar as an ingredient used in cooking foods; still others may define sugar as something they put on or in food to make it taste better. Accept all these answers, but place the emphasis on glucose being the sugar that is the source of all chemical energy for life.

Page 12

After reading the page, provide students with the following questions to prompt further discussion:

- » Where does the energy that plants need for photosynthesis come from? (*the sun*)
- » What else do plants need for the process of photosynthesis? (*carbon dioxide, water*)
- » Where does the process of photosynthesis take place? (*in leaves of the plant*)

SUPPORT—If needed and there’s time, allow students to rewatch the video about photosynthesis.

Provide students with a list of organisms (these should be a mix of plants and animals), and ask them where each organism gets its chemical energy. For the plants, students should say glucose made using sunlight energy. For the animals, students should recognize that the chemical energy comes from other things. They should say that plant eaters get their energy from plants, or producers, while consumers get their energy from plants or other animals.

SUPPORT—If students struggle with this concept, show them examples of food chains that allow them to trace energy through a system. This will also help them with the concept of food chains, for which they will develop a model in the next lesson.

SUPPORT—If necessary, remind students about producers and consumers from the previous lesson. Explain that producers (plants) make their own food and consumers get their food from producers or other consumers. Then focus the discussion on the role that glucose plays for energy.

CHALLENGE—Challenge students to draw a model of how glucose moves through the food chain from producers to consumers. Students should show that glucose is made from plants and it gets passed along to the consumers that eat the plants. That glucose continues to be passed along to the consumers that eat consumers that eat producers.

Make sure that students understand that smaller organisms tend to have a higher metabolic rate than larger organisms. You can also explain that more active organisms tend to have a higher metabolic rate than less active organisms.

Prompt discussion by asking the following question: What does your metabolism do? (*breaks down sugars to provide energy*)

3. Teach Core Vocabulary.

5 MIN

Return to Core Vocabulary Cards

During the reading and discussion of the Student Reader chapter, students should have initially prepared Core Vocabulary cards for the terms below.

sugar

glucose

photosynthesis

metabolism

Word Work

Invite volunteers to share the sentences that they have recorded on their cards using the Core Vocabulary terms. Encourage students to make changes to their cards if they learn something new as a result of the sharing.

- **sugar:** (n. a carbohydrate that living things break down to get energy) (*Sample sentence: Sugar in food provides energy that animals need to stay alive.*)
- **glucose:** (n. a form of sugar made by plants through the process of photosynthesis) (*Sample sentence: Glucose is a type of sugar.*)
- **photosynthesis:** (n. the process used by producers to make glucose and oxygen from sunlight, water, and carbon dioxide) (*Sample sentence: Photosynthesis occurs in plants.*)
- **metabolism:** (n. the continuing chemical reactions in living things that release and use energy) (*Sample sentence: An animal's metabolism is the way it turns food into energy.*)

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

4. Encourage discussion.

10 MIN

Activity Page



AP 3.1

Distribute and review Photosynthesis Model (AP 3.1). Tell students that they will draw a model of the photosynthesis process. They will complete the Activity Page based on what they have learned so far. Encourage students to ask questions, and allow them to compare their models and discuss differences. Explain that this activity will help them prepare to build a more complex model of a food chain in Lesson 4.

SUPPORT—If students struggle with their models, allow them to consult their Student Readers or return to the video you showed at the beginning of the class.

SUPPORT—Circulate around the room, paying close attention to students as they complete their models. Answer any questions they may have, and offer guidance about the accuracy of their models. If their models are incorrect, set them on the right course by asking leading questions.

Lead a discussion about the examples that students drew on their Activity Page. Ask volunteers to share their photosynthesis models. Ask students if they think that all plants photosynthesize (*No; photosynthesis occurs in plants that contain chlorophyll, which is the vast majority but not all.*) and whether there are organisms other than plants that photosynthesize (*yes; algae and others*). Also ask students if all organisms on Earth use energy from photosynthesis. (*They do not.*) (See **Know the Science 1 and 2** for support with analysis.)

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

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

- Collect the completed Photosynthesis Model Activity Pages. Scan the models that students made. If models contain gaps in the cycle, engage in further discussion, emphasizing the parts that are missing. Check to ensure labels are present and used correctly to depict what plants use for photosynthesis.

Know the Science

1. What organisms, other than plants, photosynthesize? *Algae and some bacteria!* Algae are plantlike organisms that live in the water; they can be single-celled phytoplankton or multicellular seaweed. Algae use chlorophyll to photosynthesize, or make their own food energy from sunlight. In fact, algae account for approximately half of the planet's photosynthesis. Cyanobacteria are sometimes called blue-green bacteria (*cyan* means blue). A form of bacteria, cyanobacteria are usually single-celled, though they do often grow in colonies. As with algae, they grow in water and make their own food and energy by using sunlight through the process of photosynthesis.

2. Do all producers gain their energy from photosynthesis? *No!* In some places on Earth, there are organisms that live deep below the ocean's surface. Far beneath the ocean's waters, light from the sun cannot penetrate. Yet there are many producers that live in these places. How? Because of thermal vents. Thermal vents are areas where the ocean's floor has opened—much like volcanoes on Earth's surface—and release heat and dissolved minerals. Many organisms that live in these deep places have adapted to producing food and energy from the heat and minerals that escape from the vents. Other organisms around them eat these producers, and the energy is transferred throughout deep-ocean food chains. These organisms are known as extremophiles because of the difficulty of living in such high-pressure and high-temperature environments. The process by which organisms convert minerals from thermal vents is known as chemosynthesis. In chemosynthesis, organisms convert hydrogen sulfide and other chemicals into energy in the form of simple sugars. Water and sulfur are waste products of the process.

LESSON 4

Modeling the Flow of Energy

Big Question: How can I model the flow of energy through living things?

AT A GLANCE

Learning Objectives

- ✓ Create a model that shows the relationship between sunlight, producers, and consumers.
- ✓ Explain how the energy in animals' food originated as energy from the sun.

Lesson Activities

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

NGSS References

Disciplinary Core Idea PS3.D: Energy in Chemical Processes and Everyday Life

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

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 lesson, students will develop a model of the food chain that shows where the energy that all organisms use for life, growth, and repair originates (the sun), as well as the path it follows to get from the sun to students.

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

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consumer	energy transformation	metabolism	producer
energy transfer	glucose	photosynthesis	

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 purple above.

Instructional Resources

Activity Pages



AP 4.1
AP 4.2

Activity Pages
Model Checklist (AP 4.1)

Energy’s Path Through Living
Things (AP 4.2)

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

Materials and Equipment

Collect or prepare the following items:

- | | |
|---|--|
| <ul style="list-style-type: none">• 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 | <ul style="list-style-type: none">• yarn• stapler• hole punch/three-hole punch• craft clay• old magazines with pictures of animals and plants• computer/internet access• index cards for student vocabulary deck (2 per student) |
|---|--|

Advance Preparation

Prepare for this lesson in advance by making sample models to show students for inspiration. Show students an example of each of the following:

- four-sided box
- flip-book
- diorama

Be sure that you do not show an actual food chain in your model. Inform students that they can use one of the models for their food chains but that they must come up with the food chains themselves. If you do not have computers or internet access with printers in the classroom, make sure to provide old magazines so that students have images of plants and animals they can use in their models if they so choose. Otherwise, they can use the clay or other supplies to make plants and animals, or they can draw them (such as for the flip-book).

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How can I model the flow of energy through living things? Explain to students that they will make a food chain model that shows how energy moves through living things to get to the students.

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

SUPPORT—Show students your sample models so that 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 how energy moves through living things as part of the food chain.

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 models to make sure they include all the important parts.

Reassure students that there will be enough time to build these models.

Activity Page



AP 4.1

Preview Core Vocabulary

Before students get started, write the following terms on the board or chart paper. As students work through the activity, call out these Core Vocabulary terms so that students become more familiar with them through repetition.

energy transfer energy transformation

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 make a diorama. Answer their questions, and assure them that you will go around the room to answer more questions as they get started. Also tell students that they do not have to use all the materials provided, only those necessary for their particular model. To see which materials go best with which models, encourage students to look at the samples closely. Explain that students are not limited to these materials and may add materials as they see fit if they have access to those materials.

Activity Page



AP 4.2

Distribute and review Energy's Path Through Living Things (AP 4.2). Explain to students that they will need to fill out the Activity Page before they complete their models.

SUPPORT—It may be helpful for students if they show you their model plans before building them. Once you have offered feedback and signed off on the plans, allow students to proceed.

SUPPORT—You may direct vegan or vegetarian students to complete a food web and have them insert themselves into the food web in the appropriate place. Alternately, you could have them create a food web with them at the end but have them identify the steps their food choices eliminate in the food web.

3. Facilitate the investigation.

25 MIN

Tell students that they can pick the various organisms for their food chain model as long as the last organism in the model is the student. Of course, the models must represent a realistic food chain. Therefore, it must begin with a producer, after which the other organisms must be consumers.

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 the path energy takes through living things (food chains) online.

Circulate around the room, providing support when necessary. Ask questions to prompt students, such as the following (see **Know the Science** for support):

- » Which kind of organism begins the food chain? (*producer/plant/microbe*)
- » Do all food chains follow the same pattern? (*basically, yes*)

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):

energy transfer **energy transformation**

Word Work

- **energy transfer:** (n. the movement of energy from one place to another) Point out that *transfer* means to move from one place to another. Ask students what they think an *energy transfer* would be. Have students label at least one place on their models where energy was transferred. Then have each student use the words in a sentence on their Core Vocabulary cards.
- **energy transformation:** (n. the change of energy from one form to another) Point out that *transformation* means to change form. Ask students to locate a place where the energy in their model changed form. Note to students that energy moving from place to place is not the same as energy changing form. The most obvious example of energy transforming will be sunlight changing to chemical energy as glucose, but students may also note that organisms change chemical energy to other forms to maintain their life processes.

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

Know the Science

Do all food chains follow the same pattern? *Basically, yes!* All food chains begin with a producer, whether that producer is a plant taking in the sun's energy for photosynthesis or a microbe taking in minerals from thermal vents for chemosynthesis. The producers turn the sun's energy or chemicals from the thermal vents into glucose, which acts as a food/energy source for themselves and the larger organisms—consumers—that come along and eat the producers. Organisms that eat producers are often known as primary consumers. The organisms that then come along and eat the primary consumers are known as secondary consumers. Humans are omnivores, which means that they eat pretty much everything: plants (herbivory), meat (carnivory), fish (piscivory), and sometimes insects (insectivory). The sun's energy powers the producers (the plants), and then the glucose flows into the primary consumers and then into the secondary consumers.

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

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

- Have volunteers share their physical models with the class, explaining each organism in the model and how energy from the sun moves through it to the next organism. Allow students to ask and answer questions about each presentation.
- Collect the completed Energy's Path Through Living Things Activity Pages as well as the completed physical models. Have students write their names on their physical models before they turn them in. Scan the models that students made. If models contain gaps in the food chain, engage in further discussion, emphasizing the stages that are missing. Additionally, check to make sure that students followed the guidelines for the type of model they made.

PART B

Plants and Animals

OVERVIEW

Lesson	Big Question	Advance Preparation
5. Growing Plants Without Soil	Can I grow a plant without soil?	Gather materials for student investigations. (See Materials and Equipment page 12.)
6. What Plants Need	Where do plants get the materials they need for growth?	Read Student Reader, Chapter 3.
7. Modeling Photosynthesis	How can I model photosynthesis?	Gather materials for student investigations. (See Materials and Equipment page 12.)
8. Energy Relationships Among Plants and Animals	Where do different organisms get their energy?	Read Student Reader, Chapter 4.
9. Explaining Energy Relationships Among Plants and Animals (3 days)	Where do different organisms get their energy?	Gather materials for student investigations. (See Materials and Equipment pages 12–13.)

Part B: What's the Story?

Energy travels as sunlight from the sun, strikes photosynthetic organisms, and moves through almost all living matter. Plants take energy from sunlight and use it to process the materials needed to make their own food. Some of this food is stored as sugar or starch in some of the plants' parts. Plants are producers. Other organisms then eat the plants to get the food to provide them with their own energy, which they need to move, find more food, grow, and reproduce. These organisms are primary consumers. Other consumers, secondary consumers, then eat some of the primary consumers or other secondary consumers. In this way, food in the form of chemical energy travels from the sun to plants, then from plants to primary consumers, and from primary consumers to secondary consumers.

In Lesson 5, students learn that plants can grow without soil because the things they need to live come from water and air rather than the soil itself. They learn this by checking on their plant cuttings, which they placed in water in Lesson 1 of this unit. By measuring the length and weight of their plant cuttings, students will see that the cuttings have grown despite being placed in water rather than in soil. From this, students see evidence that water and air contain the things (nutrients and carbon dioxide) that plants use to make food.

In Lesson 6, students read about what plants need to survive, reinforcing their learning from the previous lesson. The idea that plants need three things to grow and thrive—sunlight, water, and air—is reinforced with evidence and examples, including the experiments of Jan van Helmont. Students also conduct research about a plant in their area and then model how it meets its needs.

In Lesson 7, students reinforce what they learned about photosynthesis in previous lessons by making a model that demonstrates how photosynthesis works. They reveal their learning by using the words *sunlight*, *carbon dioxide*, *water*, *glucose*, and *oxygen* correctly, showing how each of these contributes to or is the product of photosynthesis.

In Lesson 8, students trace the path that energy travels to get from the sun to them: through sunlight into plants (which are producers), where it is used to produce sugar, then into the organisms that eat the plants (primary consumers), and finally into the organisms (secondary consumers) that eat the primary consumers or other secondary consumers. Students come to an understanding that they can be both primary consumers (by eating fruits and vegetables) and secondary consumers (by eating meat).

In Lesson 9, which is a continuation of what they learned in Lesson 8, students research an environment and then give a presentation showing the relationship between the plants and animals living in that environment. They primarily show how energy flows through that environment.

So, to repeat, **energy flows through plants and animals in ecosystems**, first as sunlight and later as food in a food web. Help your students grasp these concepts, and you will lay the groundwork for meeting the NGSS expectations addressed in later parts of this unit.

LESSON 5

Growing Plants Without Soil

Big Question: Can I grow a plant without soil?

AT A GLANCE

Learning Objective

- ✓ Use evidence to support an argument that plants get the materials they need for growth from air and water.

Lesson Activities

- student investigation
- discussion and writing

NGSS References

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Engaging in Argument from Evidence

Engaging in Argument from Evidence is important to the topic of living things because scientists use evidence to describe the phenomena of how living things grow and what they need to survive. In this lesson, students collect evidence by taking measurements of the plants growing in water and use this evidence to make an argument that plants mainly get the materials they need for growth from air and water (not soil). This lesson serves as an extension of the investigation that students performed in Lesson 1, and they will continue to monitor the plant growth 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 in this lesson.

energy

food

living

Instructional Resources

Activity Page



AP 1.2

Activity Page

Plant Data Sheet (AP 1.2)

Materials and Equipment

Collect or prepare the following items:

- plants in containers of water (that students started in Lesson 1)
- scales
- rulers
- water
- water pitchers
- Activity Page 1.2 (from Lesson 1)

Advance Preparation

Prepare in advance for this class by making the plants in containers of water available to students so they can easily find their containers and get started on their investigations.

Make sure you have the Activity Page 1.2 data sheets available for students. They will need to refer to the original measurements that they took on Day 1 of this unit and compare the current size and weight of the plants now to show whether growth has occurred.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Can I grow a plant without soil? Remind students that in Lesson 1, they planted cuttings of plants in containers of water. These containers did not contain soil. Rather, the investigation focuses on whether or not plants can grow with just air and water. Tell students that in today's class, they will monitor the growth of their plants to look for evidence that tells whether or not plants can grow without soil.

Ask students whether they think their plants have grown since they put the cuttings in water in Lesson 1. Accept all answers, and encourage students to explain why they think the plants will have or will not have grown during this time. Ask: Do you think it is possible for plants to grow without soil? (yes)

2. Preview the investigation.

5 MIN

Activity Page



AP 1.2

Distribute Plant Data Sheet (AP 1.2) back to students. Each student should receive their own copy of Activity Page 1.2. Review the Activity Page with students. Remind students that on Day 1 of Lesson 1, they completed part of this Activity Page. Review together what students did on Day 1:

- Students took original measurements of the plant cuttings.
- Students took the original weight of the container with water.
- Students put this information into the data table.

Tell students that today they will look for evidence that plants can grow with just air and water. Students will investigate this concept by doing the following:

- measuring their plant cuttings
- filling the container with water up to the line
- weighing the container with water
- recording data in the table
- comparing the original data to today's data
- writing explanations for their findings

3. Facilitate the investigation.

25 MIN

Have students form the same pairs. Give them time to find their plant containers and bring the containers back to their desks or stations. In addition to their containers, provide each group with the following materials:

- 1 ruler
- 1 scale
- 1 pitcher filled with water

As students work on their Activity Pages, circulate around the room to ensure that students are using the rulers and scales properly to make accurate measurements.

SUPPORT—If necessary, remind students that they need to take the plant cuttings out of the water to measure them with the ruler.

As students measure the weight of the container and water with the plant cuttings inside, remind them that in Lesson 1, they drew lines on the container to mark the height of the water. Now, they need to see if the water level went down. If it did, they need to use the pitcher and water to fill the container with water back up to the water line. (See **Know the Science** for support.)

- Make sure students are being as precise as possible with the water line and water levels. Provide guidance to students who may be pouring too much or not enough water into the containers, as these actions could skew the observations of plant growth and the data connected to them.
- If necessary, remind students that the plant cuttings need to be in the water when they measure the containers. This means they will need to put the cuttings back into the water after they have taken their measurement with the ruler.

SUPPORT—Give students examples of other observations that they can write in the final row of the data table, such as whether they can visually see signs of plant growth or other changes.

Circulate around 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 better tell whether the plant has grown since the cuttings were first placed in the containers of water. If students incorrectly fill out the data table, they may not be able to answer the follow-up questions properly, and their interpretation of whether plants can grow with just air and water may be skewed or incorrect.

Give students time to complete the investigation and record observations on their Activity Page.

Know the Science

Why are students filling up the containers to the water line? *Water evaporates!* Between the time that students originally filled their containers with water and today's class session, water in the container may have evaporated as a normal part of the water cycle. This means that the water level in the containers today will be less than the amount of water that was in the containers when students started this investigation on Day 1. It is important for students to make sure that the amount of water in the container is the same as Day 1. This is to keep the variables consistent so that students can accurately weigh the container of water. When they weigh the container with the same amount of water today, they can expect to see that the weight of the container, water, and plant increased since Day 1. The reason for this is not due to the container or the water but rather because the plant is growing.

4. Summarize and discuss.

5 MIN

Once students have had time to conduct their investigations and complete their Activity Page, bring the class back together, and hold 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. Ask if the plant grew bigger. (yes)

- » How do you know the plant grew? (*We used a ruler to see whether the cutting is longer. We compared current measurements to the original measurements. The scale says that the container with water and plant cuttings weighs more than it did on Day 1.*)
- » Why do you think the plant grew? (*It had the things it needed for growth.*)
- » What does the plant need for growth? (*air and water*)

Elicit from students that plants acquire their material for growth chiefly from air and water and that soil does not provide most of the material for plant growth.

SUPPORT—If necessary, address the following misconception: Plants do not always need soil to grow. Most students will be familiar with the types of plants that grow in soil, such as houseplants or plants they see outside. However, the purpose of this investigation is to see that growth is possible without soil.

Ask whether students have any questions about how plants are able to grow without soil. Address any additional misunderstandings.

Have students explain what they have observed using the terms *food* and *energy*. Tell students that they will have one more class in which they will look at their plant cuttings in water to confirm their conclusions and arguments.

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 1.2) for correct answers and sample student responses.

- Collect the completed Plant Data Sheet (AP 1.2) pages. Scan the data tables that students completed. Students should record that measurements increased slightly from the original measurements.
- Check students' answers to the follow-up questions. Students should write explanations that use data from the table as evidence to support their arguments about plant growth.

LESSON 6

What Plants Need

Big Question: Where do plants get the materials they need for growth?

AT A GLANCE

Learning Objective

- ✓ Explain that experiments have shown that the increase in matter during plant growth does not come from the soil.

Lesson Activities

- reading, discussion, and writing

NGSS References

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Engaging in Argument from Evidence

Energy and Matter and **Engaging in Argument from Evidence** are both important to this lesson because students trace how plants use energy from the sun to make matter in the form of glucose from air and water, which they use to meet their needs. Students back up their claims with evidence from research.

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 purple 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 165–166 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.

air

glucose

sunlight

water

carbon dioxide

hydroponics

transpiration

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 purple on the previous page.

Instructional Resources

Student Reader



Ch. 3

Activity Page



AP 6.1

Student Reader, Chapter 3 “What Plants Need”

Activity Page A Needy Plant in the Neighborhood (AP 6.1)

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
- computer/internet access
- (optional) plastic sandwich baggies (1 per student)
- index cards for student vocabulary deck (2 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Where do plants get the materials they need for growth? Remind students that in Lesson 3, they learned how plants use energy from the sun to help them make food. Ask the following:

- What else do plants use? (*carbon dioxide, water*)

Have students recall their hands-on activity for Lesson 1, in which they made plant cuttings and placed them in water. Ask them what they think will happen to the plant cuttings. Will they get bigger or shorter? Why do the students think this? Tell them that as this unit progresses, they will revisit their plant cuttings and measure them to see if and how they change over time.

2. Read and discuss: “What Plants Need.”

25 MIN

Student Reader



Ch. 3

Read together or have students read independently “What Plants Need,” Chapter 3 in the Student Reader. The selection reinforces the idea that all plants, regardless of type, need some very basic things to survive, grow, and produce food. These are sunlight, water, and air.

Preview Core Vocabulary Terms

Have students write each Core Vocabulary term on an index card. As they read and learn more throughout the unit, students can add their definition.

transpiration

hydroponics

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 15

Ask students how what they read on this page is similar to the hands-on activity they began in the previous lesson. (*In the activity, they measured the length and weight of their plant cuttings and then measured the weight of the cups containing water into which they put the cuttings. This is similar to what Jan van Helmont did.*) Ask the following:

- Do you think your experiment with the plant cuttings will have similar results to Jan van Helmont's experiment? (*Encourage students to make a yes or no guess and explain their thinking.*)

Understand that students likely will not know the answer to this question. Tell them that there are no right or wrong answers and that they are being asked to make a prediction at this point. As the experiment progresses, they will learn for themselves whether their prediction came true.

