
## Unit Overview

In this unit, students will . . .

- investigate how living organisms get energy.
- explore how living organisms use energy and how they interact in their environments.

## About This Image

This bird of prey is trying to catch its next meal. Since the bird is a consumer and not a producer, it cannot make its own food. To survive and grow, it must consume other organisms. Some animals need to eat more frequently than others. The grass in the image is a producer. Producers can make their own food for survival.

## Unit Project

As students work through the unit lessons, have them research and plan their investigations to see how different kinds of light affect plants.

To begin, have the students observe the image and discuss during what part of the day they think this picture was taken. Challenge students to research how natural and artificial light compare to providing for the plant. More support for the Unit Project can be found on pp. 159I–159L.

# UNIT 3 Energy and Matter in Organisms

The learning experiences in this unit prepare students for the mastery of:

**Performance Expectations**

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

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

**Explore Online**

In addition to the print resources, the following resources are available online to support this unit.

**Unit Pretest**

**Lesson 1 How Does Energy Get Transformed by Plants?**
- Online Student Edition
- Lesson Quiz

**Lesson 2 How Do Organisms Use Matter and Energy?**
- Online Student Edition
- Lesson Quiz

**Lesson 3 How Do Organisms Interact?**
- Online Student Edition
- Lesson Quiz

**You Solve It** What Do Plants Need?

**Unit Performance Task**

**Unit Test**

UNIT 3

## At a Glance



### Vocabulary Game: Picture It

**Materials**
- 1 set of word cards
- Timer
- Sketch pad

**Directions**
1. Mix up the cards face down on a table. Take turns to play.
2. Choose a card and note the word on it. Do not tell the word to the other players. Set the timer for 1 minute.
3. Draw pictures on the sketch pad to give clues about the word. Draw only pictures and numbers, use no words.
4. The first player to guess the word gets 1 point and an additional 1 point to use the word in a sentence correctly.
5. Then that player gets a turn to choose a word.
6. The first player to score 5 points wins.






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# Unit Vocabulary

**community:** A group of organisms that live in the same area and interact with one another.

**photosynthesis:** The process that plants use to make sugar.

**consumer:** A living thing that cannot make its own food and must eat other living things.

**population:** All the organisms of the same kind that live together in a given area.

**ecosystem:** A community of organisms and the environment in which they live.

**predator:** An animal that hunts, catches, and eats other animals.

**environment:** All of the living and nonliving things that surround and affect an organism.

**prey:** Animals that are caught and eaten by predators.

**habitat:** The place where an organism lives and can find everything it needs to survive.

**producer:** A living thing, such as a plant, that can make its own food.

**niche:** The role that a plant or animal plays in its habitat.





## Unit Vocabulary

Students can explore all lesson vocabulary terms in the **Online Glossary**.

## Vocabulary Strategies

Have students review the terms individually. Then they will pair up and share one term they didn't know before with their partner. Partners will come up with ideas on how to remember the definitions of the terms they didn't know before.

## Differentiate Instruction

**RTI/Extra Support** Pronounce each term and have students repeat it. Provide dictionaries for students to separate each vocabulary term by syllables. In small groups, students will discuss ways to remember the definitions of the terms.

**Extension** Have students use the vocabulary terms to create a flow chart showing how the terms are related.

**ELL** Pronounce each term and have students repeat it. Then pair up students by native language and have them explain each term in their native language.

## Vocabulary Game: Picture It

**Preparation**

You can use the timer on your smartphone or tablet if it is more accessible than a kitchen timer.

**Game Play**

- Students draw pictures for others to guess the word.
- Correct guesses win points.

# Integrating the NGSS* Three Dimensions of Learning

## Building to the Performance Expectations

The learning experiences in this unit prepare students for mastery of the following Performance Expectations:

### From Molecules to Organisms: Structures and Processes

**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.

### Energy

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

### Assessing Student Progress

After completing these lessons, the **Unit Project: The Best Light** provides students with opportunities to practice aspects of and demonstrate their understanding of the Performance Expectations as they work together to determine how different types of light affect plant growth.

Additionally, students can practice or be assessed on aspects of the Performance Expectations by completing the **Unit Performance Task: Business Has Bean Bad** in which they apply what they know about plants' needs and energy to figure out what might be affecting plant growth.

### Lesson 1
### How Does Energy Get Transformed by Plants?

**In Lesson 1,** students will gather evidence that plants get energy from the sun and materials for growth from water and air **(DCI Energy in Chemical Processes and Everyday Life; Organization for Matter and Energy Flow in Organisms)** and construct an argument **(SEP Engaging in Argument from Evidence)** for how matter is transported into, out of, and within an ecosystem **(CCC Energy and Matter).** Students also model **(SEP Developing and Using Models)** how well plants grow with or without water and in or out of a light source.