Page 16

Before reading the page, ask students about where plants don't grow, stressing that few plants grow in areas with no light. Ask the following:

- » Have you ever seen a large rock and looked under it? What kind of plants did you see under the rock? (*Most students will say that they did not see any plants or that they saw mold or something similar. Some may say that there was flattened grass or that the grass was turning brown or yellow.*)
- » What did you see under the rock? (*Most students will answer dirt. A few may say that they saw grass.*)

After reading, revisit these questions, but add a new question. Ask the following:

- Why were there no or very few plants under the rock? (*Because they were not receiving sunlight, they could not grow and died.*)

SUPPORT—Some students may have never seen the underside of a large object lying on the earth to be able to answer the question. You may want to look up additional images in books or on the internet and have them ready for students to view.

Page 17

After students have read the text on the page, ask them if they have ever seen a plant growing sideways or at an angle. If so, have volunteers describe what the plant looks like and where they saw it. If they can name the plant, have them do so. Ask them why they think this happens. (*The plant is growing toward the sunlight.*)

Page 18

On a piece of scrap paper, have students draw a diagram based on what they have learned from page 17. The diagram should show that a plant takes in water. Give students a couple of minutes to complete their drawing. Tell them that it does not need to be elaborate. The diagrams will not be graded, and students will not be judged on their artistic ability. Have them draw arrows on their diagram to show the direction in which the water moves.

SUPPORT—Circulate throughout the room, giving students pointers or answering questions as they complete their diagrams. The diagrams should show a plant with its roots reaching into the earth. Water should be moving into the roots, up into the plant, from the soil.

If there is time, have students carry out the experiment described on the page. Distribute one small plastic baggie to each student. Take students to a safe area outside on the school grounds, and have them place their baggies over a plant. Note, however, that they will need to give the plant time to transpire. Near the end of the day, take students back outside to see if water has formed on the inside of their baggies. Remove the baggies, and dispose of them properly.

Page 19

If there is time, collect leaves from trees around the school. Have students examine the undersides of each one to see if they can spot the tiny holes in them. Then, have students take turns using a microscope to see the holes. Ask the following:

- » What are these holes for? (*to allow air to get in and out*)
- » What do plants need from the air? (*carbon dioxide*)
- » What do plants release through the holes? (*oxygen and water*)

Page 20

After students have read the text on the page, have them revisit their predictions about what will happen to their plant cuttings. Have them amend their predictions based on what they have learned in their Student Reader. Note that some students may not need to amend their predictions, as their predictions were likely correct to begin with.

Pages 21–22

After students have read the text on each page, ask the following:

- » How do plants start every food chain? (*They produce the glucose, the food that begins the chain.*)
- » How do plants help animals breathe? (*They release oxygen, which animals breathe in.*)
- » How do plants help prevent erosion? (*Their network of roots can help hold soil or sand together.*)

3. Encourage discussion.

5 MIN

Activity Page



AP 6.1

Distribute and review A Needy Plant in the Neighborhood (AP 6.2). 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 as long as it has not been used so far in the lesson. If there are a limited number of plant types in your neighborhood, you may wish to have students work in small groups to complete the activity. Be sure that there are research materials on hand, including books, magazines, and/or internet access.

SUPPORT—If students struggle with identifying the type of plants that live in your neighborhood, provide them with a list. The list should be accompanied by images so that students can see what it is they’re choosing to research. To avoid students choosing the same plant, you may wish to institute a lottery in which students who choose the shortest or longest toothpick (or something similar) get to choose their plant first, until all students or groups have chosen.

Lead a discussion about the examples that students recorded on their Activity Page. Have individual students or groups give a brief presentation about their plants. Ask students if there are similarities in what their plants need. (See **Know the Science** for support with the analysis.)

- Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection.
 - » What did all the plants need to survive and grow? (*sunlight, water, air*)
 - » What did all plants produce, and where do they belong in the food chain? (*glucose/food; They belong at the beginning of the food chain.*)

4. Teach Core Vocabulary.

5 MIN

Word Work

Return students’ attention to the Core Vocabulary cards they have started for **transpiration** and **hydroponics**.

- **transpiration:** (n. the release of water vapor through tiny openings in plants’ leaves) Have students write the definition of *transpiration* in their own words, and encourage them to draw a simple diagram on their card.
- **hydroponics:** (n. the practice of growing plants without soil) Ask students to consider the term *hydroelectric*. Prompt them to recall that hydroelectric power comes from the generation of electricity by moving water. Ask what they can conclude about the word part *hydro* from the words *hydroponic* and *hydroelectric*. (*It has to do with water.*) Have students write a definition of *hydroponic* and underline the *hydro* part.

Know the Science

What do all plants need to survive and reproduce? Sunlight, water, and air! All plants need sunlight, water, and air to survive. The sunlight provides the energy the plants need to transform water and the carbon dioxide in air into glucose for food. This is photosynthesis. The plants then use some of this glucose to meet their energy needs, and some of it they store for later use. Water contains nutrients the plant may need. There are algae and some plants, such as seaweed, that grow near the ocean’s surface, and these do have the same needs as land-based plants: sunlight, water, and air.

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 completed student pages for A Needy Plant in the Neighborhood (AP 6.1). Scan the drawings that students made and the answers they wrote. If some of the answers are incorrect, engage in further discussion, correcting any misunderstandings students may have. Allow students to ask questions. If other students know the answers to these questions, allow student volunteers to provide those answers.

LESSON 7

Modeling Photosynthesis

Big Question: How can I model photosynthesis?

AT A GLANCE

Learning Objective

- ✓ Develop a model to show the basic idea of photosynthesis, that air, water, and sunlight are involved in the production of food (a sugar called glucose) by plants.

Lesson Activities

- student activity
- discussion and writing

NGSS References

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Engaging in Argument from Evidence

Energy and Matter are important to the topic of living things because all living things need energy to live. Photosynthesis is a process that uses sunlight to produce matter that then travels through the food chain, obtained by other organisms along the way. In this lesson, students will make models of photosynthesis to show how energy and matter are involved in this process.

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 in this lesson.

air

energy

photosynthesis

transfer

carbon dioxide

glucose

sunlight

Instructional Resources

Activity Page



AP 7.1

Activity Page

A Rough Draft of Your Model
(AP 7.1)

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

Materials and Equipment

Collect or prepare the following items:

- poster board
- foam/closed-cell extruded polystyrene foam board
- paint (assorted colors)
- paintbrushes
- construction paper (assorted colors)
- felt (assorted colors)
- chenille craft wires (assorted colors)
- markers (assorted colors)
- cardboard paper towel rolls
- scissors
- glue
- toothpicks
- clear tape
- real plant or tree leaves

Prepare for this class in advance by having enough materials available to students in case they all decide to model photosynthesis using the same materials. If you include green plant or tree leaves, collect an assortment from a plant or tree outside prior to class.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

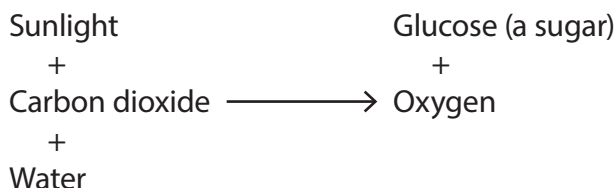
5 MIN

How can I model photosynthesis? Remind students that they learned more about photosynthesis in the previous lesson, as well as in Lesson 3, through reading and discussion. Tell students that today they will pick a creative way to model the basic idea of photosynthesis based on what they have already learned.

SUPPORT—If necessary, review with students the definition of *photosynthesis*, or have them retrieve and review their Core Vocabulary cards for the definitions they wrote.

Ask students to name the key elements involved in photosynthesis. (*sunlight, carbon dioxide, oxygen, water, glucose*)

SUPPORT—If necessary, write out a simple formula for photosynthesis on the front board that students can refer to as they work on their models, such as the following:



2. Preview the investigation.

5 MIN

Activity Page



AP 7.1

Distribute and review A Rough Draft of Your Model (AP 7.1). Tell students that they will make a model using arts and crafts materials to show the basic idea of how photosynthesis works. (See **Know the Science.**) Students will need to do the following:

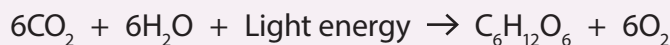
- make a model of photosynthesis
- use correct terms in the model
- use arrows that show how the process works

Show students the materials that are available to them to use. Tell them that they can pick how they want to model photosynthesis using the available materials. Let students know that if they need another material that is available in the classroom, such as paper clips or rubber bands, they must ask permission to use them first.

SUPPORT—If necessary, give students suggestions for the types of models they can make, such as dioramas, poster board displays, and flip-books.

Know the Science

What is the basic idea of photosynthesis? *Plants use sunlight, water, and carbon dioxide to make glucose and release oxygen!* Photosynthesis is the process by which plants use sunlight, carbon dioxide (from the air), and water to make energy in the form of a sugar (glucose). The process releases oxygen. Keep the concept simple. Students only need to exhibit a basic understanding of this process. Their models should include how the plant receives sunlight, carbon dioxide, and water and how the plant converts those ingredients into glucose and oxygen. Students are not expected to model cellular respiration and gas exchange. They are also not expected to model the formula for photosynthesis:



Students are not expected to show in their models how plants store glucose for later use or how the energy transfers from one organism to another.

Explain to students that there are certain criteria that their models must meet. Models must include the following:

- words or labels
- arrows to show parts of the process

Draw students' attention to the drawing box at the bottom of the Activity Page. Let students know that they can use it to sketch out their models before they make them. Remind students that models must be completed during class time, so they should not spend too long drawing out their models in detail. Reassure students that scores are based on proper knowledge of concepts, not artistic ability.

3. Facilitate the investigation.

25 MIN

Give students time to think about the type of model they want to make and gather their materials.

SUPPORT—Modeling is a skill that does not come easily to all students. Some students may have difficulty seeing the process visually. If necessary, help students think of ways to model photosynthesis. They can use poster board to make engaging displays of the process. They can use foam board as a foundation to make three-dimensional diagrams. If students are unsure how to use the materials available to them, provide some ideas. For example, toothpicks can easily stick into foam board, whereas students may want to use glue and tape for adhering felt or construction paper to poster board. Students can use an assortment of materials, such as green felt for the leaves and yellow construction paper for the sun.

Remind students that their models must include the necessary words, as well as arrows that show the process of photosynthesis. Students can choose how to model these words and arrows. For example, they can draw them onto poster board, or they can make three-dimensional arrows with words on them.

SUPPORT—If students are unclear about how to show the process of photosynthesis, refer them to the formula on the front board. Ask what the formula means. (*Sunlight plus carbon dioxide plus water is used in photosynthesis to make glucose and oxygen.*)

Circulate around the room to ensure that students have an accurate understanding of the process of photosynthesis. Provide support if necessary by using question prompts when students have misunderstandings, such as "What does the plant get from air?" (*carbon dioxide*) and "What does the plant get from soil?" (*water*)

Give students a five-minute warning toward the end of the activity so they can finish up their models.

4. Summarize and present.

5 MIN

Once students have had time to make their models and complete their Activity Page, bring the whole class back together, and invite students to share their models. Tell students to walk the class through their models by explaining each step in the process. Use the following questions as prompts:

- » How did you represent the production of glucose and oxygen in your model?
(*Sample answer: I used arrows to show small circles coming out of the leaves to represent oxygen. I labeled sugar in the leaves.*)
- » How did you represent where the plant gets light? (*Sample answer: I used yellow construction paper to make the sun and yellow craft wire to show the rays from the sun shining down onto the plant's leaves.*)

Elicit from students that the green parts of plants are responsible for photosynthesis, and that photosynthesis involves the conversion of sunlight, carbon dioxide, and water into glucose and oxygen.

5. 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 student pages for A Rough Draft of Your Model (AP 7.1). Check for completeness.
- Review students' models, checking for accuracy of the basic process of photosynthesis. Students should be able to show understanding that the green part of the plant uses light (from the sun), carbon dioxide (from the air), and water (from the soil) to make glucose (a sugar) and oxygen. Make sure students depict the process properly and effectively, use correct terminology, and use arrows to show how the parts of the process connect. Do not score based on artistic ability.

LESSON 8

Energy Relationships Among Plants and Animals

Big Question: Where do different organisms get their energy?

AT A GLANCE

Learning Objective

- ✓ Make a presentation that explains the energy relationship between the sun, plants, herbivores, omnivores, and carnivores.

Lesson Activities

- reading, discussion, writing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Engaging in Argument from Evidence

Energy and Matter are important to this lesson because students trace how energy flows from the sun into producers, from producers into herbivorous consumers, and from herbivorous consumers into carnivorous or omnivorous consumers. Students come to an understanding that all life is dependent on other organisms to meet their energy needs to survive, grow, and reproduce.

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 purple 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 165–166 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.

carnivore
decomposer

herbivore
omnivore

scavenger

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 purple above.

Instructional Resources

Student Reader



Ch. 4

Activity Page



AP 8.1

Student Reader, Chapter 4
“Energy Relationships Among Organisms”

Activity Page
Energy from the Sun to You
(AP 8.1)

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 (3 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Where do different organisms get their energy? As a refresher, have students explain what the words *producer* and *consumer* mean. Remind them that producers are organisms that make food and consumers are organisms that eat food. Students first learned about this process in Lesson 2. Use the following prompts to encourage further discussion:

- » Name one producer. (*Students should name any kind of plant.*)
- » Name one consumer that eats plants. (*Students should name any kind of animal that eats plants, or producers.*)

- » Name one consumer that eats another consumer. (*Students should name any kind of animal that eats other animals, or consumers.*)
- » What is the purpose of consuming, or eating, food? (*to get energy*)

Explain to students that in this lesson, they are going to learn more about producers and consumers. In fact, they are going to learn about specific types of consumers.

2. Read and discuss: “Energy Relationships Among Organisms.” 20 MIN

Student Reader



Ch. 4

Read together or have students read independently “Energy Relationships Among Organisms,” Chapter 4 in the Student Reader. The selection reinforces the idea that energy passes through all plants and animals, beginning with a common source (a plant, or producer).

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.

carnivore herbivore omnivore

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 23

Have students examine the gopher tortoise in the image and explain how energy can pass between the cactus and the tortoise. Help students understand that gopher tortoises eat cacti and other plants to gain energy. This energy can help the tortoise dig a deeper burrow, which is where it lives.

Pages 24–25

In their Student Readers, allow students to draw arrows showing the relationships between the various producers and consumers shown in the image. If students are not allowed to draw in their books, then make one photocopy of the image for each student. The arrows should show the direction in which the energy is moving. For example, they should draw an arrow from the algae or seaweed to the small fish (minnows). Have students draw as many arrows showing the energy relationships between the plants and animals in the image as possible during a specific allotted time, such as two or three minutes.

SUPPORT—Circulate throughout the classroom, offering tips for students who are struggling and answering any questions that they may have. You may choose to draw one energy relationship for students so that they have an example to work from.

Pages 26–27

Write the terms *herbivores* (*minnows, mussels*), *carnivores* (*some fish, crabs, water birds, raccoons*), and *omnivores* (*some fish, people*) on the board or chart paper. Have students identify examples of each in the image. Then add the word *scavengers* to the list. Explain that a scavenger is an animal that will eat dead things that it finds. It scavenges for food. Have students identify an example (*crab*) in the image. Ask students to identify the decomposers in the river. (*bacteria*)

SUPPORT—If students struggle to categorize the various animals, write their food sources on the board or chart paper in a column opposite the animals. Then have volunteers suggest the energy relationships between the various organisms. Draw a line between these on the board or chart paper so that students can see the relationships more clearly.

Page 28

After students have examined the image and read the accompanying text, ask them where they think the water that plants use comes from. (*the soil/sand*) Ask them to draw lines from the sun to every organism that is a producer. Give them approximately two minutes to do this. Explain that they do not have to draw lines from the sun to every single producer, only to one example of each kind of producer. This is a good opportunity to introduce students to specific vocabulary words. Explain that there are different types of consumers. (See **Know the Science** for help with this analysis.) These include the following:

- herbivores = animals that eat plants
- carnivores = animals that eat meat
- omnivores = animals that eat both plants and meat

Prompt further discussion by asking the following:

- Which consumers in the image are herbivores, or eat producers? (*jackrabbits and lizards*)
- Which consumers in the image are carnivores, or eat other consumers? (*snakes and foxes*)

Know the Science

What's the difference between herbivores, carnivores, and omnivores? *What they eat!*

All types of consumers fall into one of these categories. Primary consumers are consumers that eat producers; these are known as herbivores, or plant eaters. Secondary consumers are consumers that eat primary consumers or other secondary consumers. These are carnivores. Some carnivores also eat plants, which makes them omnivores. Carnivores can also be broken down into smaller groups. For example, insectivores (or consumers that eat insects) and piscivores (or consumers that eat fish) are both carnivores. Scavengers are consumers that eat things that are already dead. These, too, are types of carnivores, because the dead things they eat are animals, not plants.

3. Encourage discussion.

10 MIN

Activity Page



AP 8.1

Distribute and review Energy from the Sun to You (AP 8.1). Explain to students that they will complete the Activity Page based on what they have learned in the lesson. They will draw the path energy takes from the sun to the student. Go over the directions with students, and answer any questions they have. If students need assistance, allow them to consult any research materials that you have provided. Explain that this activity will help them prepare to build a more complex model of the path energy moves in an environment in Lesson 9.

SUPPORT—You may direct vegan or vegetarian students to complete a food web and have them insert themselves into the food web in the appropriate place. Alternately, you could have them create a food web with them at the end but have them identify the steps their food choices eliminate in the food web.

SUPPORT—Allow students to consult their Core Vocabulary cards if it will prompt them to correctly diagram and label their paths.

Lead a discussion about the examples that students recorded on their Activity Page. Ask volunteers to share their energy path models. Draw attention to similar examples that different students have identified.

Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection.

- » How does energy flow in a coral reef system?
- » How does energy flow in a desert?
- » How does energy flow in a river?

SUPPORT—Allow struggling students to consult their Student Readers if they cannot come up with an energy path for each system.

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).

carnivore **herbivore** **omnivore**

Word Work

- **carnivore:** (n. an animal that eats other animals to meet its energy needs) Have students write the definition as you dictate it: “an organism that eats meat.” Then have students draw an example of a carnivore on their card.

- **herbivore:** (n. an animal that eats plants to meet its energy needs) Have students write the definition as you dictate it: “an organism that eats plants.” Then have students draw an example of an herbivore on their card.
- **omnivore:** (n. an animal that eats both plants and other animals to meet its energy needs) Have students write the definition as you dictate it: “an organism that eats both plants and meat.” Then have students draw an example of an omnivore on their card.

5. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

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

- Collect the completed student work on Energy from the Sun to You (AP 8.1). Scan the models that students made. Be sure that the models show correct paths that energy takes to get from the sun to students, and check that the labels are all correct. If students have mislabeled anything or missed a step in the path, go back over the models with them. Allow them to ask questions, and have other student volunteers answer the questions.
- Correct any misconceptions that students may have about the process of energy flow between organisms. For example, students may believe that no plants are carnivorous. Explain that there are a few exceptions, including the Venus flytrap, which catches bugs in its “jaws” and consumes them for energy.

LESSON 9

Explaining Energy Relationships Among Plants and Animals

Big Question: Where do different organisms get their energy?

AT A GLANCE

Learning Objective

- ✓ Make a presentation that explains the energy relationships among the sun, plants, herbivores, omnivores, and carnivores.

Lesson Activities (3 days)

- student research
- small-group discussions
- group presentations

NGSS References

Disciplinary Core Idea LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concept: Energy and Matter

Science and Engineering Practices: Engaging in Argument from Evidence

Energy and Matter are important to the topic of living things because all living things need energy and matter to live. Energy flows through organisms in an environment, starting with the energy that plants get from the sun. Day 1 of this lesson is also an opportune time for students to do a final observation of their plant cuttings in water to conclude that plants get most of the things they need to grow from air and water.

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 in this lesson.

carnivore
consumer

energy
environment

herbivore
omnivore

scavenger

Instructional Resources

Activity Pages



AP 9.1

AP 1.2

Activity Pages

Research Guide (AP 9.1)

Plant Data Sheet (AP 1.2)

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

Materials and Equipment

Collect or prepare the following items:

Day 1

- library or computer (internet) access
- printer or copy machine
- library books
- Activity Page 1.2 (from Lesson 1)

Day 3

- timer
- Core Vocabulary Cards (each student) for the following words: *photosynthesis*, *herbivore*, *omnivore*, *carnivore*, *producer*, *consumer*, *scavenger*

Advance Preparation

Prepare in advance for this class by scheduling time at the school library or computer lab, as students will need to conduct research on their assigned organism. If you have enough computers for each student in your classroom, the research for Day 1 can be conducted in the classroom.

On Day 1, you will assign each student an organism to research. Students will conduct research on their organisms independently. Each organism belongs to a specific environment.

On Day 2, students will identify their environment and form small groups around assigned organisms that belong in the same environment. These small groups will work together to prepare a presentation showing how energy flows through the organisms in the environment.

On Day 3, student groups will present their energy flows, and the class will discuss each. Each student will need to access his or her Core Vocabulary cards to keep track of the terms that each group uses during its presentation.

During the presentation, students will need to show the class pictures of their organisms. Therefore, students will need access to a printer to print pictures of their organisms from the internet, or they can use a copy machine to photocopy a picture of their organisms from library books. Alternatively, students can also check out library books, bring them to class, and show students pictures of their organisms from the library book during the presentation.

The table on the next page shows the individual organisms and the environments in which they belong. Use this table to assign organisms to students, as well as to make sure students form the correct groups when they are told to do so. This table can also be used to ensure students form the correct chains to show the order in which energy travels through the environment.

Type of Organism	Desert (hot)	Coral Reef	Tropical Rainforest	Lake	African Grassland
Producer	Saguaro cactus	Blue-green algae	Brazilian nut tree	Green algae	Elephant grass
Herbivore (Primary consumer)	Wood rat	Sea urchin	Toucan	Zebra mussel	Zebra
Carnivore (Secondary consumer)	Diamondback rattlesnake	Spider crab	Caiman	Lake whitefish	Hyena
Apex predator (Tertiary consumer)	Red-tailed hawk	Black-tipped reef shark	Jaguar	Sea lamprey	Lion
Scavenger	Coyote	Bristle worm	Velvet worm	Tadpole	Vulture

THE CORE LESSON THREE DAYS, 45 MIN EACH

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

5 MIN

Where do different organisms get their energy? Remind students that in previous lessons they learned about how energy flows through environments from one organism to another. They also learned about the definitions of *producer* and *consumer*, as well as *carnivore*, *herbivore*, *omnivore*, and *scavenger*.

Tell students that over the next three days they will research, prepare, and present information on organisms that belong to particular environments. On the first day, each student will be assigned an organism to research independently. On the second day, students will form groups based on their organisms and prepare their presentations. Then, on the third day, each group will present how energy flows from one organism to another through their environment. Each student will be responsible for presenting on the organism that they research on Day 1.

2. Preview the investigation.

5 MIN

Activity Page



AP 9.1

Distribute and review Research Guide (AP 9.1). Review the Day 1 section of the Activity Page with students. Tell students that they will research the organism they were assigned. Explain that students will need to print or copy a picture of their organism (or check out a library book) so that they can have a picture to show the class during their presentations.

Preview the Day 2 section of the Activity Page with students. Go over the part about omnivores. Explain that once the groups are formed and students have had a chance to discuss how their organisms connect in the chain of energy flow, they should identify another organism within that environment that is an omnivore. They will be asked to discuss this informally during their presentation.

Preview the Day 3 section of the Activity Page with students. Review the presentation criteria with students to make sure they understand what they need to do for their presentations.

- Identify the environment and the organism.
- Explain how energy flows through each organism in the environment.
- Explain how the organisms are connected in a food web.
- Discuss a possible omnivore that would be present in the environment.

SUPPORT—Give students an example of how they might talk about their organism during the presentation. For instance, one student might say, “My organism is the jackrabbit. It gets its energy by eating cacti and sagebrush, which get their energy from the sun.” Then, the next student might say, “My organism is the king snake. It gets its energy from the jackrabbit, which gets its energy from cacti, which gets its energy from the sun.” Finally, the last student could say, “My organism is the kit fox. It gets its energy from the king snake, which gets its energy from the jackrabbit, which gets its energy from cacti, which gets its energy from the sun.” Point out to students that these sample sentences tell how the energy is passed through the organisms in the environment.

Draw students’ attention to the section under Day 3 about audience participation. Tell students that as they watch the presentations, they will participate by listening to make sure each group uses the Core Vocabulary words listed on the Activity Page. Tell students that you will give them more specific instructions on how to do this on Day 3.

3. Facilitate the research.

25 MIN

Assign each student his or her organism. Do not tell students which environment their organism belongs in. Do not tell students whether their organism is a producer; a primary, secondary, or tertiary consumer; or a scavenger. This is information that students will need to identify for themselves during their research.

Circulate around the room as students conduct their research. As students answer the questions on the Activity Page, provide some additional guiding questions, such as the following:

- Does my organism live in the water or on land? (*Sample answer: water*)
- Does my organism get its energy directly from the sun? (*Sample answer: Everything on Earth gets some energy from the sun, but an octopus lives too deep in the ocean to get direct energy from the sun.*)
- Does my organism live in hot or cold climates? Rainy or dry? (*Sample answer: It lives in the cold, deep parts of oceans.*)

SUPPORT—If necessary, remind students that energy in all environments begins with the sun. Tell students that they will not have to research information on the sun and should limit their research only to their organism.

Remind students that, as part of their research, they must print or copy one picture of their organism. The picture can be in black and white.

4. Revisit the plant investigation.

10 MIN

Activity Page



AP 1.2

Leave time at the end of the class for students to revisit their plant cuttings in containers of water. This will be the final time that students take measurements and make observations to look for changes to their plant. Students should have access to Plant Data Sheet (AP 1.2) so they can complete the data table, review their findings, and answer the final question on the Activity Page.

Hold a whole-class discussion at the end to see whether students' findings reinforce and support the claims they made in Lesson 5.

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

5 MIN

Activity Page



AP 9.1

Where do different organisms get their energy? Remind students that they already conducted research on their assigned organism. Tell them that today, they will form groups and work together to prepare a presentation for Day 3. Encourage them to pull out their notes and pictures from their research on Day 1.

Tell students to get out the Activity Pages that they started on Day 1 of the lesson. Explain that they will use the Day 2 section of the Activity Page to guide their discussion and group preparations.

2. Preview the investigation.

5 MIN

Write the following environments on the front board or chart paper (students should not see these environments ahead of time). (See **Know the Science** for support.)

- desert (hot)
- coral reef
- tropical rain forest
- lake
- African grassland

Explain to students that these are five different environments. Tell them that each of their organisms belongs to one of these environments.

Identify different parts of the room for members of each environment to meet and form groups. For instance, say, "If your organism belongs to the desert environment, meet in the back of the room."

Know the Science

Aren't these ecosystems? *Technically, yes!* An ecosystem is a distinct community in which living and nonliving organisms interact. The environments listed on the front board are examples of types of ecosystems that can be found on Earth. However, we are not using the term *ecosystem* in this lesson, as students will begin to learn about ecosystems later in the unit. Therefore, for the purposes of this lesson, call these *environments* instead.

SUPPORT—If necessary, provide support to students who may not know which group to join. Ask prompting questions that allow students to describe where their organism lives, and see if students can arrive at their correct environment on their own.

NOTE—Blue-green algae can be found in lake environments as well as coral reefs, so be sure to redirect students into the correct groups based on the table shown on page 72 of this Teacher Guide. Make sure these students understand that they are not wrong if they select the incorrect group to join.

NOTE—Vultures can be found in many environments, including grasslands and hot deserts, so be sure to redirect students into the correct groups based on the table shown on page 72 of this Teacher Guide. Make sure students understand they are not wrong if they select the incorrect group to join.

Give students time to find and form their groups. Tell students to bring their Activity Pages with them to their teams. They can also bring their pictures of their organisms with them for reference.

SUPPORT—If necessary, help students form groups by prompting them to think about where their organism lives. Ask: “Does your organism live someplace warm or cold? Does your organism live on land or in water?”

As students form groups based on environment, tell them to share the name of their organism with other members of the group. This can be a useful way to make sure each student is in the right group/environment.

3. Facilitate the investigation.

25 MIN

Circulate around the room as students work in their small groups. Encourage students to use their Activity Pages for Day 2 to guide their discussion.

SUPPORT—If necessary, help students identify whether their organism is a producer, consumer, or scavenger. If students need support figuring out whether their consumer is a primary, secondary, or tertiary consumer (apex predator), ask them guiding questions such as “What animal eats your organism?” or “What does your organism eat?”

As you circulate throughout the room, stop by each group, and have them summarize for you how energy flows through their environment, passing through the specific organisms assigned. Correct any misunderstandings, and make sure that students properly understand the correct order in which energy from the sun flows, from producers through to tertiary consumers to scavengers.

Encourage groups to rehearse what each student will say during the presentation. Remind students that they will need to use the Core Vocabulary terms identified on their Activity Pages during their presentations, so they should rehearse their presentations using those terms.

4. Encourage student questions.

10 MIN

Bring the whole class back together for the final few minutes of class time. Tell students that they will start presenting at the beginning of the next class. Encourage them to ask any questions about energy and organisms that they may have.

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

5 MIN

Where do different organisms get their energy? Tell students that today groups will present how energy from the sun flows through the organisms in their environments.

Remind students that each presentation must specifically tell how each organism gets its energy. Each student will present his or her own organism and explain that organism's role as a link in the chain of energy flow.

Students must also organize—and present—in the correct order in which energy flows through the organisms in their environment. When it is each student's turn to present, he or she must show the class the picture of his or her organism.

2. Prepare for presentations.

5 MIN

Activity Page



AP 9.1

Have students take out Research Guide (AP 9.1) and review the Day 3 section. Tell students to find their Core Vocabulary cards for the terms listed on the Activity Page and place them in a row on their desks.

Explain that as each group presents, students will listen carefully for the use of each term. If students hear the group use a term, they should put the card for that term in a stack on their desk. Tell students that at the end of each presentation, you will ask the class whether the group used all the terms from the cards. If there are any cards that did not make it into the stack, then the class will be asked to tell which terms the group forgot to say in their presentation.

Tell students that each team will have three to five minutes to present.

3. Present and discuss.

25 MIN

Set a timer for each group's presentation. Make sure groups do not take longer than five minutes each.

As each group presents, check for proper understanding of how energy from the sun flows through the organisms in that environment. If students get something incorrect, do not stop their presentation to correct them. Make a note about the misunderstanding, and discuss it privately with the group afterward.

At the end of each presentation, ask the group to discuss omnivores using the following prompts:

- » Did your group identify an omnivore that would live in your environment?
- » If so, what is the omnivore?
- » Where does the omnivore fit in the chain of energy in your environment?

At the end of each group presentation, ask the audience the following questions:

- » Did the group use all the Core Vocabulary terms? (*Students' sorted stacks of Core Vocabulary cards should reveal which terms were used.*)
- » Which Core Vocabulary terms did the group not use? (*Students should verify with one another examples of terms that were not included, if any.*)

4. Summarize and discuss.

5 MIN

Once all the groups have had time to do their presentations, hold a whole-class discussion to summarize what students learned. Students should be able to explain how energy from the sun moves through producers to various levels of consumers to scavengers.

Ask if all these environments have producers, consumers, and scavengers. (yes)

- » How do you know whether something is a producer? (*It makes its own food.*)
- » How do you know whether something is a consumer? (*It eats producers or other consumers.*)
- » How do you know whether something is a scavenger? (*It eats dead consumers.*)

Elicit from students that similar chains of energy flow can be found in different environments.

5. 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.

- Collect the completed Research Guide (AP 9.1) Activity Pages. Check for completeness and accuracy of responses.
- Review students' presentations, checking for all the required criteria:
 - Each student states at least two sentences about the assigned organism.
 - Each student shows a picture of the assigned organism.
 - Each student explains how the organism serves as a link within the energy chain of that environment and tells how it relates to the link before it and after it.
 - Groups describe the flow of energy correctly and stand in the correct order according to their organism's place in the chain.
 - Groups use all the identified Core Vocabulary terms in their presentation.
 - Groups talk about other links that could connect to their organisms in the same environment (e.g., omnivores).
 - Presentations last three to five minutes each.

PART C

Matter Cycles Through Ecosystems

OVERVIEW

Lesson	Big Question	Advance Preparation
10. Ecosystems	What is an ecosystem? What are some different types of ecosystems?	Read Student Reader, Chapter 5.
11. A Local Ecosystem	What lives where I live?	Gather materials for student investigations. (See Materials and Equipment page 13.)
12. Food Chains and Food Webs	What are food chains and food webs?	Read Student Reader, Chapter 6.
13. Modeling the Cycle of Matter in an Ecosystem	How can I show cycles of matter in an ecosystem?	Read Student Reader, Chapter 7. Gather materials for the hands-on investigation. (See Materials and Equipment page 13.)
14. Changes in Ecosystems	What happens when ecosystems are disrupted?	Read Student Reader, Chapter 8.
15. People and the Environment (2 days)	What happens when human activity disrupts an ecosystem?	Gather materials for student investigations. (See Materials and Equipment page 13.)

Part B: What's the Story?

An ecosystem includes the living and nonliving things in a specific area. Ecosystems can be very small or very large. A dog can be an ecosystem for its fleas. Miles and miles of prairie can be the ecosystem for grazing animals and their prey. A food chain within an ecosystem shows the path of energy flow from the sun to a producer to a consumer. A food web shows the multiple feeding interrelationships among different organisms and the environment within an ecosystem. These relationships are part of the cycling of matter in an ecosystem. When ecosystems are disrupted by natural causes or human activity, the interrelationships are affected.

In Lesson 10, students extend their understanding of the needs of plants and animals from previous lessons by exploring what an ecosystem is and distinguishing ecosystems and environments. They conclude that ecosystems, regardless of size, are areas of interaction between the living and nonliving parts.

In Lesson 11, students explore a local ecosystem, looking for interactions among plants, animals, and the environment. They will identify the living and nonliving things and describe how they interrelate and affect one another to further develop an understanding of how matter and energy move through an ecosystem.

In Lesson 12, students delve more deeply into the interrelationships in an ecosystem by distinguishing between food chains, which show a path of energy transfer, and food webs, which identify the interrelationships among many organisms in an ecosystem.

In Lesson 13, students read notes from a rain forest field experience and then translate those notes into a model of the rain forest ecosystem described in the reading. In their ecosystem model, students identify and describe the interactions in the system to show the cycles of energy and matter transfer that allow multiple species to meet their needs in order to survive.

In Lesson 14, building on their understanding of what an ecosystem is and how matter moves in an ecosystem, students read about how ecosystems can be disrupted and how the changing of one aspect of the ecosystem affects the balance of interactions within the ecosystem.

In Lesson 15, to explore how changing an aspect of an ecosystem affects other aspects of the system, students take two class periods to research a human activity that disrupts an ecosystem and then write a report citing evidence that links the activity to the disruption.

So, to repeat, **food chains and food webs identify the relationships that describe how matter and energy move through an ecosystem**. The key concept for students to grasp is that the interrelationships among living and nonliving things are what enables organisms to survive. Help your students grasp these concepts, and you will lay the groundwork for meeting the NGSS expectations.

LESSON 10

Ecosystems

Big Question: What is an ecosystem, and what are some different types of ecosystems?

AT A GLANCE

Learning Objective

- ✓ Define the term *ecosystem* and describe at least four examples.

Lesson Activities

- reading, discussion
- drawing
- vocabulary instruction

NGSS References

Disciplinary Core Idea LS2.A: Interdependent Relationships in Ecosystems

Crosscutting Concept: Systems and System Models

Crosscutting Concept: Scale, Proportion, and Quantity

Science and Engineering Practices: Developing and Using Models

Scale, Proportion, and Quantity are important to the topic of ecosystems because ecosystems differ vastly in size. An ecosystem can be as small as a terrarium or as large as the Sahara. Students will learn the definition of an ecosystem and read about examples of ecosystems and how they range in scale of size.

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 purple 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 165–166 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 energy matter

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 purple on the previous page.

Instructional Resources

Student Reader



Ch. 5

Activity Page



AP 10.1

Student Reader, Chapter 5 "Ecosystems"

Activity Page

Ecosystem: Yes or No (AP 10.1)

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

Online Resources



Prepare for this lesson in advance by preselecting the pictures of ecosystems and non-ecosystems that you wish to show students.

- Examples of ecosystem pictures to show students can include coral reefs, an aquarium, or a puddle.
- Examples of non-ecosystem pictures to show students can include the moon, the sun, rain, or a newly formed piece of lava rock.

See the Online Resources for a link to suggested images.

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

Materials and Equipment

Collect or prepare the following items:

- 6 assorted pictures of ecosystems and non-ecosystems
- drawing paper
- colored pencils or crayons
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 10.1

What is an ecosystem, and what are some different types of ecosystems? Distribute and review Ecosystem: Yes or No (AP 10.1). Without discussing what an ecosystem is, tell students that you will show them a variety of images and students must silently record on their Activity Pages whether the picture shows an ecosystem. Students begin by describing the picture that they see in the first column. If the picture shows an ecosystem, students mark an X in the Yes column. If the picture does not show an ecosystem, students mark an X in the No column. (See **Know the Science 1** for support.)

Know the Science

1. What is the difference between an ecosystem and a non-ecosystem? *Interaction!* An ecosystem is made up of living organisms and nonliving things, such as air, sun, water, and soil. A non-ecosystem would be a single element, or feature, such as sand, water, or a rock, that does not show any interactions with living things.

SUPPORT—Students are not expected to know the definition of an ecosystem yet. This is an engagement activity to see if students already understand what an ecosystem might be or whether they can guess. Tell students not to worry whether they get the answers right or wrong.

Show students three pictures of ecosystems and three pictures of non-ecosystems. Mix them up so that you do not show all the ecosystem pictures or all the non-ecosystem pictures together in a row.

2. Encourage student questions.

5 MIN

Have partners discuss their answers to the Activity Page. Ask students whether their answers match what their partner recorded. Encourage partners to discuss whether they notice any patterns about what makes something an ecosystem. You can use prompts, such as the following:

- » What do the non-ecosystem pictures have in common? (*Sample answer: They are pictures of just one feature, such as a rock.*)
- » What do the ecosystem pictures have in common? (*Sample answer: They show things that work together to make places where different organisms live.*)
- » What kinds of things do you notice in the ecosystem pictures? (*Sample answer: The pictures show more than one thing.*)
- » What kinds of things do you notice in the non-ecosystem pictures? (*Sample answer: They are pictures of just one thing.*)
- » Do you think ecosystems are a mix of living and nonliving things? (*Sample answer: yes, because it looks like some parts are able to move and some parts look like they might always be still*)

3. Read and discuss: “Ecosystems.”

15 MIN

Student Reader



Ch. 5

Read together or have students read independently “Ecosystems,” Chapter 5 in the Student Reader. The selection defines *ecosystem* and describes different types of ecosystems that exist around the world.

Preview Core Vocabulary Terms

Before students read, write **ecosystem** on the board or chart paper. Have students write the vocabulary term on an index card. As they read and learn more, students can add a definition.

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 29

After students read the page, draw their attention to the picture of the tree. Emphasize that 1,200 different species living in one type of tree is a lot!

Ask students why so many species might live in the tree. (*The tree provides food; the tree provides shelter.*)

SUPPORT—Discuss with students the meaning of the term *ecosystem*. Have a volunteer read aloud the definition from the vocabulary box on the page. Point out that the term *ecosystem* is made up of the prefix *eco-* and the word *system*. Explain that *eco-* as a prefix refers to the environment or surroundings and that it comes from the ancient Greek word meaning house. *System* is a word that students have likely heard and used in everyday language. Ask students to tell what a system is. Elicit from them that a system is an organized group of related objects or components. Now that students understand the meaning of *eco-* and *system*, ask them to describe an ecosystem in their own words.

SUPPORT—Make sure students understand that an ecosystem is not the same thing as an environment. The two terms are similar, but *ecosystem* implies a bounded area, big or small. *Environment* is a very general term that refers to the conditions surrounding an organism, including climate, water, and soil conditions. But an ecosystem makes up the whole system in which that organism lives. An ecosystem is the interactions between and among living organisms and how they interact with other living and nonliving things to secure food and shelter to survive.

Page 30

As students read about organisms interacting in an ecosystem, discuss what it means for organisms to interact directly versus indirectly. Use this opportunity to make sure students recall what producers, consumers, and decomposers are. Give students an example of organisms interacting directly, such as when a grasshopper (consumer) eats grass (a producer). Then give them an example of organisms interacting indirectly, such as in the case of birds and grass. A bird might eat the grasshoppers that eat the grass, but the bird might not eat the grass itself. This is an example of an indirect relationship between the bird and the grass. (See **Know the Science 2** for support.)

SUPPORT—Discuss why healthy ecosystems contain many different types of living things. Explain that when there are many different types of organisms in an ecosystem that support one another, they can help each other survive. For instance, having a variety of producers in an ecosystem gives consumers options for what to eat, which means there might be less competition among consumers for plant food.

Know the Science

2. Are we describing food webs here? Sort of! The concept of living things interacting with one another and depending on one another for survival within an ecosystem borders on the discussion of food webs. Students will learn about food webs in a later lesson, so it is not necessary to discuss how food webs work now. For the purposes of this lesson, students only need to know that organisms interact in different ways and that sometimes they can be indirectly affected by one another.

Pages 31–32

Pause after reading these pages, and have students tell what the nonliving parts of an ecosystem are. Examples can include water, sunshine, soil, air, rocks, sand, shells, bones/animal carcasses, and wind.

Go through each type of nonliving part mentioned on the pages, and pause to discuss them using the following prompts:

- » What would happen to the organisms if their water were taken away? How do you think this would affect an ecosystem?
- » What would happen to the organisms if their ecosystem suddenly stopped getting as much sunlight? How would this affect the ecosystem as a whole?
- » Why is soil an important part of an ecosystem? What do you think would happen without it?

CHALLENGE—If time permits, have students do research on why a nonliving thing of their choice (that is not already discussed on the pages), such as wind, is important to an ecosystem.

Page 33

After reading the first paragraph, ask students to explain why shelter is important for an ecosystem. (*Organisms need shelter to survive.*) Then ask why shelter helps organisms survive. (*It lets them hide from predators, sleep in safety, and be protected from weather.*)

Pause after looking at the picture of the bacteria. Ask: “Is the inside of your mouth an ecosystem? Why or why not?” (*yes, because the bacteria have all they need inside the mouth to survive*)

Page 34

After reading the page, check understanding by asking students to explain what all ecosystems have in common. (*They all contain the things necessary for organisms to survive.*)

Discuss how small an ecosystem can be. Consider the ecosystem in the terrarium pictured and fish tanks that provide food and shelter for the different living things in the tank. Consider microscopic organisms that survive in small bodies of water or small insects, such as fleas, that live on animals.

CHALLENGE—Have students research examples of large ecosystems, such as the Sahara, and small ecosystems, such as a backyard or the area underneath a rock.

4. Demonstrate examples and guide discussion.

5 MIN

Analyze with students 1) what an ecosystem is, 2) what an ecosystem must have, and 3) how living and nonliving things interrelate or depend on each other within ecosystems. (See **Know the Science 3** and **4** for support with the analysis.)

- Pass out drawing paper and colored pencils or crayons to students. Have them draw an ecosystem of their choice, or give them a specific ecosystem to draw, such as an ecosystem that would be found in a desert, in an aquarium, or inside the trunk of a tree. Instruct students to show in their drawings how organisms are connected and how they rely on nonliving things. Encourage students to use arrows or labels in their drawings. Students are not graded on artistic ability.

Use the following prompts to guide the drawing activity:

- » What are some organisms found in your ecosystem? (*Accept reasonable student answers and question responses that may not be true for the chosen ecosystem.*)
- » What are the nonliving things found in your ecosystem? (*Sample answers: sand, rocks, water*)
- » What do the plants need to survive? (*Sample answers: sun, water, the right temperature for the plants*)
- » What do the animals need to survive? (*Sample answers: sources for food, ways to keep warm*)
- » How do the living and nonliving things work together to sustain life in this ecosystem? (*Students should address the concepts of needs and dependencies in the relationships.*)

Know the Science

3. Why are we drawing ecosystems? *To familiarize students with the things that make up an ecosystem!* Ecosystems can be large or small and contain living organisms and nonliving things, all of which work together in harmony to create a stable environment to maintain life. By giving students an opportunity to draw ecosystems, we can gauge their understanding of the different parts of an ecosystem and how those parts have interdependent relationships. Students do not have to discuss food webs yet, as they will learn about those in a later lesson. However, their drawings should show that the parts of an ecosystem work together.