### Lesson 2
### How Do Organisms Use Matter and Energy?

**In Lesson 2,** students will understand that animals need food for the materials necessary for body growth and repair and that they obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment **(DCI Cycles of Matter and Energy Transfer in Ecosystems)**. Students will create a model to explore the energy animals need for body warmth and motion, which comes from the food animals eat **(SEP Developing and Using Models),** and will describe how energy in the food organisms eat was once energy from the sun **(CCC Energy and Matter).**

### Lesson 3
### How Do Organisms Interact?

**In Lesson 3**, students gather evidence about food chains **(DCI Organization for Matter and Energy Flow in Organisms; Interdependent Relationships in Ecosystems)** to make models **(SEP Developing and Using Models)** that describe the movement of energy in an ecosystem **(CCC Systems and System Models; Energy and Matter).**

## NGSS Across this Unit

*Explore Online!*
Online only.

| Next Generation Science Standard | Unit Project | Lesson 1 | Lesson 2 | Lesson 3 | Unit Performance Task | You Solve It! |
|---|---|---|---|---|---|---|
| SEP Developing and Using Models | | • | • | • | • | |
| SEP Engaging in Argument from Evidence | • | • | | | • | |
| SEP Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena | | • | | • | | • |
| SEP Evaluating, Obtaining... Communicating Information | • | • | • | • | • | |
| SEP Planning and Carrying Out an Investigation | • | | • | | • | |
| DCI **PS3.D** Energy in Chemical Processes and... Life | • | • | • | | | • |
| DCI **LS1.C** Organization for Matter and Energy Flow .. | • | • | • | • | • | • |
| DCI **LS2.A** Interdependent Relationships in Ecosystems | | | | • | | |
| DCI **LS2.B** Cycles of Matter and Energy... in Ecosystems | | | • | • | | |
| CCC Energy and Matter | • | • | • | • | | • |
| CCC Systems and System Models | | | • | • | • | |

## NGSS Across the Grades

### Before

**From Molecules to Organisms: Structures and Processes**
**4-LS1-1**

**Energy**
**4-PS3-1**

### Grade 5

**From Molecules to Organisms: Structures and Processes**
**5-LS1-1**

**Energy**
**5-PS3-1**

### After

**From Molecules to Organisms: Structures and Processes**
**MS-LS1-6** Construct a scientific explanation... for the role of photosynthesis in the cycling of matter and flow of energy...

**Energy**
**MS-PS3-6** Undertake a design project to...absorbs thermal energy by chemical processes.*

*Trace Tool to the NGSS™* Go online to view the complete coverage of these standards across this grade level and time.

# 3D Unit Planning

## Lesson 1 How Does Energy Get Transformed by Plants? pp. 160–177

### Overview

**Objective** Develop and use models to support an argument that plants acquire material for growth mainly from air and water.

SEP Developing and Using Models
SEP Engaging in Argument from Evidence
DCI **PS3.D** Energy in Chemical Processes and Everyday Life
DCI **LS1.C** Organization for Matter and Energy Flow in Organisms
CCC Energy and Matter
**Math** and **English Language Arts** standards and features are detailed on lesson planner pages.

| | *Print and Online Student Editions* | *Explore Online!* |
|---|---|---|
| **ENGAGE** | **Lesson Phenomenon** pp. 160–161<br>**Can You Explain/Solve It?** How can plants grow without soil? | **Can You Explain It!** Video |
| **EXPLORE/ EXPLAIN** | **Plant Growth** pp. 162–169<br>Can It Grow?<br>**Apply What You Know** What Do Plants Need to Grow?<br>**ENGINEER IT!** What's the Right Amount?<br>**HANDS-ON** Lights Out!<br>**Getting Energy From Food** pp. 170–172<br>Who Needs Food?<br>**Apply What You Know** In and Out | **HANDS-ON Worksheet** |
| **ELABORATE** | **Take It Further** pp. 173–174<br>**Careers in Science & Engineering:** A Moss-Powered Radio | **Take It Further** Not Only Plants!<br>**Take It Further** Design Your Own Hydroponics System |
| **EVALUATE** | **Lesson Check** pp. 175–176<br>**Lesson Roundup** p. 177 | **Lesson Quiz** |

### HANDS-ON ACTIVITY PLANNING

#### Apply What You Know

**What Do Plants Need to Grow?**

20 minutes
Small groups

**Materials**
- drawing or writing paper
- pen or pencil

**Preparation/Tip** Encourage students to ask questions and suggest possible improvements for the plans that are shared to help them start thinking more about the engineering processes. If you choose, students can conduct their experiments to obtain evidence.