4. Why are students watching a video about the Hawaiian Islands? *To see an example of an ecosystem!* Hawaii is a fun example for teaching students about ecosystems since the islands are remote and clearly defined by being surrounded by water and the species are self-contained. The video tells students how many of the organisms arrived on the island of Hawaii to begin with and how the organisms interact and live within a system that works to maintain stability. Volcanic eruptions with lava flow, however, are an example of an event that disrupts the ecosystem. When lava covers the environment, plants and animals die, and their matter decomposes to become rich mulch that then allows new things to grow.



Show a video of the ecosystem of a Hawaiian island. 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

Ask what students can observe about this ecosystem.

- » How did the living organisms get to live on the island? (*wind, water, wings*)
- » What happens when the organisms die? (*They decompose and turn into rich mulch that lets other things grow.*)
- » What are some of the nonliving things found in the Hawaiian ecosystem? (*volcanoes, lava, water, sunshine, air, mud/soil*)
- » What are some of the living things found in the Hawaiian ecosystem? (*fungi, birds, trees, spiders*)
- » How do you think these living and nonliving things interact? (*Sample answer: The birds drink the water from the lake; the trees grow from the soil and water on the island.*)
- Prompt students to link details in this analysis and discussion back to the reading selection.
 - » Why do organisms survive well in healthy ecosystems? (*Organisms have what they need to survive, and a healthy ecosystem is balanced and provides those things to the organisms.*)
 - » What did you read about in the reading selection that is similar to these activities? (*Ecosystems are made up of living and nonliving parts that work together to sustain life.*)

5. Teach Core Vocabulary.

5 MIN

Word Work

Instruct students to add the following headings to the Core Vocabulary card for **ecosystem**. (n. all the living and nonliving things that interact in a given area) As a class, determine the best responses for each heading, and add them to the Vocabulary Card.

- definition: (*Sample answer: a place where living and nonliving things interact*)
- example: (*Sample answer: a coral reef*)
- phrase: (*Sample answer: rain forest ecosystem*)
- similar term: (*Sample answer: habitat*)

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 10.1) for correct answers and sample student responses.

- Collect the completed Ecosystem: Yes or No (AP 10.1) pages. Scan the tables to check for proper understanding of what an ecosystem is. Students should demonstrate understanding that interactions in the system of plants, animals, decomposers, and the environment allow living things to meet their needs for survival.
- Collect the completed drawings. Evaluate whether the drawing is a model of the interactions within an ecosystem that allow species to meet their needs.
- 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 difference between an ecosystem and an environment.

LESSON 11

A Local Ecosystem

Big Question: What lives where I live?

AT A GLANCE

Learning Objective

- ✓ Define the term *ecosystem* and describe at least four examples.

Lesson Activities

- student investigation
- discussion

NGSS References

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Science and Engineering Practices: Developing and Using Models

Crosscutting Concepts: Scale, Proportion, and Quantity; Systems and System Models

Systems and System Models are important to the topic of living things because the living and nonliving things that are found in an environment make up an ecosystem and are interdependent.

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 in this lesson.

ecosystem

environment

system

Instructional Resources

Activity Page



AP 11.1

Activity Page

Ecosystem Investigation (AP 11.1)

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

Materials and Equipment

Collect or prepare the following items:

- bright-colored cones or flags

Advance Preparation

Prepare in advance for this class by identifying an outdoor area on the school grounds where students can observe living and nonliving things as part of an ecosystem. This should preferably be an area of the grounds that contains an abundance of organisms: trees, bushes, plants, cacti, etc. More organism variety will give students more to investigate and discuss.

If your outdoor area contains grassy fields, check with school personnel first to make sure that any sprinklers will not go off during the time that you are outside with students.

As an option, you can use bright-colored cones or flags to create a perimeter for students to stay within. Set up the cones or flags before the class begins.

Since this is an outdoor activity, check the weather ahead of time to make sure it is agreeable, and give students advance notice so they can dress accordingly for the day.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What lives where I live? Remind students of the definition of *ecosystem* that they learned in the previous lesson. Emphasize that an ecosystem is made up of the living and nonliving parts that are found in an environment and that those parts have interdependent relationships within their system. (See **Know the Science.**)

Know the Science

Is an ecosystem the same as an environment? No! An ecosystem is the community of organisms that interact and depend on one another within a physical environment. It is the interactions between and among the environment and the organisms that live in it. Thriving ecosystems are a balance of living organisms, food supply, and shelter. There are predators and prey, and there may be naturally occurring disasters such as fire or flooding. Environments are the set of physical features that surround an organism, not about the interactions within the environment. An ecosystem can consist of different environments and the interactions within those environments.



Distribute and review Ecosystem Investigation (AP 11.1). Tell students that today, they will go outside to look for evidence of an ecosystem on the school grounds by identifying the living and nonliving things in the environment and analyzing how those parts interrelate and affect each other.

SUPPORT—Remind students that ecosystems can have huge differences in size and complexity. An ecosystem can be small, such as a pond or a backyard, or it can be large, such as an entire biome. Explain that for this activity, students will be looking at a relatively small ecosystem.

Review the parts of the Activity Page, and take time to answer any questions students may have. Tell students that you will leave a few minutes at the end of class for a whole-class discussion on what students find during their investigations.

SUPPORT—If necessary, review the concept of things in the environment interrelating by talking about interdependent relationships in an ecosystem. For example, animals eat plants and also eat other animals. Every part of an ecosystem plays an important part in maintaining the balance of the organisms that live there.

2. Preview for investigation and demonstrate examples.

5 MIN

To prepare students to think about the types of things to look for in the outdoor investigation, have each student turn to a neighbor and discuss the following points:

- » What is an ecosystem? (*Sample answer: living and nonliving things that form a community of organisms and their environment*)
- » What can you find in an ecosystem? (*Sample answer: living things and the living and nonliving things that affect them*)
- » Are nonliving things essential to an ecosystem? (yes)
- » What are some nonliving things that are essential to an ecosystem? (*Sample answer: shelter and a way to move from place to place, such as water for swimming or sand for walking on*)

3. Facilitate the investigation.

25 MIN

Tell students to bring their Activity Pages and pencils. Lead students to the outdoor area that you selected in advance. Identify for students physical boundaries to ensure students stay within a particular part of the site, such as “Do not wander farther than the playground equipment,” or “Do not go beyond the large oak tree.” Tell students that they are free to roam around the supervised area.

Circulate around the outdoor area as students study the environment. Prompt students to fill out their Activity Pages as they observe different things.

SUPPORT—Give students some investigation cues that can help them learn more about the ecosystem. For instance, tell students to get close to the ground and inspect whether they can see any insects, worms, or other organisms living

in the grass or gravel. Ask them to look for different plants. Prompt students to get close up to trees and bushes to see whether there are any organisms crawling on leaves or branches. Ask them to describe the other living things they see, such as ivy or lichens or spores, even if they can't identify them. Encourage students to notice the animals flying in the sky, such as birds, butterflies, or bees. Make sure students are paying attention to the nonliving things in the environment, too.

CHALLENGE—Challenge students to think about or describe how energy and matter cycle through this ecosystem, starting with the sun.

Give students a five-minute warning to wrap up their investigations, and lead all students back to the classroom together.

4. Summarize and discuss.

5 MIN

Leave time at the end for students to discuss their findings as a whole class. Have volunteers take turns describing how the living and nonliving things that they observed interrelate and affect one another. Ask students if what they investigated is an example of an ecosystem and to tell why.

5. 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.

- Collect the completed student work on Ecosystem Investigation (AP 11.1). Check for correct identification of living and nonliving things as well as a correct understanding of how these things interact and interrelate to affect each other.

LESSON 12

Food Chains and Food Webs

Big Question: What are food chains and food webs?

AT A GLANCE

Learning Objective

- ✓ Compare a food chain to a food web.

Lesson Activities

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

NGSS References

Performance Expectation LS2.A: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Disciplinary Core Idea LS2.A: Interdependent Relationships in Ecosystems

Crosscutting Concept: Systems and System Models

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to the topic of food chains and food webs because models can be used to help study and understand the cycling of matter and energy within an ecosystem.

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 purple 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 165–166 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.

food chain

food web

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 Core Vocabulary terms, as designated in purple on the previous page.

Instructional Resources

Student Reader



Ch. 6

Activity Page



AP 12.1

Student Reader, Chapter 6 “Food Chains and Food Webs”

Activity Page

Chains and Webs (AP 12.1)

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

Materials and Equipment

Collect or prepare the following items:

- assorted pictures of organisms that belong to a food chain
- index cards
- tape or glue
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (2 per student)

Advance Preparation

Preview the activity in Section 4 of this lesson to prepare in advance by printing pictures of organisms that belong to a food chain. Students will work in pairs for this activity, so make enough copies for each pair of students. Cut out the pictures, and paste them to the backs of index cards so students can work with something sturdy. See the following table for examples of organisms to use for the pictures.

Ecosystem	Marine	Desert	Tropical
Producer	Seaweed	Grass	Orchid
Primary Consumer	Sea urchin	Ant	Ant
Secondary Consumer	Squid	Cactus wren	Tamarin
Tertiary Consumer	Shark	Snake	Eagle

1. Focus student attention on the Big Question.

5 MIN

Online Resources



What are food chains and food webs? Introduce students to food chains and food webs by showing them the short video of eagles hunting for food. (See the Online Resources for a link to the video.) As they watch, prompt students to think about the following:

- » What is a food chain? (*a series of organisms listed in a way that shows which is a food source for another*)
- » Which organisms are part of the food chain being shown? (*eagle, its prey, and the food sources of its prey*)
- » What is at the top of this food chain? (*eagles*)
- » What does it mean to be at the top of the food chain? (*Nothing eats the top consumer.*)

At the end of the video, discuss what students observed, and review the answers to these questions as a class. Ask students if they think all ecosystems have their own food chains. (yes)

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

2. Encourage student questions.

5 MIN

Encourage students to consider questions about food chains based on the video they watched. Prompt them to think about which organisms consume each other. Use this opportunity to review their knowledge of the terms *producer*, *consumer*, and *decomposer* and use these terms in the discussion. (See **Know the Standards.**)

Know the Standards

Food Chain and Food Web Relationships The Evidence Statements for the Performance Expectation focus on understanding the relationships among organisms in which energy and matter move through an ecosystem, rather than the definitions of different types of organisms. The emphasis is on the interactions in the system of plants, animals, decomposers, and the environment that allows multiple species to meet their needs.

To be clear, when glucose moves through an ecosystem, it is both matter and chemical energy. The chemical bonds that make up the matter, the glucose, contain the potential energy that, when released, drives other chemical reactions. So, it is correct to say that matter and energy flow through the ecosystem.

3. Read and discuss: “Food Chains and Food Webs.”

15 MIN

Student Reader



Ch. 6

Read together or have students read independently “Food Chains and Food Webs,” Chapter 6 in the Student Reader. The selection explains food chains and food webs and compares them so that students understand the difference. The main goal of this reading selection is to show students how energy and matter flow through an ecosystem and can be modeled visually.

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. Have students write each Core Vocabulary term on an index card. As they read and learn more, students will add definitions to the cards.

food chain

food web

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 35

Discuss with students the meaning of the term *food chain*. Have a volunteer read aloud the definition from the vocabulary box on the page. Refer students to the diagram of the food chain on the page. Ask students to explain what the arrows mean in the chain. (*One organism is food for another.*)

SUPPORT—Ask students what chains are made of. (*links*) What happens when a link is taken out of a chain? (*The chain is broken.*) This means that all these organisms depend on each other for food.

Pages 36–37

As students read about food webs, have them think about the term *web*. Ask them to describe what they think of when they think of a web. Explain that a web usually refers to a network. Students are already familiar with spider webs and the internet (World Wide Web). Use these examples to discuss more about what webs are, and relate it back to a food web. Ask students to tell why there is not an arrow after the person eating chicken. (*There is no organism that eats the human.*) Explain that this food chain ends with the person in the picture.

SUPPORT—Compare and contrast a food chain and a food web. Have students study the different diagrams to see the visual differences. Then ask what they have in common. (*They both use arrows; they both show what organisms eat which organisms.*) Explain that a chain goes in one direction.

SUPPORT—Have students examine the food web and find a food that more than one animal depends on (*corn*) and an animal that eats several types of food (*crow*). Then have students tell the top consumers in this food web.

CHALLENGE—If time permits, challenge students to research or think of examples of top consumers in an ecosystem.

Pages 38–39

Pause after the first paragraph on the spread. Address the misconception that all plants are part of a food chain by telling students that some plants are not edible or eaten by consumers. Therefore, those plants are not part of a food chain. However, many plants—including their flowers, leaves, and fruit—are part of a food chain.

SUPPORT—Have students trace a food chain within the food web on the spread. (*phytoplankton, clam, sea duck; phytoplankton, small fish, large fish, osprey; phytoplankton, small fish, wading bird*) Elicit from students that there are three different food chains represented by this food web. Ask students to tell what the food chains have in common within the web. (*The food chains all start with phytoplankton being eaten.*) Have students identify where the food chain starts to branch out to create the web.

Page 40

After reading the page, review the example of the otters and kelp. Ask students to explain how the sudden lack of otters affects the amount of kelp in the kelp forest. (*Without as many otters, there are more sea urchins. More sea urchins eat more kelp. Therefore, there are fewer kelp in the kelp forest.*) Ask students to summarize the relationship between the otters and the kelp, eliciting from them that the otters help keep balance in the food chain and that without the otters, the food chain becomes unstable. Elicit from students that webs are interconnected and that some parts can directly or indirectly affect other parts.

CHALLENGE—Have students come up with more examples of relationships within food webs, such as what would happen if an organism disappears or dies and how it affects other parts of the web.

4. Demonstrate examples and guide discussion.

10 MIN

Choose one or more of the following examples to stimulate further discussion. Analyze with students 1) what a food chain is, 2) what a food web is, and 3) how food chains and food webs are used to study the cycling of energy and matter within an ecosystem.

Use the front board to draw a food chain or food web as a whole class. Give students an ecosystem to focus on, such as an ecosystem within a tropical rain forest, desert, or coral reef. Use the following prompts to guide the drawing activity:

- » What is the producer in this ecosystem? (*Sample answer: green plant*)
- » What are the consumers that eat the producers? (*Sample answer: tree frogs, squirrels, deer*)
- » What are the consumers that eat other consumers? (*Sample answer: lizards, jackrabbits, mountain lions*)
- » What would be the top consumer? (*Sample answer: mountain lions, bobcats, coyotes*)

Use arrows in the drawing to show how energy and matter move through the food chain or food web.

Draw a rough sketch of the following organisms on the front board or chart paper for students to fill in (use the image below to know where to place each organism):

- fox
- cat
- thrush
- slug
- grass
- rabbit

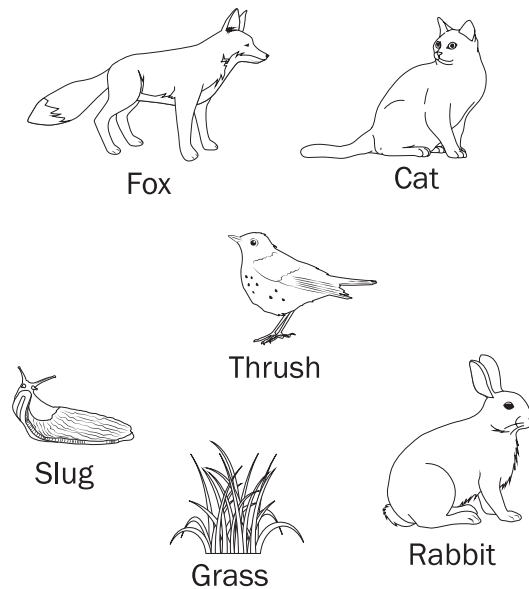
SUPPORT—For extra support, write the following food chains on the front board or chart paper for students to use as reference when filling in the food web:

grass → slug → thrush → cat

grass → slug → thrush → fox

grass → rabbit → fox

grass → rabbit → cat



Have volunteers come up to the front board to add one arrow to the food web. Each student adds one arrow to the diagram to show how the organisms relate and cycle energy and matter through the ecosystem.

SUPPORT—If necessary, ask students prompting questions when they come up to the front board or chart paper, such as “What does a slug eat?” (*grass*)

When the web is complete, review it with the whole class to trace how the organisms relate. Discuss which organism is the top consumer. (*Arrows added to the diagram should point from the organism that is a food source to the consumer that eats it. The slug and the rabbit eat grass. The thrush eats the slug. The cat would eat the rabbit and the thrush. The fox would eat the rabbit, thrush, and potentially also the cat.*)

- Place students into pairs, and pass out picture cards or organisms to each group.
- Have students work together to place the picture cards in order (from left to right) according to the organism's place in the food chain.

SUPPORT—If necessary, remind students that producers will be the first picture on the left, the picture that starts the food chain.

Online Resources



- Show a video that reviews food chains and food webs. (See the Online Resources for a link to a suggested video.) Ask what students can observe.
 - » How do energy and matter cycle through the ecosystem? (*Producers make energy from the sun that gets eaten and transferred from one organism to another.*)
 - » What are some producers shown in the video? (*sunflower, oak tree*)
 - » What are some consumers shown in the video? (*squirrel, hawk, humans*)
 - » How does a food chain relate to a food web? (*A food chain shows the order in which energy and matter flow through organisms, and a food web shows how all of the organisms are interrelated. There can be multiple food chains in a food web.*)

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.
 - » What is the difference between a food chain and a food web? (*A food chain shows the order in which energy and matter flow through a series of organisms, and a food web shows how all the organisms are interrelated.*)
 - » What did you read about in the reading selection that is like these activities? (*Energy and matter cycle through organisms, beginning with producers and ending with consumers, and then the cycle starts over again even after organisms die.*)
 - » Why can't you identify all the relationships in a food web? (*There are too many, some microscopic, to quantify.*)
 - » What does it mean to be at the top of a food chain? (*Nothing eats the organism at the top of the food chain until after it dies.*)

5. Teach Core Vocabulary.

5 MIN

Word Work

Compare chains and webs. (*Both connect things, but chains have links and webs have many different connections. A chain can be broken, and a web can be damaged but still work.*)

As a class, compare food chains and food webs. Make a list of the similarities and differences on the board or chart paper. Have students add to or improve their definitions, in their own words, on their Core Vocabulary cards for **food chain** and **food web**.

- **food chain:** (n. a series of organisms listed in a way that shows which is a food source for another)
- **food web:** (n. multiple connected food chains in an ecosystem)

Distribute and review Chains and Webs (AP 12.1). Then ask students to draw a simple food chain and a food web on the page. Invite them to share their drawings and compare food chains and food webs.

6. Check for understanding.

5 MIN

Formative Assessment Opportunity

Evaluate the completed Chains and Webs (AP 12.1) student work to see if students understand these key concepts:

- Both food webs and food chains show how energy and matter move through an ecosystem.
- Food webs show feeding relationships in an ecosystem.
- Food chains show levels of feeding relationships in a set of organisms.
- Food chains begin with a producer that gets its energy from the sun.
- Producers use energy from the sun to create food. Consumers eat the producers and use that energy. Decomposers make the energy from dead organisms available to producers.

Activity Page



AP 12.1

Activity Page



Answer Key

LESSON 13

Modeling the Cycle of Matter in an Ecosystem

Big Question: How can I show cycles of matter in an ecosystem?

AT A GLANCE

Learning Objective

- ✓ Create and use a model to show the cycling of matter and food energy from producers to consumers to decomposers, and show how the interactions of producers, consumers, and decomposers meet the needs of the living things in an ecosystem.

Lesson Activities (2 days)

- reading, discussion
- hands-on modeling activity

NGSS References

Performance Expectation LS2.A: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Disciplinary Core Idea LS2.A: Interdependent Relationships in Ecosystems

Crosscutting Concept: Systems and System Models

Science and Engineering Practices: Developing and Using Models

Developing and Using Models is important to the topic of ecosystems because models can be used to help study and understand the cycling of matter and food energy (in the form of glucose) within an ecosystem.

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 in this lesson.

decomposer ecosystem scavenger

Instructional Resources

Student Reader



Ch. 7

Activity Page



AP 13.1

Student Reader, Chapter 7

“Rain Forest Ecosystem
Field Diary”

Activity Page

Modeling the Cycling of Matter
and Energy (AP 13.1)

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

Materials and Equipment

Collect or prepare the following items:

- poster board
- markers (assorted colors)
- heavy paper or index cards
- tape
- internet access and the means to project video for whole-class viewing (marine food chain)

THE CORE LESSON TWO DAYS, 45 MIN EACH

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

5 MIN

How can I show cycles of matter in an ecosystem? Briefly review with students what they have learned about how matter and food energy in the form of glucose move through food chains and food webs in this unit.

Preview the next two days. First, students will read about a rain forest ecosystem in “Rain Forest Ecosystem Field Diary,” Chapter 7 in the Student Reader. They will use the information they learn to make models of how matter—such as oxygen, water, and food energy—are cycled through the ecosystem through producers, consumers, scavengers, and decomposers. On the first day, students will do their reading and start working on their poster board models. On the second day, students will finish their poster board models, discuss them, and turn them in.

Online Resources



SUPPORT—If necessary, show students a video to review the concept of producers, consumers, and decomposers; food chains; and food webs. (See the Online Resources for a link to suggested videos.) As they watch, prompt students to think about the following questions:

- How does energy and matter move through the ecosystem?
- How do organisms use energy?
- What happens to energy as it moves through the food chain?

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

2. Encourage student questions.

5 MIN

Invite students to pose questions about how food energy and matter move through the ecosystem. Encourage them to use the terms *producer*, *consumer*, *scavenger*, and *decomposer* in their questions and answers.

3. Read and take notes: “Rainforest Ecosystem Field Diary.”

15 MIN

Student Reader



Ch. 7

Read together or have students read independently “Rain Forest Ecosystem Field Diary,” Chapter 7 in the Student Reader. The selection describes a rain forest ecosystem through a field researcher’s notes.

SUPPORT—When reading aloud together as a class or as students read independently, prompt students to take notes. For instance, tell them to write down the organisms that are producers, consumers, scavengers, and decomposers. Have students identify the energy source (sun) and matter (food and other chemicals) that are cycling through the ecosystem described in the scenario.

If students have not finished reading the Student Reader independently after fifteen minutes, tell them that they will be able to return to the reading selection later as they work on their models.

4. Preview the investigation.

5 MIN

Activity Page



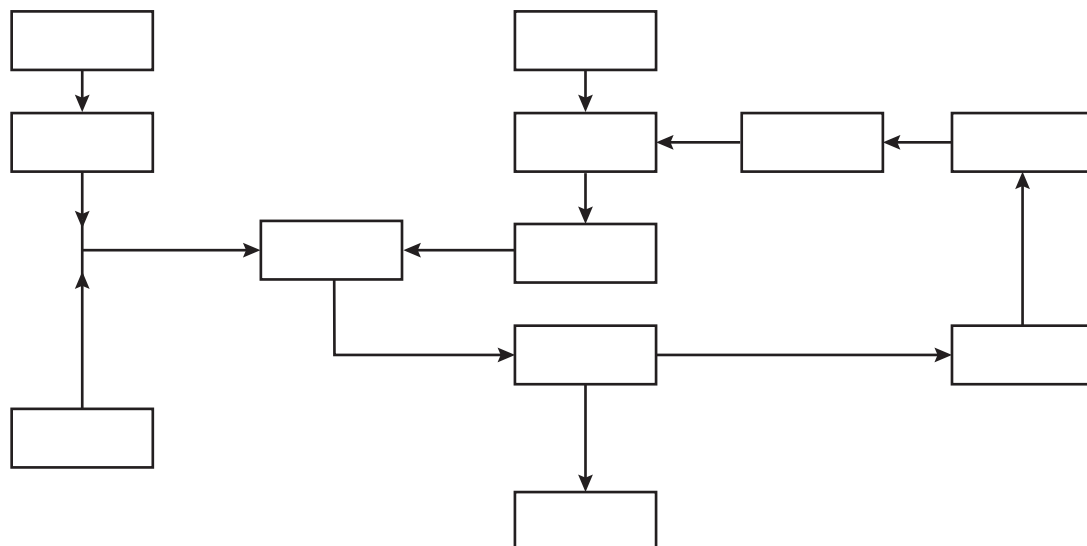
AP 13.1

Distribute Modeling the Cycling of Matter and Energy (AP 13.1). Review the Activity Page so students are clear on what they are making and the criteria for their models. Emphasize that the models must meet the following requirements:

- Show how matter, such as oxygen, water, and food energy, moves through the ecosystem.
- Show the relationship between organisms and the exchange of matter from and back into the environment.
- Identify the producers, consumers, scavengers, and decomposers, as specified in the Student Reader.
- Use illustrations and captions.

Point out that students are specifically being asked to create flowcharts as their models. Make sure students are familiar with how to draw flowcharts. Explain that flowcharts are normally made up of boxes and circles with lines and arrows that connect them. Tell students that for this activity, they should draw pictures of the organisms instead of just writing their names into a box.

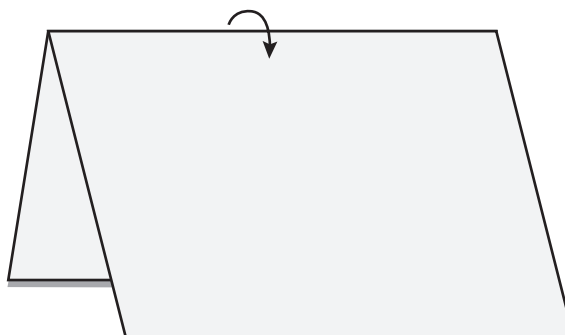
SUPPORT—If necessary, help students understand how a flowchart works by drawing an example flowchart on the board or chart paper. Use the flowchart on the next page as a guide. Emphasize the use of arrows in a flowchart, and explain that flowcharts consist of many different levels that show the order in which things move. Tell students that they can show that a process repeats itself by drawing an arrow from the bottom of the flowchart all the way to the top of the flowchart.



Remind students that they do not have to draw a sketch or write anything on the Activity Page. The Activity Page is there just for support to tell the students what to do. Explain that you will not collect the Activity Page; the only thing you will collect is the completed poster board model.

Show students the materials that they can use to make their poster board models. Give them time to collect their materials and bring them back to their desks. Students will be working on their posters independently.

SUPPORT—If necessary, model for students how to make the folded paper captions. First, take a paper card, and fold it in half. Write a caption on the inside of the card. Then, tape or glue the back of the card to poster board. Lift the top of the card so students can see how the card opens to display a caption. Use the image below as a guide.



5. Facilitate the investigation.

15 MIN

Circulate around the room as students work on their poster board models. Encourage students to refer to their notes from the Student Reader or to the Student Reader itself as many times as necessary in order to get all the information necessary for their models.

CHALLENGE—Give students the option to find a creative way to differentiate producers, consumers, and decomposers on the flowchart. Besides just drawing pictures of the specific organisms, students could use a color-coding system so that all the producers are drawn in green marker, all of the consumers are drawn in red marker, and all of the decomposers are drawn in brown marker, for example. If students choose to do this, they must also include a key on the poster board to tell what the meanings of the colors are.

Have students put their materials and poster boards away, storing them in a safe place. Tell them that they will continue working on their poster board models during the next class session.

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

5 MIN

How can I show cycles of matter in an ecosystem? Review the progress students made on their models in the previous session. Explain to students that today they will finish working on their poster board models. Invite and discuss any questions students may have about the reading or their models.

Then have students take out their poster boards that they started on Day 1, their materials, the Student Reader Chapter 7, and Activity Page 13.1.

2. Facilitate the investigation.

25 MIN

Circulate around the room as students continue working on their models. As you walk around, check students' progress to ensure they are addressing the intent of the Performance Expectation. (See **Know the Standards.**) Check for the following:

- Students are making flowcharts.
- Students are using illustrations.
- Students are writing captions on folded index cards.
- Students are using lines and arrows to show the relationships of how matter cycles through an ecosystem.
- Students understand the correct manner in which matter cycles through an ecosystem.
- Students indicate the correct producers, consumers, scavengers, and decomposers per the Student Reader.

Know the Standards

Cycles of Matter and Energy Transfer in Ecosystems The Evidence Statements for the Performance Expectation focus on modeling the cycling of matter in the ecosystem between and among plants, animals, decomposers, and the environment. To do this, students' models should identify and describe the interactions in the system that allow multiple species to meet their needs.

SUPPORT—If students do not correctly identify the producers, consumers, scavengers, and decomposers, then their entire model will be incorrect. Use the following information to guide students on the right path:

- The producers are orchids, banana trees, bamboo, and coconut trees.
- The primary consumers are macaws, monkeys, fruit bats, and grasshoppers.
- The secondary consumers are vampire bats and frogs.
- The tertiary (or top-level) consumers are pythons and leopards.
- The scavengers are vultures, ants, and millipedes.
- The decomposers are earthworms and coral fungi.

Tell students they do not have to write lengthy captions. The point of the captions is to describe interdependent relationships and the movement of matter among the organisms within the ecosystem. The captions must support the illustrations and relationships depicted in the flowchart models.

SUPPORT—If necessary, give students examples of acceptable captions. For example, at the bottom of the flowchart underneath the decomposer organism, an appropriate caption might be “The decomposed material is then cycled back into the earth to provide nutrients for new organisms to grow.”

3. Summarize and discuss.

10 MIN

Leave time at the end of class for a whole-class discussion about the models that students created. Invite volunteers to share their models, and have students use their models to describe one or all of the following:

- the cycling of matter in the ecosystem (between plants, animals, decomposers, and the environment)
- how the interactions in the ecosystem allow multiple species to meet their needs
- what would happen if a new species (such as a new animal that has no predators) were introduced into the ecosystem; how this type of event would affect the balance of the interactions within the ecosystem
- what would happen if a species were removed from the ecosystem; how this type of event would affect the balance of the interactions within the ecosystem
- how changing an aspect of the ecosystem would affect other aspects of the ecosystem, such as if there were a period of long drought that created a scarcity of water

4. 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 poster board models (you do not have to collect the Activity Pages, as students just used them as guides for the activity). Students should be scored based not on artistic ability, but rather on the ability to clearly and accurately communicate how materials move through the ecosystem as described in the Student Reader.

Check the poster board models against the criteria list found on the Activity Page to ensure completeness and accuracy. Models should be able to do the following:

- tell how matter is cycled through the ecosystem identified in the Student Reader
- show the interdependent relationships within the ecosystem among the producers, consumers, and decomposers
- identify and label the correct producers, consumers, scavengers, and decomposers per the Student Reader:
 - The producers are orchids, banana trees, bamboo, and coconut trees.
 - The primary consumers are macaws, monkeys, fruit bats, and grasshoppers.
 - The secondary consumers are vampire bats and frogs.
 - The tertiary (or top-level) consumers are pythons and leopards.
 - The scavengers are vultures, ants, and millipedes.
 - The decomposers are earthworms and coral fungi.
- include illustrations, captions, and arrows that describe the process
- show that the cycling of matter does not end with decomposers and that it goes back to the beginning to nourish the new producers

LESSON 14

Changes in Ecosystems

Big Question: What happens when ecosystems are disrupted?

AT A GLANCE

Learning Objective

- ✓ Describe specific ways that an ecosystem and its food webs can be disrupted and protected.

Lesson Activities

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

NGSS References

Disciplinary Core Idea LS2.A: Interdependent Relationships in Ecosystems

Crosscutting Concept: Systems and System Models

Science and Engineering Practices: Developing and Using Models

Systems and System Models are important to the topic of food webs and ecosystems because an ecosystem is a self-contained system that, when healthy, is balanced and able to sustain life for the organisms that live there. When ecosystems become unbalanced due to changes or disruptions, they are no longer healthy and may not provide food and shelter that organisms need.

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 purple 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 165–166 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.

disruption interruption

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 Core Vocabulary terms, as designated in purple on the previous page.

Instructional Resources

Student Reader



Ch. 8

Activity Page



AP 14.1

Student Reader, Chapter 8
"Changes in Ecosystems"

Activity Page
Things That Disrupt
Ecosystems (AP 14.1)

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

Materials and Equipment

Collect or prepare the following items:

- drawing paper
- ruler
- crayons or colored pencils (assorted colors)
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What happens when ecosystems are disrupted? Discuss familiar disruptions in ecosystems that students have experienced: heavy rain, freezing, drought, or flooding, for example. Discuss changes students have or have not observed after a disruption. Sometimes these do not affect ecosystems very much at all. Other times, they can destroy ecosystems and harm (or kill) the organisms that lived there. Help students conclude that ecosystems can be disrupted by nature, by human activities, or by events that have both natural and human causes.

Activity Page



AP 14.1

Distribute and review Things That Disrupt Ecosystems (AP 14.1). Tell students that they will read each example and guess whether the event is caused by nature, humans, or both by placing an X in the column. Review the table, and show students the example that was done for them.

Students will need a few minutes to complete the table.

2. Encourage student questions.

5 MIN

In partners, have students discuss their answers to the table on the Activity Page. Ask prompting questions to guide partner discussions, such as the following:

- How does introducing a new species/overhunting/drought change an ecosystem?
(Sample answer: These types of events change whether there is enough food in an ecosystem.)
- Do you think a volcanic eruption has a small or large impact on an ecosystem?
(large)

- What do you think is an example of a small change to an ecosystem? Why?
(*Sample answer: If a fire burns a small area of a crop but is quickly put out, the change is small in comparison to burning the whole crop.*)
- What do you think is an example of a large change to an ecosystem? Why?
(*Sample answer: If a fire is out of control and burns large areas of crops, it can cause a big loss of available foods for many people and animals.*)

3. Read and discuss: “Changes in Ecosystems.”

15 MIN

Student Reader



Ch. 8

Read together or have students read independently “Changes in Ecosystems,” Chapter 8 in the Student Reader. The selection describes examples of human activities that cause ecosystems to become disrupted.

Preview Core Vocabulary Terms

Before students read, write **disruption** 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 47

Draw student attention to the coral on the page. Ask students to describe the differences they see. (*the color change in the coral*) Have students tell what they think these changes mean. (*The coral reef is dying.*) Ask prompting questions, such as, “Which coral do you think attracts the most organisms?”

SUPPORT—Discuss the vocabulary term *disruption*. Explain that this is a term students may hear in everyday language but that each person may have a different idea of what it means for something to be disrupted. Explain that a disruption means that something has been changed, altered, or disturbed. It does not always mean that something is ruined forever. Tell students that sometimes ecosystems can be disrupted but that resilient ecosystems can bounce back and recover from the disruption. This happens when disruptions are minor. Major disruptions, on the other hand, can ruin entire ecosystems and cause them to never recover.

SUPPORT—If necessary, provide more vocabulary support by having students think of examples of disruptions that they experience, see, or hear about in everyday life. For example, a traffic jam on the way to school is a disruption because it might cause the student to be late to school.

CHALLENGE—Have students research the types of damaging activities that cause coral reefs to die, such as coral mining, pollution, overfishing, canal digging, disease, and warming ocean waters. Then have them tell whether these activities are caused by human activities or natural causes.

Pages 48–49

After reading the third paragraph, pause and explain to students that when fires are started by responsible people, they are controlled by professional firefighters who are skilled at making sure the fire does not spread to areas where it is not supposed to go. Controlled fires do not cause as much destruction and devastation to ecosystems as fires that are caused by lightning or by accident, which may spread uncontrollably.

CHALLENGE—If time permits, have students research wildfires in California or other states and tell how those fires were started, as well as the effects of those fires on the ecosystem in those areas. Challenge students to address some of the beneficial effects of wildfire.

Page 50

Draw student attention to the food web. Ask students what would happen if lobsters could be caught without any rules or limitations. Discuss what would happen to the population of mussels and seaweed. Ask students to explain how a decline in the population of lobster would affect the population of gulls.

CHALLENGE—If time allows, have students compare overfishing to overhunting by researching hunting rules. There are government rules about what kinds of animals people are allowed to hunt, when they are allowed to hunt them, and how many they are allowed to kill. Have students tell what would happen to the animals on land without those rules in place. Then have students tell why some hunting is beneficial to certain ecosystems. (*population control*)

Page 51

Pause after reading the first paragraph, and emphasize the idea that each tree or plant that is cut down could be a home or food source to an animal and that the loss of a single tree can be a disruption to an ecosystem.

After reading the rest of the page, ask: “What happens when animals lose their homes, such as trees?” (*They must move; they have to make new homes.*) Ask students to tell what would happen if an animal does not find a new home quickly enough. (*It could get eaten by a predator or die from lack of food.*)

Discuss with students how invasive species end up in new locations. Use the following prompts:

- » What kinds of natural processes can cause species to end up in new places? (*wind, water*)
- » What kinds of human activities can cause species to end up in new places? (*keeping exotic pets, boats and planes traveling from place to place*)

SUPPORT—Have students reiterate why invasive species can be harmful to ecosystems, and check for understanding. (*resource competition, predation, population overgrowth*)

CHALLENGE—If time permits, have students research other interesting examples of invasive species, such as the Burmese python in Florida, the kudzu plant in Georgia, or the emerald ash borer in Ohio, and tell how those species came to exist in their new locations. Then have students tell possible solutions for controlling the population of those organisms.

After reading the first paragraph, explain to students that more and more, companies are trying to produce household products, such as laundry detergent and soap, that are good for the environment. These products are often advertised as “eco-friendly,” which implies that they will not harm ecosystems. These products are often made with more natural ingredients and fewer harsh chemicals, such as bleach, that can be toxic to the environment.

SUPPORT—Dry soil may be one cause of ecosystem disruption. If necessary, make sure students understand that dry soil is hard for certain plants to grow in. Some plants, such as desert cacti, are used to growing in dry soil because they have adaptations that allow them to store water all year long. However, most plants are used to having access to water on a continuous basis through the soil. When the soil dries up, the plants no longer get as much water as they need, and the plants could end up drying up and dying. Have students describe the chain reaction between dry soil and organisms that depend on trees for living in a balanced ecosystem.

CHALLENGE—Have students research a famous oil spill in history and discuss its effects on the ecosystem.

4. Demonstrate examples and guide discussion.

10 MIN

Choose one or more of the following examples to stimulate further discussion. Analyze the following with students:

- how certain events disrupt ecosystems and food webs
- what kinds of activities or natural events disrupt ecosystems and food webs
- how ecosystems can be protected from disruption (see **Know the Science** for support with the analysis)

Draw a human activity story strip.

- Pass out drawing materials to students, including drawing paper, a ruler, and assorted colors of crayons or colored pencils.
- Tell students to draw four even boxes on the paper, and this will become their story strip. Students can make their boxes vertical or horizontal on the page.

Know the Science

Are there interdependent relationships in ecosystems? Yes! There are several ways in which organisms have interdependent relationships in ecosystems. One such way is through food. Organisms within an ecosystem are related through food chains and food webs. Shelter and protection are another way in which the interdependence between relationships exists within ecosystems. Many animals and living things use trees and plants for shelter and protection from predators, competing species, or weather. The goal of the activities in this section is for students to understand the interdependent nature of ecosystems, in which disruptions can have a trickle-down effect on the other organisms in the ecosystem.

- In each box, students draw a picture that tells a simple story about a human activity affecting an ecosystem. For example, Box 1 could show a picture of a pretty forest. Box 2 could show a picture of people cutting down trees. Box 3 could show a picture of no more trees in the forest. Box 4 could show a picture of animals moving to a new home.
- Students can choose to show a human activity from the Student Reader or one that has not yet been discussed.

SUPPORT—If students need ideas for human activities that were not covered in the Student Reader, you can recommend waste, pollution, overhunting, or overpopulation.

Online Resources



Show a video that reviews how deforestation is a human activity that disrupts ecosystems. (See the Online Resources for a link to a suggested video.) After students watch the video, ask them follow-up questions such as these:

- » Which human activity contributes the most to deforestation? (*agriculture/farming*)
- » How does deforestation disrupt ecosystems? (*Many animals depend on the forests for food and shelter. Without those forests, the organisms can go hungry or die.*)
- » What can people do to help reverse the effects of deforestation? (*plant new trees*)

Online Resources



Show a video that reviews how humans negatively and positively affect ecosystems. (See the Online Resources for a link to a suggested video.) After each example, pause the video to discuss why the human activity harms or helps the balance of an ecosystem. Use the following question prompts to guide the discussion:

- » How does human population affect ecosystems? (*Growing populations put a strain on ecosystems because more people need more resources.*)
- » In what way does pollution harm ecosystems? (*Water, air, and soil can become polluted and harm the organisms that need these factors to survive.*)
- » How can climate change negatively impact ecosystems and food webs? (*As the climate changes, certain organisms may not be able to survive in certain parts of the world anymore. If those organisms die and become extinct, this will impact the food web.*)
- » How do you think protecting endangered species helps ecosystems? (*Protecting endangered species prevents them dying off, so this human activity can preserve their place in a food web to have a balanced ecosystem.*)

Use this link to download the CKSci Online Resources Guide for this unit, where specific links to these resources may be found:

www.coreknowledge.org/cksci-online-resources

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

- » What kinds of changes can disrupt an ecosystem? (*Natural events such as drought and earthquakes, as well as human activities such as deforestation, can disrupt ecosystems.*)
- » What did you read about in the reading selection that is like these activities? (*Ecosystems react to changes that occur naturally and through human activities.*)

5. Teach Core Vocabulary.

5 MIN

Word Work

Instruct students to prepare a Core Vocabulary card for **disruption**. Ask students to compare the words *disruption* and *interruption*. Discuss what the root word *rupt* might mean. Explain that *rupt* is a root word that comes from a Latin word that means break.

Compare the prefixes *dis-* and *inter-*. Guide students to understand that *dis-*, which can mean not, also means apart and that *inter-* means between. So, there is a difference between the two words. To disrupt is to break apart. To interrupt is to break between. Both can be applied to changes in an ecosystem, although a disruption indicates something more severe than an interruption. Have students write an example of an ecosystem disruption. (*Sample answer: Drought that dries up a pond disrupts an aquatic ecosystem.*)

6. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

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

- Collect the completed Things That Disrupt Ecosystems (AP 14.1) student pages. Scan the tables to check for proper understanding of whether the events are caused by nature, human activities, or both.
- 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, such as explaining why sometimes ecosystems are not able to recover from disruptions or why some types of human activities may seem bad for the ecosystem but are actually beneficial.

LESSON 15

People and the Environment

Big Question: What happens when human activity disrupts an ecosystem?

AT A GLANCE

Learning Objective

- ✓ Gather evidence to show how a specific ecosystem can be disrupted by changes in the environment and by human activities.

Lesson Activities (2 days)

- student research
- student writing

NGSS References

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Crosscutting Concepts: Scale, Proportion, and Quantity; Systems and System Models

Science and Engineering Practices: Developing and Using Models

Systems and System Models are important to the topic of ecosystems because it is important to understand the components of a system and how those components interact to maintain a healthy balance within the system itself.

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 in this lesson.

disruption

ecosystem

environment

evidence

Instructional Resources

Activity Page



AP 15.1

Activity Page

Research and Writing Guide
(AP 15.1)

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

Materials and Equipment

Collect or prepare the following items:

Day 1: library or computer (internet) access

Prepare in advance for this class by scheduling time at the school library or computer lab, as students will need to conduct research on their assigned organism. If you have enough computers for each student in your classroom, the research for Day 1 can be conducted in the classroom.

On Day 1, students will conduct research on human activities that disrupt ecosystems.

On Day 2, students will write a report on their findings using paper or computers.

THE CORE LESSON TWO DAYS, 45 MIN EACH

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

5 MIN

What happens when human activity disrupts an ecosystem? Remind students that in previous lessons, they learned about the interdependent relationships found within ecosystems. Interdependent relationships mean that changes to one organism (or nonliving thing) can result in changes to other organisms (or non-living things). Tell students that they also learned that a healthy ecosystem is made up of multiple organisms that have their needs for food and shelter met in a way that maintains stability. When the ecosystem becomes disrupted, those needs can no longer be met. (See **Know the Science** for support.)

Discuss with students some things not related to humans that can disrupt an ecosystem, such as natural disasters. Use prompts such as the following to help prepare students for their research:

- » What's an example of a natural disaster that can disrupt an ecosystem?
(forest fire)

Know the Science

If an ecosystem is disrupted, is it destroyed? No. Ecosystems are continually being disrupted and restabilized due to human and natural activity. For example, clearing forest land for farming will disrupt the plants and animals that live in the ecosystem. Some organisms that use the trees for shelter and food will move. But some plants, such as dandelions, and some animals, such as birds, different insects, and mice, may adapt to the new ecosystem.

- » What would happen during a forest fire? (*Trees would burn down.*)
- » If there are no trees, what happens to the animals that lived in the trees? (*They wouldn't have a place to live; they would have to move and find a new home.*)
- » If there are no trees, what happens to the animals that ate the leaves of those trees? (*They wouldn't be able to eat; they would have to find new things to eat.*)
- » If the animals could no longer eat or did not have trees for hiding and protection, they might die. What happens to the stability of that ecosystem? (*It gets thrown off balance.*)

2. Preview the research activity.

5 MIN

Activity Page



AP 15.1

Distribute Research and Writing Guide (AP 15.1). Review the Activity Page with students, and explain that they will use the outline to guide their writing. Remind students that they will work on researching a human activity during Day 1 and writing their reports on Day 2.