**In and Out**

1 class period
Pairs

**Materials**
- microscope or hand lens
- drawing utensils (crayons, colored pencils)

**Preparation/Tip** After reading the texts, have students speculate about the exchange of gases.

#### HANDS-ON

**Lights Out!**

1 class period
Partners/Small groups

**Objective** Students will model what happens when one key element in photosynthesis (energy from light) is restricted and how it affects plant growth and survival.

**Materials**
- 2 small potted plants
- masking tape
- marker
- measuring cup
- water
- metric ruler
- graph paper
- colored pencils

**Preparation/Tip** Plan a space by windows where the "in the light" plants can be kept out for this time period. Prepare a cabinet to house the "in the dark" plants.

# Lesson 2 How Do Organisms Use Matter and Energy? pp. 178–195

## Overview

**Objective** Understand that animals need food for the materials necessary for body growth and repair and that they obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment.

SEP Obtaining and Communicating Information
SEP Planning and Carrying Out an Investigation
SEP Developing and Using Models
DCI **PS3.D**, **LS1.C**, **LS2.B**
CCC Energy and Matter
CCC Systems and System Models

**Math** and **English Language Arts** standards and features are detailed on lesson planner pages.

| | *Print and Online Student Editions* | Explore Online |
|---|---|---|
| **ENGAGE** | **Lesson Phenomenon** pp. 178–179<br>**Can You Explain/Solve It?** What are the sources of the raw materials and energy that allow frogs to grow and change from an egg into a full frog? | Can You Explain It? Video |
| **EXPLORE/ EXPLAIN** | **Growth, Change, and Regrowth** pp. 180–187<br>Body Building<br>HANDS-ON What Was for Dinner?<br><br>**Animal Energy** pp. 188–190<br>Brrr! It's Cold Outside!<br>Apply What You Know Where's the Heat? | HANDS-ON Worksheet |
| **ELABORATE** | **Take It Further** pp. 191–192<br>**Careers In Science & Engineering** Animal Nutritionist | Take It Further In the Water<br>Take It Further Engineer It!: Feed Me Now! |
| **EVALUATE** | **Lesson Check** pp. 193–194<br>**Lesson Roundup** p. 195 | Lesson Quiz |

## HANDS-ON ACTIVITY PLANNING

### Apply What You Know

#### Where's the Heat?

20 minutes
Pairs

**Materials**
- thermometer
- forehead thermometer strips
- writing/note paper
- writing utensils
- timer

**Preparation/Tip** Model for students how to use the thermometer and forehead thermometer strips.

### HANDS-ON

#### What Was for Dinner?

1 class period
Small groups

**Objective** Students plan and carry out an investigation to determine which type of fruit provides the most energy.

**Materials**
- selection of fruits and vegetables
- balance
- nutrition information
- paper plates
- calculator
- gloves for handling fruit

**Preparation/Tip** Make sure students do not have any allergies to the foods they will be handling. Provide them with gloves, and do not allow students to eat the fruits.

# 3D Unit Planning, continued

## Lesson 3 How Do Organisms Interact? pp. 196–213

### Overview

**Objective** Develop and use models to explore how organisms interact and survive in environments where their needs are met.

**SEP** Science Models...Explain Natural Phenomena
**SEP** Developing and Using Models
**DCI** **LS1.C** Organization for Matter and Energy Flow in Organisms
**DCI** **LS2.A** Interdependent Relationships in Ecosystems
**CCC** Systems and System Models
**CCC** Energy and Matter

**Math** and **English Language Arts** standards and features are detailed on lesson planner pages.

| | *Print and Online Student Editions* | *Explore Online!* |
|---|---|---|
| **ENGAGE** | **Lesson Phenomenon** pp. 196–197<br>**Can You Explain/Solve It?** How are these animals interacting at the watering hole? | **Can You Explain It!** Video |
| **EXPLORE/ EXPLAIN** | **Living Things and Their Environment** pp. 198–204<br>It's Alive!<br>**Apply What You Know** What's In Your Environment?<br>**ENGINEER IT!** Let's Clean Up!<br>**HANDS-ON** What's Out There?<br>**Relationships in an Ecosystem** pp. 205–208<br>What Group Are You In? | **HANDS-ON Worksheet** |
| **ELABORATE** | **Take It Further** pp. 209–210<br>**People in Science & Engineering** It's All Fun and Games | **Take It Further** Engineer It! Tiny Ecosystems<br>**Take It Further** Animal Atlas |
| **EVALUATE** | **Lesson Check** pp. 211–212<br>**Lesson Roundup** p. 213 | **Lesson Quiz** |

### HANDS-ON ACTIVITY PLANNING

#### Apply What You Know

**What's In Your Environment?**

20 minutes
Partners

**Materials**
- writing paper
- pen or pencil

**Preparation/Tip** Pair students of mixed ability.

#### HANDS-ON

**What's Out There?**

1 class period
Partners

**Objective** Students will develop a research-based model of a one square meter area to find which kinds of organisms interact in that small ecosystem.