When reviewing the questions on the Activity Page for Day 1, tell students that they need to describe the ecosystem being disrupted, whether it is a rain forest, a grassland, a coral reef, a lake, etc.

Review the report criteria with students to make sure they understand what they need to focus on for their reports. Specifically, reports must accomplish the following:

- Introduce the human activity that disrupts the ecosystem.
- Identify and describe evidence that supports how the ecosystem has been disrupted by that human activity.
- Identify the sources used for the research.
- Consist of five paragraphs.
 - Paragraph 1 introduces the human activity.
 - Paragraphs 2–4 describe evidence of the human activity disrupting the ecosystem.
 - Paragraph 5 is a conclusion.
- Explain that changing an aspect of an ecosystem will affect other aspects of the ecosystem.

SUPPORT—Give students an example of types of evidence that they could use for their research. For instance, data may show a certain number of species living in a wooded area for a certain number of years and then show a decline in the number of species living in that area after the woods have been cleared for urbanization.

Tell students that they do not have to propose solutions to these human activities.

3. Facilitate the research.

35 MIN

Have students conduct their research independently. They can use library books or online resources to do their research.

Circulate around the room as students conduct their research. As students answer the questions on the Activity Page, provide some additional guiding questions, such as the following:

- How is the food web disrupted by that human activity?
- How does the cycling of matter become disrupted by that human activity?
- How does changing that aspect of the ecosystem affect other parts of the ecosystem?
- What evidence can you find of the ecosystem becoming disrupted?

SUPPORT—If necessary, remind students that there are interdependent relationships within ecosystems. Remind students about food webs, and discuss what happens when an organism is removed from the web. For instance, if an animal eats a certain type of plant but that plant dies off and no longer exists, then the animal would be affected by the loss of that plant. The loss of the plant affects several organisms within the food web.

SUPPORT—If necessary, explain that a disrupted ecosystem does not mean that all the organisms within the ecosystem have died or gone extinct. A disrupted ecosystem means that the ecosystem has been thrown off balance and is no longer stable or healthy for some organisms.

SUPPORT—If students struggle to come up with human activities that can disrupt ecosystems, provide the following suggestions: cutting trees, clearing land for new construction, farming/agriculture, plastic production, emission of greenhouse gases, overfishing, urbanization, overhunting.

NOTE—If your school has a specific policy or preference for citing research resources, tell students how you prefer for them to format their resources, or tell them what kind of information to include, such as author name, publication date, journal title, and page number.

Remind students that they need to research three pieces of evidence to support that the human activity they chose has disrupted the ecosystem. They will write about each piece of evidence in their reports.

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

5 MIN

Activity Page



AP 15.1

What happens when human activity disrupts an ecosystem? Remind students that they already conducted research on their human activities and collected evidence on how the human activity disrupts the ecosystem.

Tell students to use the Activity Pages that they started on Day 1 of the lesson to organize what they want to discuss in their written reports. Then they will write their five-paragraph reports on paper or on a computer.

Review the report criteria with students to make sure they understand what they need to write about. Specifically, reports must accomplish the following:

- Introduce the human activity that disrupts the ecosystem.
- Identify and describe evidence that supports how the ecosystem has been disrupted by that human activity.
- Identify the sources used for the research.
- Consist of five paragraphs.
 - Paragraph 1 introduces the human activity.
 - Paragraphs 2–4 describe evidence of the human activity disrupting the ecosystem by discussing the interdependence/interconnectedness of the organisms and the nonliving parts of the ecosystem.
 - Paragraph 5 is a conclusion.
- Explain that changing an aspect of an ecosystem will affect other aspects of the ecosystem.

Remind students that they do not have to propose solutions to these human activities.

2. Support student writing.

30 MIN

Circulate around the room as students work independently on their written reports. Explain to students that each paragraph should clearly explain the interconnectedness of the living and nonliving parts of the ecosystem as it relates to the evidence being cited.

SUPPORT—If necessary, remind students to only focus on one piece of evidence in each of the body paragraphs of the report. They should introduce the evidence first and then explain why this is important in proving that the ecosystem was disrupted by the human activity. The evidence they are using should make sense to the reader in the context of the paragraph.

As you circulate around the room, ask students to tell a little bit about their research findings. For example, ask the following:

- What is the human activity that you chose to focus on? (*Student answers will vary.*)
- What kind of evidence did you find? (*Provide prompts as needed, such as asking how the evidence is connected to a specific human action.*)

Give a five-minute warning for students to finish up their reports and write their concluding paragraphs.

3. Summarize and discuss.

5 MIN

- Lead a whole-class discussion about students' findings. Have volunteers share the types of human activities they focused their research on and tell why or how the activity disrupts the ecosystem.
- Make a class list of the evidence students cited that showed an environment was disrupted.

- Ask the class follow-up questions, such as the following:
 - » Does this human activity have a small- or large-scale impact on ecosystems? What evidence supports your conclusion?
 - » How would an ecosystem be able to recover from this disruption? (*Student answers may include plans for rebuilding, replanting, or planning ways to prevent a similar disruption later.*)
- If time allows, ask a challenge question, such as the following:
 - » What is a proposed solution to this problem (the human activity)? (*Sample answer: Replant the trees once the debris has been cleared.*)

4. Check for understanding.

5 MIN

Activity Page



Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 15.1) for correct answers and sample student responses.

- Collect and review the completed Research and Writing Guide Activity Pages, checking for completeness. If you told students to use a specific format for citing resources, make sure those formats were followed.
- Collect and review students' reports, checking for all of the required criteria:
 - The report contains five paragraphs. Paragraph 1 introduces the human activity. Paragraphs 2–4 describe evidence of the human activity disrupting the ecosystem. Paragraph 5 is a conclusion.
 - It introduces the human activity that disrupts the ecosystem.
 - It identifies and describes evidence that supports how the ecosystem has been disrupted by that human activity.
 - It explains that changing an aspect of an ecosystem will affect other aspects of the ecosystem.

UNIT REVIEW

Energy and Matter Review Game

Big Question: What have I learned about ecosystems?

AT A GLANCE

Learning Objective

- ✓ Fluently discuss the flow of matter and food energy in ecosystems.

Lesson Activities

- review discussion
- vocabulary game

NGSS References

5-PS3-1 Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain warmth) was once energy from the sun.

5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the 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

The Big Idea

Ecosystems are complex and dynamic systems of living things and the nonliving factors in their environment. The ever-changing nature of ecosystems and their delicately balanced interrelationships function through the consumption and production of matter and the transfer and transformation of energy that fuels life processes. The Big Questions that students have explored in this unit focus students on the reality that living things require energy to sustain their life processes. The energy that organisms use has to come from somewhere.

- Producers use energy from sunlight to make their own food.
- Producers then become food, the energy source, for consumers. As such, they pass forward energy from the sun.
- Eventually all organisms die, and their matter is broken down by decomposers for energy, still another transfer of energy that originated from the sun.

During life processes, organisms use and release energy in chemical reactions. Photosynthesis and metabolism are systems of chemical reactions through which organisms transform matter. Matter and energy are constantly cycled among organisms in ecosystems in these processes.

Core Vocabulary

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

carnivore	energy transfer	herbivore	photosynthesis
consumer	energy transformation	hydroponics	producer
decomposer	food chain	metabolism	scavenger
disruption	food web	omnivore	sugar
ecosystem	glucose	organism	transpiration

Language of Instruction: Students should refer to their full set of Core Vocabulary cards during the review discussion.

Instructional Resources

Activity Pages



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

Activity Pages

Energy and Matter Review
Game (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:

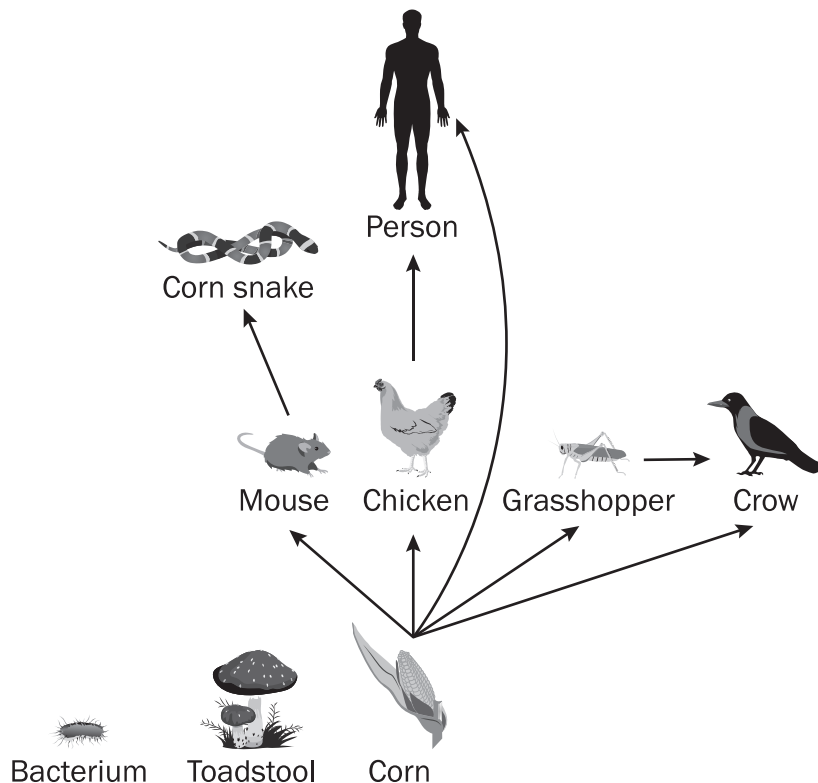
- front board
- front board markers (or chalk)
- question and answer cards/sheet
- timer (or phone)

LESSON PREPARATION

Write approximately twenty questions (with answers) for the game on your own cards or on a sheet of paper. Have the questions ready to read when you play the game with the class, and make sure students cannot see or have access to the answers. 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. Additionally, some questions should require a model of a food chain or food web to be drawn or labeled. If one or more of your questions require a food chain or food web, draw the models on the front board before class starts, and cover them with a big sheet of paper so students cannot see them. A bank of sample questions is provided here:

1. Where do producers get the energy they need to make their own food? (*sun or sunlight*)
2. What is a consumer? (*an organism that eats another organism*)
3. Name one thing animals use food for. (*body repair, growth, motion, warmth*)
4. The process in which plants use sunlight to make glucose is known as what? (*photosynthesis*)
5. When food is converted into energy, this process is known as what? (*metabolism*)

6. What is an example of a carbohydrate? (*sucrose, fructose, glucose*)
7. What is an herbivore? (*an organism that only eats plants*)
8. An organism that eats animals is called a what? (*carnivore*)
9. What do decomposers do? (*break down dead organic material*)
10. What is an ecosystem? (*a community of organisms and a physical environment that interact*)
11. Name four examples of an ecosystem. (*desert, lake, river, coral reef, tundra, grasslands, forest, rain forest*)
12. What is a food chain? (*a model that shows how organisms depend on the next as a source of food*)
13. What is a food web? (*a model that shows how multiple food chains interconnect to represent how organisms depend on each other as a source of food*)
14. Name two human activities that disrupt ecosystems. (*deforestation, agriculture, urbanization, controlled forest fires, overhunting, overfishing, overpopulation*)
15. Name two natural events that can disrupt an ecosystem. (*volcanic eruption, earthquake, hurricane, tornado, fire, drought, flood*)
16. True or false: Plants cannot grow without soil. (*false*)
17. The following organisms live in a marine ecosystem: dolphin, shrimp, algae, shark. Place the organisms in order of their food chain. (*algae, shrimp, dolphin, shark*)
18. Study the food web on the board or chart paper. Which organism would increase if the snake population decreases? (*example: mouse*)
19. Study the food web on the board or chart paper. Which organisms are herbivores? (*grasshopper, mouse, chicken*)



20. Fill in the food chain on the board or chart paper:

sun > producer > consumer > scavenger > _____ (decomposer)

Shuffle the questions into a random order so that you do not have too many similar questions back to back.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What have I learned about ecosystems?

Review with students what they learned throughout this unit about the following:

- photosynthesis
- metabolism
- flow of energy among organisms
- herbivores, carnivores, and omnivores
- producers, consumers, scavengers, and decomposers
- food chains
- food webs
- ecosystems
- ecosystem disruptions

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 cards. Explain that they will also have to recall concepts, including models such as food chains and food webs, that they learned in the unit. Place students in two or three large groups, and explain that each group will perform as a team. Distribute Energy and Matter Review Game (AP UR.1). Review the game rules and instructions together.

Make sure the front board or chart paper is clean and markers (or chalk) are available for students to use.

3. Review together.

35 MIN

Assign each team a number, and write the team numbers on the board or chart paper. This is where you will keep score of the game points.

Use a fair, random method to determine which team will go first.

To play, each team will send one student up to the board or chart paper to compete against the other teams. Students are ready with their markers (or chalk) to write the answers on the board or chart paper. Read the question, and use your timer to give the students thirty seconds to answer. Since this is a race, you must pay attention to which student answers the question first and then check their work to see if

the answer is correct. If the answer is not correct, then the student that answered first does not get a point. If the student that comes in last answers the question correctly, that student wins the point for their team. If all students get the answer wrong, give the class one more chance to answer it correctly. If no team answers correctly, nobody gets the point, and the next students come up to the board or chart paper for the next question.

As you use each question, discard the card for that question—or cross that question out on your question sheet—so that you do not ask the same question twice.

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.

For additional vocabulary reinforcement prior to administering the Unit Assessment, distribute Vocabulary Crossword Puzzle (AP UR.2) and Vocabulary Review (AP UR.3) as take-home assignments.

Activity Pages



AP UR.2

AP UR.3

Teacher Resources

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Name _____

Date _____

Activity Page 1.1

Use with Lesson 1.

Library Scavenger Hunt

Use the library's resources to research a living thing.

Which living thing did you choose?

Complete the chart to explain what makes your living thing alive.

Life Process	How It Works
Does it move? If so, how?	
Does it breathe or respire? If so, how?	
Is it sensitive to changes in its environment? If so, how?	
Does it grow? If so, how?	
Does it reproduce? If so, how?	
Does it get rid of waste? If so, how?	
Does it take in or make nutrients? If so, how?	

Name _____

Date _____

Activity Page 1.2 (Page 1 of 2)

Use with Lesson 1.

Plant Data Sheet

There are many ways to grow plants! Today you will use simple materials to see how a plant will grow.

Collect your materials.

What materials will you use to grow your plant?

Take measurements of the plant.

How will you measure the original length of your plant?

Fill the container with water. Draw a line with your marker at the water level.

Place the plant into the water.

Weigh the plant, water, and container together.

How will you weigh the plant, water, and container?

Fill in the data table below.

Measurements	Lesson 1	Lesson 5	Lesson 9
Length of plant			
Weight of water, plant, and container			
Other observations			

Answer the questions that follow for Lesson 5.

What observations can you make about how the plant changed from Lesson 1 to Lesson 5?

What do plants need to grow?

Write an argument about plant growth based on your observations.

What evidence do you have to support your argument?

Answer the question that follows for Lesson 9.

Review your answers from Lesson 5.

Was your argument about plant growth accurate, based on your observations and evidence from Lesson 9? Explain your answer using evidence from your latest observations.

Name _____

Date _____

Activity Page 2.1

Use with Lesson 2.

Organisms and Chemical Energy

Complete the table. Select one living organism for each line, and answer each question that follows. Be sure to choose both plants and animals. You may choose any plant or animal that hasn't been used in class already. The first example has been done for you.

Living Thing	Where does it get its food, or chemical energy?	Does it move to get food?	How does it stay warm?
muskkrat	It gets energy from the plants and other animals that it eats.	It uses its arms and legs to walk and swim to get food.	Its body generates heat to help keep it warm. Its body has a covering of hair to help keep it warm.

Name _____

Date _____

Activity Page 3.1

Use with Lesson 3.

Photosynthesis Model

Draw a model of photosynthesis. Show the source of the energy the plant uses, as well as where in the plant the process takes place. Label what, besides energy, the plant uses and what it releases once the process is completed.

Name _____

Date _____

Activity Page 4.1

Use with Lesson 4.

Model Checklist

Build your model. Choose from one of the following types:

- four-sided box
- flip-book
- diorama

Use the information below as you build your models.

- **Four-sided box**
 - Draw one part of the food chain on each side of the box.
 - Use arrows in your drawings to show how the box should be turned in the order of how energy flows through the food chain.
 - Use labels to show important parts of the energy passing through the food chain.
- **Flip-book**
 - Use a separate piece of paper for each part of the energy passing through the food chain.
 - Use labels to show important parts of energy passing through the food chain.
 - When you put the pages together, put the beginning of energy passing through the food chain on the bottom, and work your way to the top. The top of your book should have the final part of energy passing through the food chain.
 - Fasten the pages together in this order to make a book.
- **Diorama**
 - Show the progression of energy passing through the food chain.
 - Begin on the left, and move to the right side of the diorama.

Name _____

Date _____

Activity Page 4.2

Use with Lesson 4.

Energy's Path Through Living Things

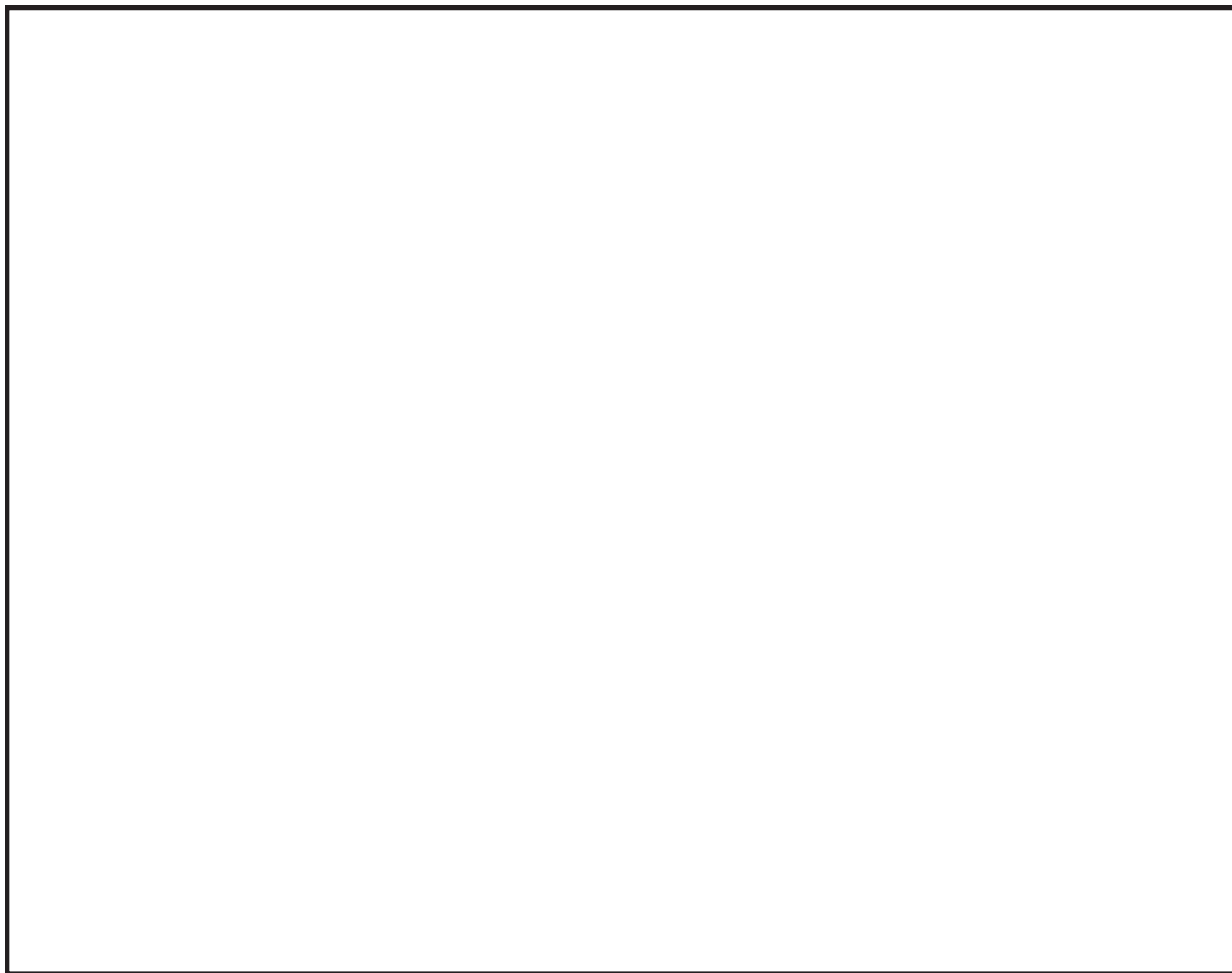
Answer each question below to help you build your model.

Which model will you build?

Where does the energy in the food chain begin? _____ Make this the starting point for your model.

You should be the final organism in your model. When possible, include at least three other organisms between the starting point and you.

Before you build your model, plan it out first. Draw it in the box below.



Name _____

Date _____

Activity Page 6.1

Use with Lesson 6.

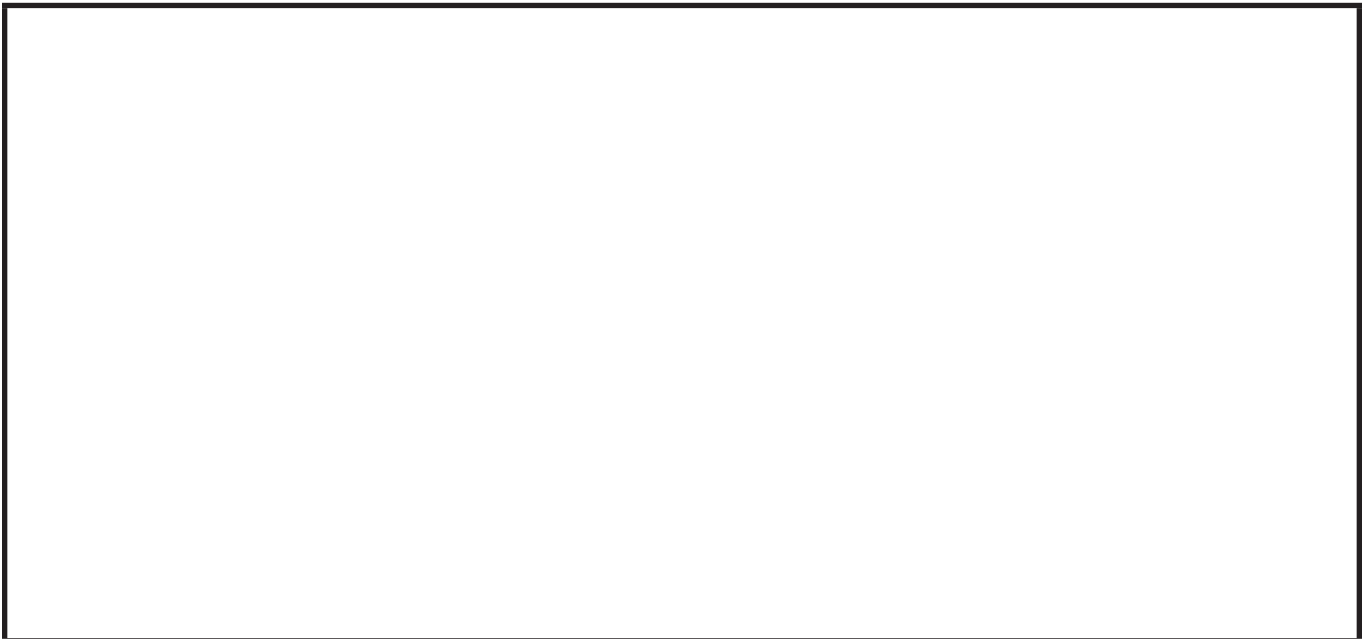
A Needy Plant in the Neighborhood

Like animals, all plants have needs they must meet to survive, grow, and reproduce.

Research a plant that grows in your neighborhood. You can choose any plant you wish. It can be a kind of tree, bush, weed, flower, or crop. Explain what needs the plant has and how it meets those needs.

Write the name of your plant here: _____

Draw what your plant looks like in the box.



What are your plant's needs?

How does your plant meet those needs?

What consumes your plant?

Name _____

Date _____

Activity Page 7.1

Use with Lesson 7.

A Rough Draft of Your Model

Today you will model how photosynthesis works!

Think about the kind of model you want to make. Use the space below for notes or to sketch a rough draft of your model.

Collect your materials.

Make your model. Use the following criteria:

- Include the following terms in your model: *sunlight, carbon dioxide, water, glucose, oxygen.*
- Include arrows in your model that show how the parts of the process connect.

Name _____

Date _____

Activity Page 8.1

Use with Lesson 8.

Energy from the Sun to You

Energy passes from the sun into plants and then into everything that eats the plants.

Draw the path energy gets from the sun to you. Where possible, your path should include a producer, a consumer, a secondary consumer, and then you.

After you have completed the path, label each organism as a producer or a consumer. Then, label each consumer as an herbivore, a carnivore, or an omnivore. When you are done, go back to your path, and add a scavenger.

Name _____

Date _____

Activity Page 9.1 (Page 1 of 3)

Use with Lesson 9.

Research Guide Day 1

Over the next three days, you will conduct an activity that includes researching an organism, preparing a presentation with your group, and presenting information about how energy from the sun flows through the organisms within an environment.

Answer these questions before you start.

What organism are you researching? _____

How will you research this organism? _____

Perform your research. Answer the following questions as you learn about your organism.

Where does your organism get its energy? _____

What does your organism eat? _____

What other organisms eat your organism? _____

Do you think your organism is a producer, consumer, scavenger, or decomposer? Why?

What kind of environment does your organism live in? _____

Print or photocopy a picture of your organism. You can also check out a library book with pictures in it.

Research Guide Day 2

Find your group based on the environment where your organism lives.

Discuss the following with your group:

- which organism is the producer
- which organisms are the consumers
- which organism is the scavenger
- how all of the organisms in your group link together to keep energy moving through the environment
- how each organism relates to the link before it and after it in the energy chain
- possible omnivores that would be found in the same environment

Answer the questions that follow.

What is your environment? _____

Which organism in your environment is the producer? _____

Which organism in your environment is the primary consumer? _____

Which organism in your environment is the secondary consumer? _____

Which organism in your environment is the tertiary consumer, or main predator? _____

Which organism in your environment is the scavenger? _____

Write down the order in which energy flows through the organisms in your environment.

How does your assigned organism relate to the organism before and after it?

What kind of omnivore would you expect to find in your environment?

Study the presentation criteria on the next page to make sure your group is ready to present.
Rehearse your presentation with your group.

Research Guide Day 3

Present your group's organisms and environment. Use the following criteria for your presentation:

- Team members stand in order from producer to scavenger.
- Team members take turns presenting.
- The first team member to present introduces the environment.
- Each team member states two or three sentences about his/her organism and does the following:
 - introduces the organism
 - talks about the organism in the order in which energy flows through the environment, starting with the producer and ending with the scavenger
 - tells where the organism gets its energy
 - explains the organism's link in the chain of energy by telling how the organism relates to the organism before or after it (example: *My organism gets its energy from _____, which gets its energy from _____, which gets its energy from _____.*)
 - shows the audience a picture of the organism
- Teams present for three to five minutes each.
- Teams identify a possible omnivore that would exist in their environment.
- Teams use the following terms: *sunlight, energy, photosynthesis, herbivore, omnivore, carnivore, producer, consumer, scavenger.*

Listen carefully to each presentation as an audience member. See whether each team uses the terms mentioned above.

Ecosystem: Yes or No

Ecosystems exist all over the world. But what is an ecosystem?

Complete the table below as your teacher shows you pictures.

What is the picture of?	Yes, this is an ecosystem.	No, this is not an ecosystem.

Name _____

Date _____

Activity Page 11.1

Use with Lesson 11.

Ecosystem Investigation

Ecosystems can be small or large, but they exist everywhere, including at your school!

Describe the ecosystem you are investigating.

What living organisms, including plants and animals, did you notice in the environment?

What nonliving things did you notice in the environment?

How do the living and nonliving things interrelate and affect each other?

What do you think would happen if one of the living or nonliving things were taken away? What kind of impact would it have on the environment?

Do you think this is an example of an ecosystem? Why or why not?

Name _____

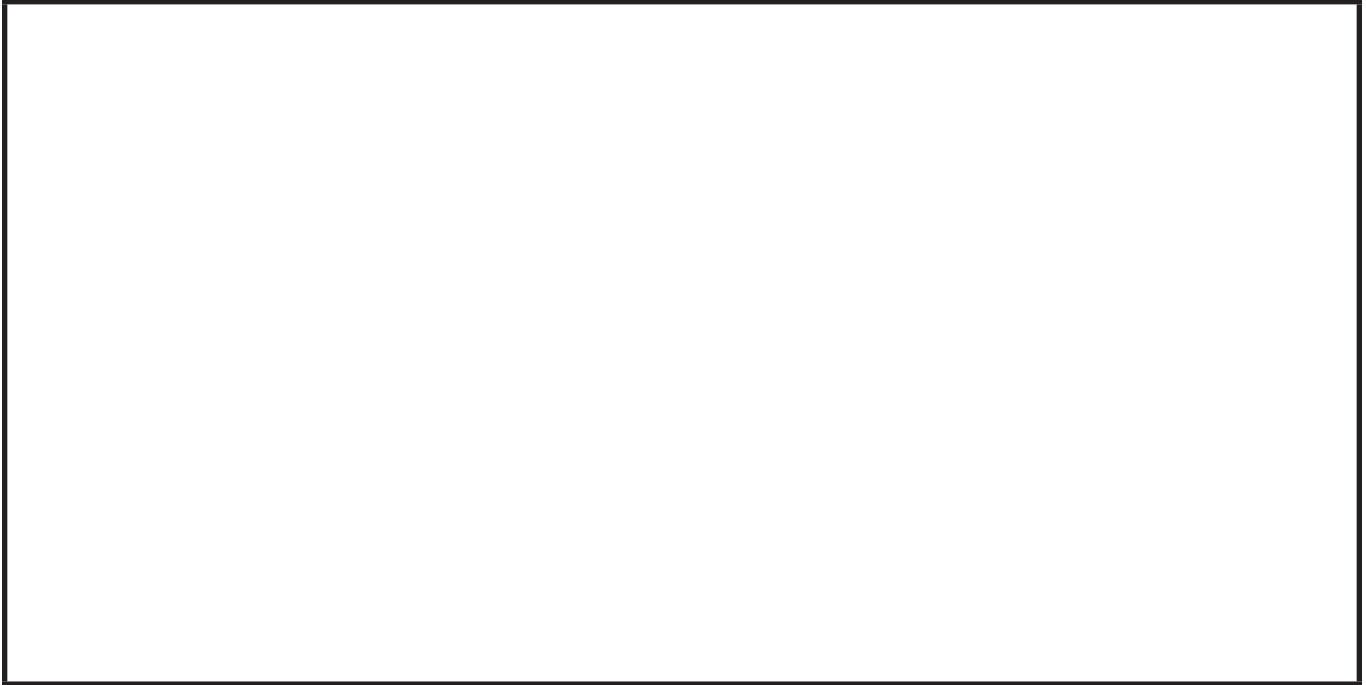
Date _____

Activity Page 12.1

Use with Lesson 12.

Chains and Webs

Draw a picture of a food chain with at least three different organisms.



Draw a picture of a food web in an ecosystem. Include the food chain you drew as well as five other organisms.



Name _____

Date _____

Activity Page 13.1

Use with Lesson 13.

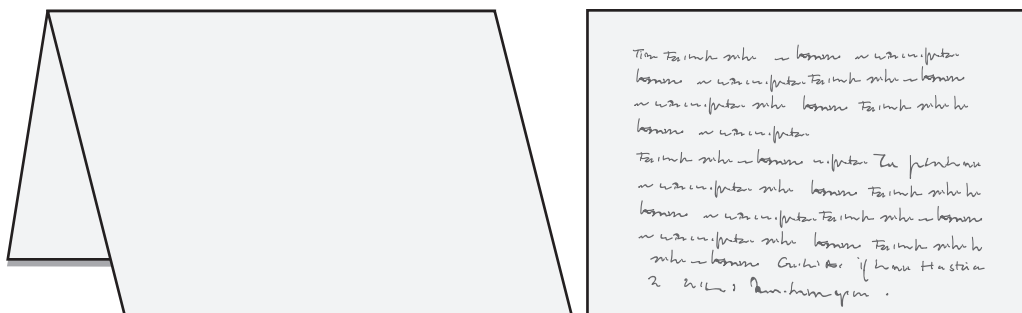
Modeling the Cycling of Matter and Energy

You read about an ecosystem in a rain forest. Now it's time to make your model.

Gather your materials, including the notes you took while reading Chapter 7 Rain Forest Ecosystem Field Diary.

Make a poster that shows how matter and energy cycle through the organisms identified in the rain forest ecosystem. Use the following as a guide and criteria list for your models:

- Model the flow of matter and energy as a flowchart.
- Show what happens to gas (oxygen), water, and plant materials throughout the cycle.
- Identify and label the specific organisms from the reading, including producers, consumers, scavengers, and decomposers.
- Make folded paper captions that tape to the poster board, open up, and describe the interdependent relationships and steps in the cycle. (See below for an example.)



Name _____

Date _____

Activity Page 14.1

Use with Lesson 14.

Things That Disrupt Ecosystems

Ecosystems exist all over the world. But they can often be changed by events that occur within or near them.

Complete the table below to tell whether each event is something caused by nature, human activities, or both.

Event	Caused by Nature	Caused by Humans	Caused by Both
<i>Volcanic eruption</i>	X		
Overhunting			
Introducing new species			
Drought			
Disease			
Overfishing			
Wildfires			
Pollution			

Name _____

Date _____

Activity Page 15.1 (Page 1 of 2)

Use with Lesson 15.

Research and Writing Guide

Over the next two days, you will conduct research on a human activity that disrupts an ecosystem. You will gather evidence that supports how that activity disrupts the ecosystem and write a report about it.

Day 1

Answer these questions.

What is the human activity you are researching?

Describe the ecosystem being disrupted.

What sources are you using for your research?

What three pieces of evidence show that the human activity disrupts the ecosystem?

Day 2

Use the five-paragraph outline below to organize your report. Write what you will cover in each paragraph on the line.

Paragraph 1 (Introduction):

Paragraph 2 (Body):

Paragraph 3 (Body):

Paragraph 4 (Body):

Paragraph 5 (Conclusion):

Use the following criteria for your report:

- Report is five paragraphs.
 - Paragraph 1 introduces the human activity.
 - Paragraphs 2–4 describe evidence that the human activity has disrupted the ecosystem by discussing interdependent relationships.
 - Paragraph 5 provides a conclusion.
- Report explains that changing an aspect of an ecosystem will affect other aspects of the ecosystem.

Name _____

Date _____

Activity Page UR.1

Use with Unit Review.

Energy and Matter Review Game

Game Rules

In this game, you will work with your team to answer the most questions and score the most points.

- One student from each team will approach the board or chart paper and have their markers or chalk ready.
- The teacher will read a question.
- The students from each team will race to write the correct answer on the board or chart paper (or draw a correct model/diagram on the board or chart paper).
- Students will get thirty seconds to answer the question, and they will be timed.
- The team that gets the answer correct first wins a point.
- If no student answers the question correctly, the teacher opens up the question to the rest of the class, and students can race to raise their hands and answer it first.
- After each question, a new student from the team approaches the board or chart paper and has a chance to answer. All students will get at least one chance to answer a question at the board or chart paper.
- Students can bring their Core Vocabulary cards with them to the board or chart paper and use them to search for the answers.
- The team with the most points at the end wins.

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 the words in the word bank to complete the crossword puzzle. Not all words will be used.

carnivore	ecosystem	glucose	metabolism	predator
consumer	energy	herbivore	natural	producer
decomposer	food chain*	hunting	oxygen	scavenger
deforestation	food web*	metabolism	photosynthesis	sunlight

*No spaces between words are included in the puzzle.

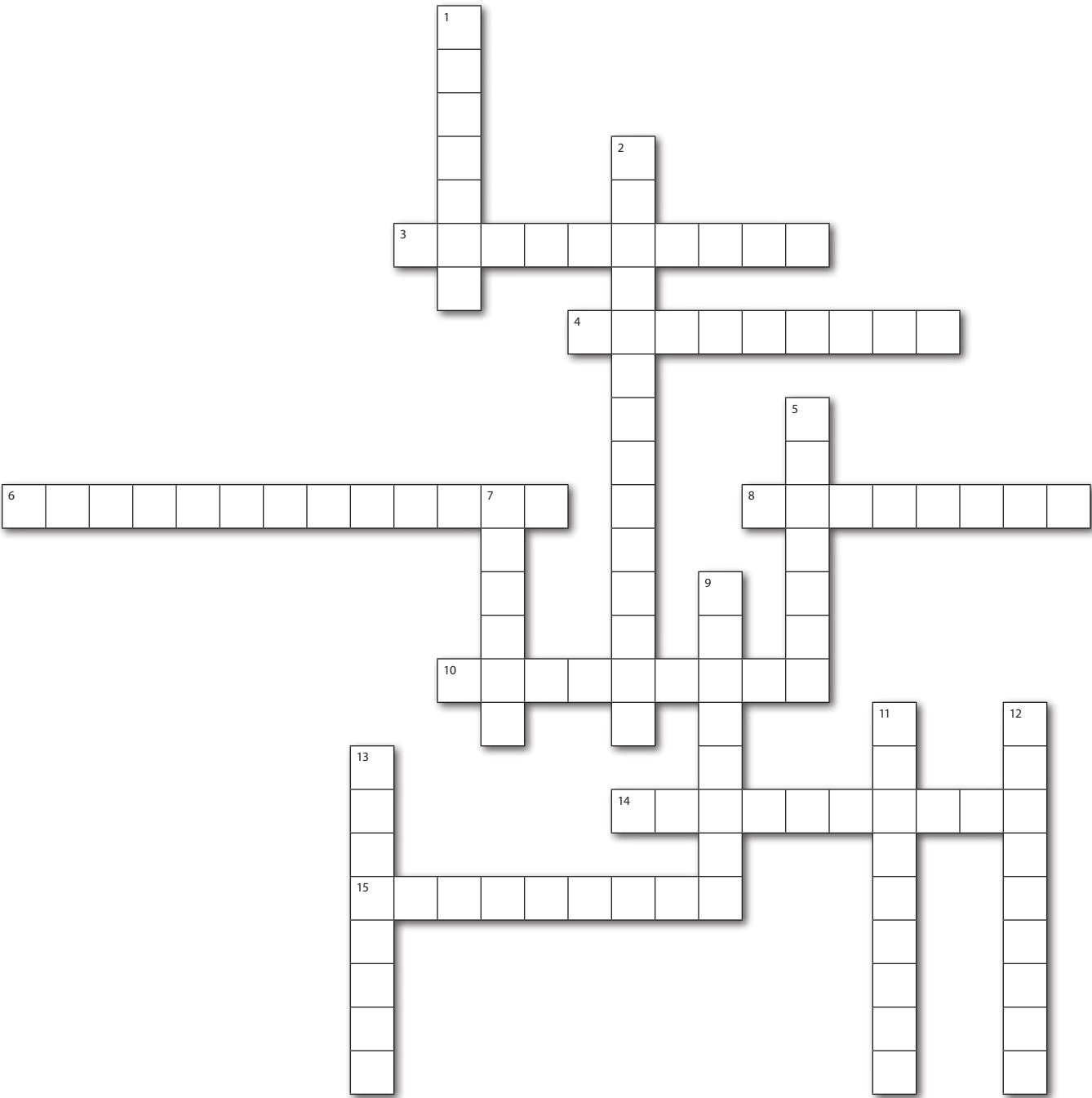
Across

3. the process of converting food into energy
4. a series of organisms listed in a way that shows which is a food source for another
6. a type of human activity that disrupts an ecosystem
8. the main source of energy for plants
10. an animal that only eats plants
14. the type of organism that helps return matter back to the earth
15. an animal that feeds on dead or decaying matter

Down

1. multiple connected food chains in an ecosystem
2. a process in which plants make energy from the sun
5. the sugar that is made during photosynthesis
7. a gas that is released during photosynthesis
9. an example of this type of organism is seaweed
11. lakes, deserts, and forests are examples of this
12. an animal that eats other animals
13. an organism that eats another organism

Vocabulary Crossword Puzzle, *continued*



Name _____

Date _____

Activity Page UR.3 (Page 1 of 2)

Use with Unit Review.

Vocabulary Review

Complete each sentence with the correct Core Vocabulary term. Not every term in the word bank will be used. Review the cards in your Core Vocabulary deck before you begin.

balanced	carbon dioxide	carnivores	chain	consumer	decomposer	
ecosystem	energy	environment	glucose	herbivores	human	levels
metabolism	nature	omnivores	photosynthesis	predator	producer	
scavenger	sun	unbalanced	water	web		

1. Overfishing is an example of a(n) _____-caused disruption to an ecosystem.
2. When a plant uses energy from the _____ to make _____, this is known as _____.
3. A tree is an example of a(n) _____.
4. A(n) _____ helps break down organic matter to return it to the earth for new organisms to grow.
5. If you want to study the linear relationship between organisms that depend on each other for food, you would look at a food _____.
6. If you want to study the flow of energy between multiple organisms and how they depend on each other for food, you would look at a food _____.
7. The process that converts food into fuel or energy that an organism can use for growth is called _____.
8. A(n) _____ eats other organisms, such as plants.
9. Rabbits eat grass and other plants. This makes them _____.
10. A community in which multiple organisms interact and depend on one another for balance is a(n) _____.

Vocabulary Review, *continued*

11. Fires, floods, and droughts are examples of _____-caused disruptions to ecosystems.
12. Photosynthesis uses _____ and _____ to make glucose.
13. An ecosystem in which organisms have what they need to survive is called _____.
14. A vulture is an example of a(n) _____.

Name _____

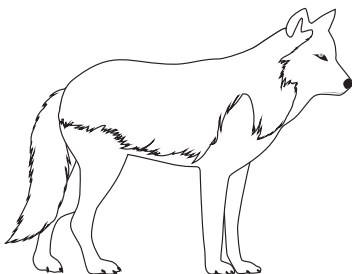
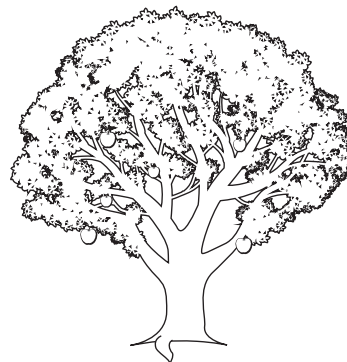
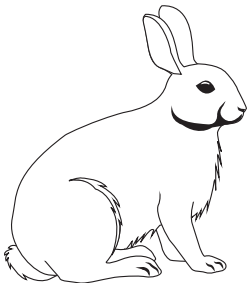
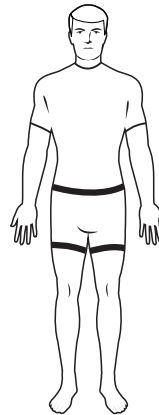
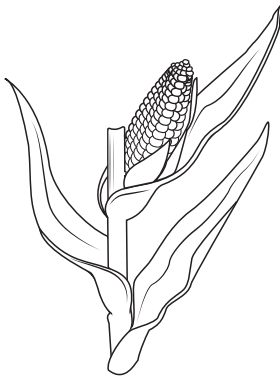
Date _____

Unit Assessment: What Have I Learned About Energy and Matter in Ecosystems?

Answer the items below to show what you have learned.

1. Which of the following words or phrases are true of all the organisms shown in the illustrations below? Circle all the correct answers.

- | | |
|------------------|-------------------|
| a) dying | f) take in energy |
| b) growth | g) eat meat |
| c) larva | h) take in water |
| d) metamorphosis | i) pupa |
| e) reproduction | j) hatch from egg |



2. On each line, tell whether the organism is a producer or a consumer. Then explain where it gets its energy.
- a) corn _____
 - b) rabbit _____
 - c) wolf _____
 - d) human _____
 - e) apple tree _____
3. Using organisms from the illustrations in item 1, draw in the box below how energy gets from the sun to you.



4. Based on your answers to the previous questions, tell where the energy for most life on Earth comes from. Explain how it gets from one organism to another.

5. Read the paragraph below, and then answer the question.

Most plants grow in soil. They take in sunlight and carbon dioxide through their leaves and nutrients through their roots. Hydroponics is a method of growing plants without soil. Plants are placed in water instead of soil. Even without soil, they still grow.

Which of the following statements are correct?