**Materials**
- gloves
- string
- wooden dowels
- meterstick or other measuring device
- collecting jar
- scissors
- hand lens
- field guides for the local environment

**Preparation/Tip** Make sure students have access to gloves and are careful with any wildlife they may encounter.

**You Solve It** Go online for an additional interactive activity.

## What Do Plants Need?

This virtual lab offers practice in support of **PE 5-LS1-1** and **5-LS2-1.**

**SEP** Scientific Investigations Use a Variety of Methods
**SEP** Scientific Knowledge Is Based on Empirical Evidence
**SEP** Science Models... and Theories Explain Natural Phenomena
**DCI** **5-PS3.D**, **5-LS1.C**
**CCC** Energy and Matter, Cause and Effect

### 3D Learning Objectives

1. Students will determine the cause and effect of three different plants growing in three different colored lights.
2. Students will analyze data to determine what type of light plants need to grow.

### Activity Problem

You will be experimenting on what type of light plants grow best in. Your tasks include:

1. taking measurements of three of the same plants under three different colored lights
2. planting two more different types of seeds to repeat the experiment
3. analyzing the data you collected and writing a lab report

### Interaction Summary

1. Students choose one of three seeds.
2. They turn the lights (green, white, and orange) on.
3. Students record measurements of the three plants at 15, 30, and 45 days.
4. The students repeat the experiments with the other two types of seeds.
5. They analyze collected data and write a report on the light the plants grew best in.

## Assessment

### Preassessment

**Assessment Guide,** Unit Pretest

The Unit Pretest focuses on prerequisite knowledge and is composed of items that evaluate students' preparedness for the content covered within this unit.

### Formative Assessment

**Student Edition,** Apply What You Know, Lesson Check, and Self Check

### Summative Assessment

**Assessment Guide,** Lesson Quiz
The Lesson Quiz provides a quick assessment of each lesson objective and of the portion of the Performance Expectation aligned to the lesson.

**Student Edition,** Performance Task pp. 214–215
The Performance Task presents the opportunity for children to collaborate with classmates in order to complete the steps of each Performance Task. Each Performance Task provides a formal Scoring Rubric for evaluating students' work.

**Student Edition,** Unit 3 Review pp. 216–218

**Assessment Guide,** Unit Test
The Unit Test provides an in-depth assessment of the Performance Expectations aligned to the unit. This test evaluates students' ability to apply knowledge in order to explain phenomena and to solve problems. Within this test, Constructed Response items apply a three-dimensional rubric for evaluating students' mastery on all three dimensions of the Next Generation Science Standards.

**Assessment Online** Go online to view the complete assessment items for this unit.

# Differentiate Instruction

## Leveled Readers

The **Science & Engineering Leveled Readers** provide additional nonfiction reading practice in this unit's subject area.

**On-Level Reader • How Do Organisms and Their Environments Form an Ecosystem?**
This reader reinforces unit concepts and includes response activities for your students.

**Extra Support • How Do Organisms and Their Environments Form an Ecosystem?**
This reader shares title, illustrations, vocabulary, and concepts with the On-Level Reader; however, the text is linguistically accommodated to provide simplified sentence structures and comprehension aids. It also includes response activities.

**Enrichment • Predators of Shark River**
This high-interest, nonfiction reader will extend and enrich unit concepts and vocabulary and includes response activities.


### Teacher Guide

The accompanying Teacher Guide provides teaching strategies and support for using all the readers.

**Leveled Readers** All readers are available online as well as in an innovative, engaging format for use with touchscreen mobile devices. Contact your HMH Sales Representative for more information.

## ELL

ELL teacher strategies in this unit:

Lesson 1: pp. 162, 170, 173
Lesson 2: p. 182
Lesson 3: pp. 200, 207

## RTI/Extra Support

Strategies for students needing extra support in this unit:

Lesson 1: pp. 165, 166, 168
Lesson 2: pp. 186, 191
Lesson 3: pp. 198, 200, 203, 206

## Extension

Strategies for students who have mastered core content in this unit:

Lesson 1: p. 174
Lesson 3: p. 203

# Making Connections

## Connections to the Community

Use these opportunities for informal science learning to provide local context and to extend and enhance unit concepts.