- a) Plants take in energy from the sun through their leaves.
- b) Plants take in nutrients from water even without soil.
- c) Plants take in nutrients from the sun through their leaves.
- d) Plant roots take in nutrients from water in the soil.
- e) Plant roots take in energy from water in the soil.
- f) Plant leaves take in carbon dioxide from the air.
- g) Plant leaves take in carbon dioxide from water.

6. In the box below, draw a model of how photosynthesis works. Label your model with the following words:

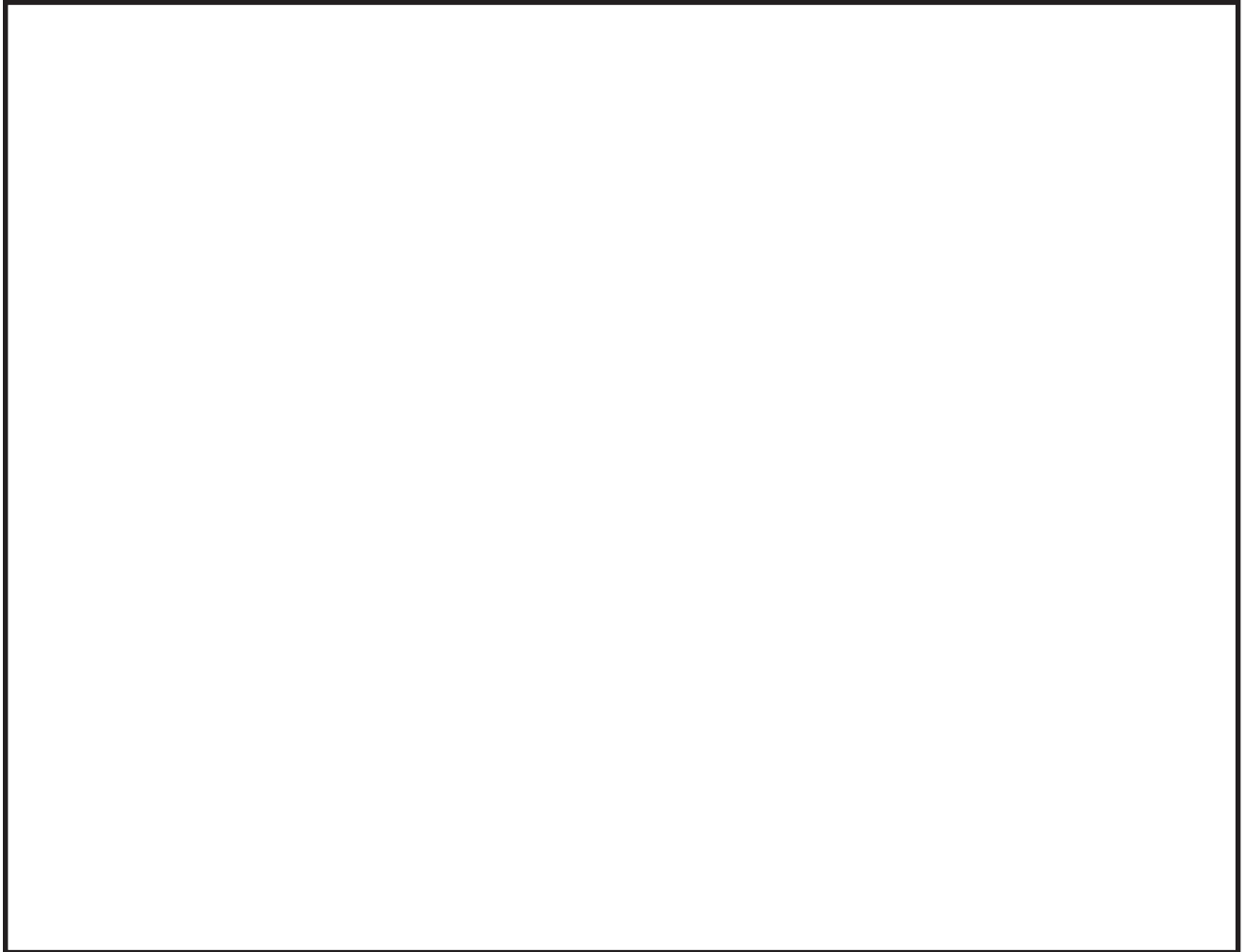
energy

oxygen

carbon dioxide

water

glucose



7. Complete the paragraph below. Be sure to use the Core Vocabulary that you have learned during this unit.

_____ use the process of photosynthesis to make food using energy from the _____. Organisms that eat plants to gain energy are known as _____.

Organisms that eat other animals to gain energy are known as _____. Organisms that eat both plants and other animals to gain energy are known as _____.

- 8.** An ecosystem is all the living and nonliving things that make up a specific environment. It includes sunlight, water, air, plants, animals, rocks, soil, and everything else in that environment. Ecosystems can be found on land or in water.

Write the words *ecosystem* or *not an ecosystem* to describe whether each term represents an ecosystem.

- a) desert _____
- b) tropical rain forest _____
- c) rivers and streams _____
- d) air _____
- e) space _____
- f) coral reef _____
- g) tundra _____
- h) forest _____

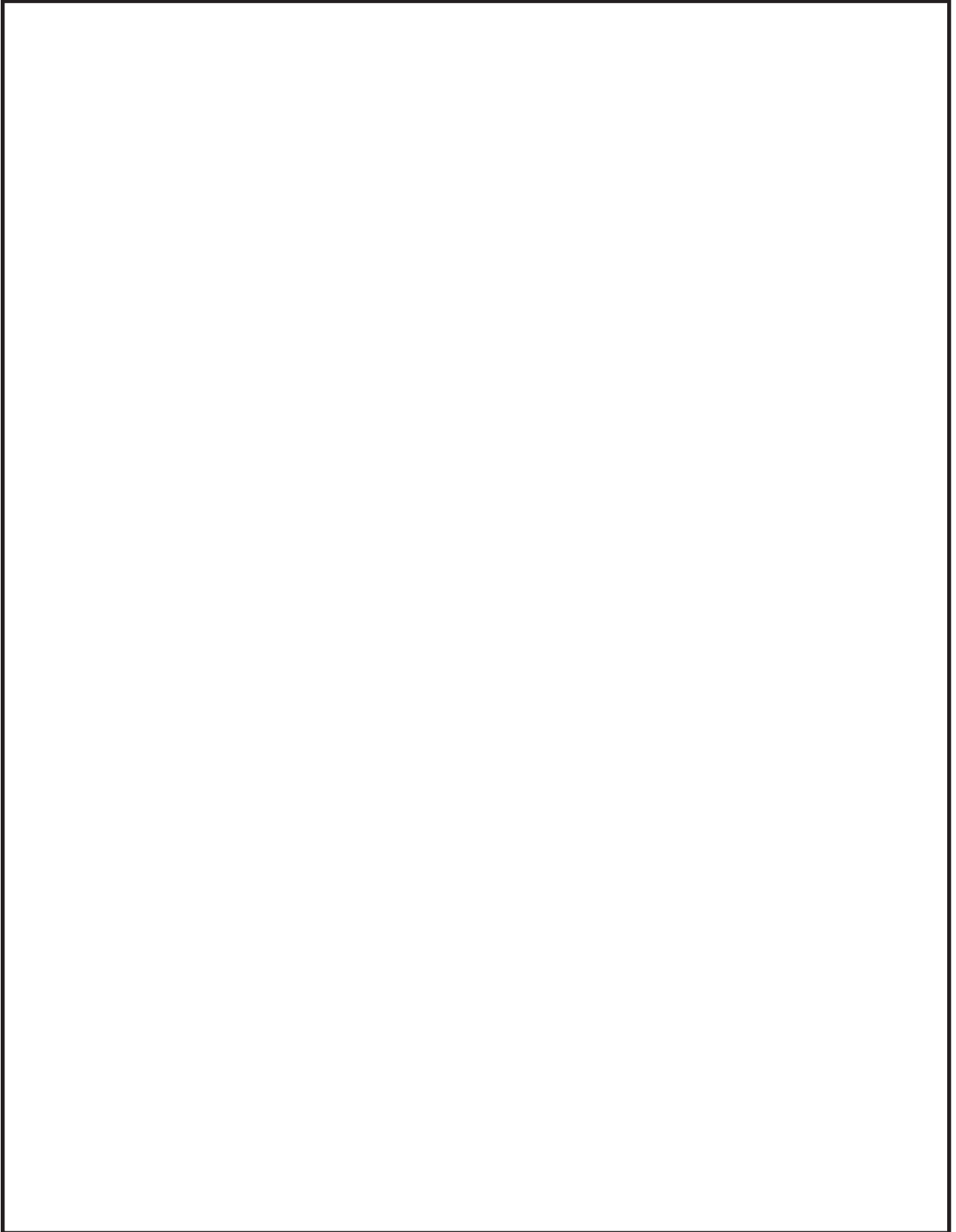
- 9.** A food chain is one path that energy moves along. A food web is made up of many paths that energy moves along.

Based on the definition above, complete the following activities.

- a) Write a food chain with at least four organisms in it.

- b) Describe a food web with at least three food chains in it.

10. In the box below, draw an ecosystem. Use arrows to show how energy and matter cycle through the system. Be sure to include decomposers. Name the ecosystem, and label each part. When labeling the parts of your system, use the Core Vocabulary that you have learned during this unit.



11. For each activity below, identify if the activity disrupts or protects the ecosystem.

- a)** building a dam: _____
- b)** restoring wetlands: _____
- c)** conserving forests: _____
- d)** dumping waste in the oceans: _____
- e)** removing waste from the oceans: _____
- f)** chopping down forests: _____
- g)** rerouting rivers: _____
- h)** building roads: _____

12. Think about the area in which you live. Do you live in the country, a small town, or a city? Describe what the area around you is like. If you live in a city, what is the country around your city like? Then, use evidence to explain how people have changed the environment there over time or are changing it today. Evidence can include things you have seen on TV, read about on the internet, or seen with your own eyes. Explain how these changes might have affected the ecosystem in the area.

Activity Pages Answer Key: *Energy and Matter in Ecosystems*

AP 1.1 Library Scavenger Hunt (page 127)

Student responses to each life process for their living thing should match the life process to how it works. Simple answers should be acceptable at this point in the unit.

AP 1.2 Plant Data Sheet (pages 128–129)

Student should have a list of materials they will use to grow the cutting as well as a plan to measure and weigh the plant. The type of plants used for the cutting, as well as how well the plant grows, will vary, but the following applies to healthy growth of the cuttings:

Lesson 1 observations should note little to no growth as well as observations about the cutting.

Lesson 5 observations should note plant growth such as larger size and weight as well as possible root structures forming.

- Students should note that plants need water and light to grow.
- Accept plausible student arguments supported by the evidence students have from the growth of their cuttings.

Lesson 9 observations should note continued plant growth such as larger size, larger weight, possible flower blooms starting, and root structures continuing to develop.

- Students should use the evidence from the final observations to strengthen the arguments they wrote from Lesson 5.

AP 2.1 Organisms and Chemical Energy (page 130)

Accept all plausible student responses. Student responses should reflect a developing understanding of how organisms obtain energy.

AP 3.1 Photosynthesis Model (page 131)

Student models should show a flow of energy from the sun to their plant as well as the plant producing sugar in the leaves. Labels should also be present for carbon dioxide and oxygen.

AP 4.2 Energy's Path Through Living Things (page 133)

Students should identify the model they will build, starting with energy from the sun. Student plans should be a starting point for the model they make.

AP 6.1 A Needy Plant in the Neighborhood (page 134)

Students should identify the plant they drew. They should identify that the plant needs light, oxygen, and carbon dioxide. They could include other needs, such as space. The roots and leaves should be identified as how the plant meets the needs. Accept all reasonable answers telling what consumes the plant.

AP 7.1 A Rough Draft of Your Model (page 135)

Accept all reasonable student models that can be made using available materials. The terms listed in the criteria section should be on the final model. Arrows should show the flow of energy and matter through the plant during photosynthesis.

AP 8.1 Energy from the Sun to You (page 136)

Student drawings should show a food chain or food web that should include a producer, a consumer, a secondary consumer, and him or her if they are meat-eating students. For vegan and vegetarian students, they should leave out the carnivore stage where appropriate. Each consumer should be labeled correctly as an herbivore, a carnivore, or an omnivore. A scavenger should be included in the final work.

AP 9.1 Research Guide **(pages 137–139)** **Day 1**

- Students will identify the organism they are going to research as well as how they will research.
- Student research should show where the organism gets energy, what it eats, and what organism eats their organism. Students should identify the type of organism and support their answer.
- Students should also include a representation of their organism.

Day 2

Students should correctly identify the environment their organism lives in as well as other organisms that interact with their organism. They should also correctly identify the relationships between the organisms.

AP 10.1 Ecosystem: Yes or No **(page 140)**

Students should identify what they see in each picture, as well as whether or not it is an ecosystem.

AP 11.1 Ecosystem Investigation **(page 141)**

- Students should identify organisms in the ecosystem they located and studied.
- Students should identify the nonliving things in the environment, such as air, earth structures, and human-made structures.
- Accept all plausible relationships students note between the living and nonliving things in the ecosystem they studied.
- Students should note how the ecosystem would change if something were taken away from the ecosystem. This change may or may not impact the ecosystem.
- Student arguments for why the ecosystem they studied was or was not an ecosystem should be supported by evidence from the observations and learning from the lessons.

AP 12.1 Chains and Webs **(page 142)**

Student food chain drawings should include at least three different organisms. Student food webs should include the food chain and additional organisms.

AP 13.1 Modeling the Cycling of Matter and Energy **(page 143)**

Student posters should meet the criteria from the Activity Page and accurately reflect the science behind what they are presenting.

AP 14.1 Things That Disrupt Ecosystems **(page 144)**

Student answers should accurately identify the cause of each disruption. Some disruptions may have both human and natural origins, such as introducing new species, disease, and wildfires.

AP 15.1 Research and Writing Guide **(pages 145–146)**

Day 1—Students should identify the human activity they are researching and the ecosystem it disrupts. Students should cite credible sources and supply three pieces of evidence that show how the human activity disrupts the ecosystem.

Day 2—Student outlines should include general details of what they will cover specifically in their report. Use the criteria on Page 2 to assess student reports.

AP UR.2 Vocabulary Crossword Puzzle **(pages 148–149)**

ACROSS:

- 3.** metabolism
- 4.** food chain
- 6.** deforestation
- 8.** sunlight
- 10.** herbivore
- 14.** decomposer
- 15.** scavenger

DOWN:

- 1.** food web
- 2.** photosynthesis
- 5.** glucose
- 7.** oxygen
- 9.** producer
- 11.** ecosystem
- 12.** carnivore
- 13.** consumer

AP UR.3 Vocabulary Review **(pages 150–151)**

- 1.** human **2.** sun, glucose, photosynthesis **3.** producer
- 4.** decomposer **5.** chain **6.** web **7.** metabolism
- 8.** consumer **9.** herbivores **10.** ecosystem
- 11.** nature **12.** carbon dioxide, water **13.** balanced
- 14.** scavenger

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. a, b, e, f, h (5 points)

2. a) corn: producer, from the sun
b) rabbit: consumer, from plants
c) wolf: consumer, from other animals
d) human: consumer, from plants and other animals
e) apple tree: producer, from the sun (5 points)

3.	Above Average	Student response shows an understanding that energy moves from the sun into producers, such as plants, and from there into consumers, which eat the producers/plants. He or she also shows an understanding that some consumers can eat other consumers and get their energy that way. Models should begin with the sun and end with humans, with producers and other consumers in between and arrows showing the direction in which the movement occurs.
	Average	Student response shows an understanding that energy moves from the sun into producers, such as plants, and from there into consumers, which eat the producers/plants. He or she also shows an understanding that some consumers can eat other consumers and get their energy that way. Models should begin with the sun and end with humans and include arrows showing the direction in which the movement occurs. Response will only include one organism between the sun and humans.
	Adequate	Student response shows a basic understanding that energy moves from the sun into producers, such as plants, and from there into consumers, which eat the producers/plants. His or her model, however, may have producers and consumers in an incorrect order or may lack the necessary arrows to indicate the direction in which energy flows.
	Inadequate	Student does not answer the question, or his or her response betrays a clear misunderstanding of how energy moves from the sun into producers and then consumers to get to humans.

(5 points)

4. Sample answer: The energy for most life on Earth comes from the sun. Plants use sunlight to make and store food. When consumers eat the plants, chemical energy moves from the plants into the consumers. When other consumers eat these consumers, this food energy then moves from the primary consumers into the secondary consumers. (2 points)

5. a, b, d, f (3 points)

6.

Above Average	Student response clearly models how photosynthesis works, showing how energy moves from the sun into a plant to help the plant make glucose from carbon dioxide and water, releasing oxygen as waste. Student also labels each part of the model and uses arrows to show how materials are moving into and out of the plant.
Average	Student response models how photosynthesis works, showing how energy moves from the sun into a plant to help the plant make glucose from carbon dioxide and water, releasing oxygen as waste. Student also labels each part of the model but may not show how materials move into or out of the plant.
Adequate	Student response models how photosynthesis works, showing how energy moves from the sun into a plant to help the plant make glucose from carbon dioxide and water, releasing oxygen as waste. However, the model is not labeled properly, or some of the labels are missing.
Inadequate	Student does not complete the model of how photosynthesis works or misunderstands the process, not labeling or mislabeling materials and/or not showing how materials move into or out of the plant for the process to work.

(5 points)

7. plants, sun, herbivores, carnivores, omnivores (5 points)

8. a) desert: ecosystem
b) tropical rain forest: ecosystem
c) rivers and streams: ecosystem
d) air: not an ecosystem
e) space: not an ecosystem
f) coral reef: ecosystem
g) tundra: ecosystem
h) forest: ecosystem

(5 points)

9. a) Sample answer: grass, a mouse, a snake, a hawk
 b) Sample answer: the sun, grass, a mouse, a hawk; the sun, grass, a mouse, a cat; the sun, grass, cattle, humans; the sun, flowers, a caterpillar, a bird (5 points)

10.

Above Average	Student response clearly models how energy and matter cycle through an ecosystem of his or her choice, with the system named, each part labeled, and Core Vocabulary used.
Average	Student response models how energy and matter cycle through an ecosystem of his or her choice, with the system named, most parts labeled, and Core Vocabulary used.
Adequate	Student response models how energy and matter cycle through an ecosystem of his or her choice, with the system named, some parts labeled, and some Core Vocabulary used.
Inadequate	Student doesn't model how energy and matter cycle through an ecosystem, or the model fails to accurately reflect the process. The system may not be named, most or all of its parts go unlabeled, and few if any Core Vocabulary terms are used.

(5 points)

11. a) building a dam: disrupts
 b) restoring wetlands: protects
 c) conserving forests: protects
 d) dumping waste in the oceans: disrupts
 e) removing waste from the oceans: protects
 f) chopping down forests: disrupts
 g) rerouting rivers: disrupts
 h) building roads: disrupts

(3 points)

12. Sample answer. I live in a city. Outside the city, there are many forests. The area where the city is today used to be a forest. People cut down the trees, and they built many buildings, including homes, stores, and office buildings. Because of this, the animals that once lived here had to move to new areas or died. (2 points)

Glossary

Purple 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

air, n. the mixture of gases in the atmosphere

C

carbon dioxide, n. a gas released from organisms when they breathe

carnivore, n. an animal that eats other animals to meet its energy needs (25)

chemical, n. any pure substances consisting of matter

chemical reaction, n. a change in the atomic structure of a chemical

consumer, n. a living thing that gets energy by eating other organisms for food (4)

D

decomposer, n. an organism that breaks down dead plant and animal matter and returns nutrients to the soil (7)

disruption, n. a disturbance that interrupts a process (47)

E

ecosystem, n. all the living and nonliving things that interact in a given area (29)

energy, n. the capacity to do work, such as the chemical energy found in sugar

energy transfer, n. the movement of energy from one location to another

energy transformation, n. the change of energy from one form to another

environment, n. a geographic area

evidence, n. information that supports an argument or point of view

F

food, n. any material with nutrients that organisms consume to obtain energy for life processes

food chain, n. a series of organisms listed in a way that shows which is a food source for another (35)

food web, n. multiple connected food chains in an ecosystem (36)

G

glucose, n. a form of sugar made by plants through the process of photosynthesis (12)

H

herbivore, n. an animal that eats plants to meet its energy needs (24)

hydroponics, n. the practice of growing plants without soil (20)

I

interruption, n. an action or factor that stops a process

L

living, adj. alive, able to respond to stimuli and reproduce

M

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

metabolism, n. the continuing chemical reactions in living things that release and use energy (14)

O

omnivore, n. an animal that eats both plants and other animals to meet its energy needs (27)

organism, n. a single living thing (1)

P

photosynthesis, n. the process used by producers to make glucose and oxygen from sunlight, water, and carbon dioxide (12)

producer, n. a living thing that makes its own food (2)

S

scavenger, n. an animal that eats organisms that have already died (6)

sugar, n. a carbohydrate that living things break down to get energy (11)

sunlight, n. energy released by the sun in the form of light

system, n. a set of things or parts that form a complex whole

T

transfer, v. to move from one location to another

transpiration, n. the release of water vapor through tiny openings in plants' leaves (18)

W

water, n. a chemical made up of hydrogen and oxygen necessary for all life

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 engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances, such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page, 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, just by pulling on the plug, when a teacher is supervising.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ / ____ / ____ /

Student signature and date

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your 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, can be cleaned and will last for more than one activity, or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

Consider some of the following as methods for acquiring the science materials:

- **School Supply Drive**—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- **Open Houses**—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- **Parent Teacher Organizations**—Reach out to the local PTO for assistance with acquiring materials.
- **Science Fair Drive**—Consider adding a table to your science fair as part of a science materials drive for future units.
- **College or University Service Project**—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- **Local Businesses**—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or 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 a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher's Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

While engaged in the activity or demonstration

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration

- 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 doesn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence, or they missed a step when performing the activity. Review and provide feedback on students' investigation plans 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 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 *why* something happened will help them to develop a better sense of how to do science.



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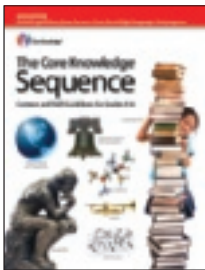
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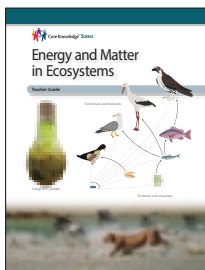
Energy and Matter in Ecosystems

Core Knowledge Science 5



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 from the middle to upper elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 5 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the
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