### At Home

**YARD ANALYSIS** Have students walk around their yard or a nearby grassy area and observe whether most of the area gets a lot of sunshine throughout the day or little sunshine. Then have them observe the types of plants that live in the sunny and shady areas. Afterward, engage the class in discussing their observations and making any connections between them. *Use with Lesson 1.*

**GETTING ENERGY** After students read *Animal Energy,* have them look around their yard or a nearby area for an insect or small animal and observe its movements over a period of time. Then have them write a short paragraph describing how the insect or animal gets its energy. *Use with Lesson 2.*

### In the Community

**ANIMAL AND PLANT CARDS** Have students work with a responsible adult to observe five animals and five plants in the community and write a description of each organism on an index card. Instruct students to include information about the organism's habitat, niche, population, and community on the card, as well as a description of predators it has. *Use with Lesson 3.*

**TALK TO A GARDENER** Have a gardener or lawn care expert visit the class and talk to students about the importance of sun, water, and fertilizer in the care of plants and lawns. If possible, have the expert bring in examples of plants that have had too little sun or nutrients. *Use with Lesson 2.*

### Culture

**HUMANS AND PLANTS** Cultures in different regions have used plants and plant parts in various ways for thousands of years. For example, cotton is used in clothing and wood is often used in furniture or buildings. Have students choose a culture and research a unique plant or a unique way that people from that culture have used a plant. Students should present their findings to the class. *Use with Lesson 1.*

**Home Letters** Use these one-page letters to engage family members with unit concepts.

## Collaboration

Opportunities for students to work collaboratively in this unit:

**Build on Prior Knowledge**
pp. 161, 179, 197

**Discussion**
pp. 175, 193, 211

**Draw, Pair, Share**
p. 198

**Feedback**
pp. 162, 164

**Think, Pair, Share**
pp. 174, 189, 192

**Write, Pair, Share**
pp. 170, 205

## Connections to Science

Opportunities to connect to other content areas in this unit:

**Connection to Earth and Space Sciences**

Lesson 1, p. 163 **Systems and System Models**

Lesson 3, p. 207 **Developing and Using Models**

# Unit Project


## Unit Project: The Best Light

Small groups 1 class period for setup, 2 weeks of observation, 1 class period for analyzing results

For this task, small groups of students will work together to investigate how different kinds of light affect the growth of plants. Students may have limited knowledge of different kinds of light bulbs, different kinds of plants, and the importance of controlling variables in an investigation, so provide references, guidance, and instruction as needed. The unit project supports content in Lesson 1.

### 3D Learning Objective

- Investigate how a type of light affects the growth of a plant.
- Make daily observations.
- Draw conclusions about how different light sources affect plants.

### Skills and Standards Focus

This project supports building student mastery of **Perfomance Expectation 5-LS1-1.**

SEP Planning and Carrying Out an Investigation
SEP Engaging in Argument from Evidence
DCI **ETS1.B** Defining and Delimiting Engineering Problems
DCI **PS3.D** Energy in Chemical Processes and Everyday Life
CCC Energy and Matter

### Suggested Materials

- young plants, multiples of different varieties in individual containers
- a desk lamp for each group
- different types of light bulbs (fluorescent, LED, and incandescent)
- apron
- recording sheets and writing utensils
- print and/or online reference materials
- camera to document plant growth

### Preparation and Planning Tips

Ensure that each group has a lamp, a group of plants, access to different types of bulbs, and a set of print resources or a list of URLs for information about plants and types of lightbulbs you have previously reviewed. Make sure students understand that in order to investigate the effect of light on plants, they must understand the importance of controlling variables.

## Differentiate Instruction

**RTI/Extra Support** With students, identify the variables in this investigation: the plants, the amount of water, the type of light, and the distance of the light from the plant.

**Ask: What would happen if every team used different plants?** Possible answer: You could not compare how the same plant reacts to different sources of light.

**Extension** Challenge students to research the differences among the light bulbs (incandescent, fluorescent, and LED), including how they are made, the intended purposes of each, and their wattage. Then have them present their findings to the class.

Explore Online

Go online to access the Unit Project downloadable worksheet for students.

Name _____

UNIT PROJECT

# The Best Light

Think about the things that plants need to grow and survive. What kind of environment is best for plants to grow in? For this project, you will work in teams to conduct an investigation to see how different kinds of light affect the growth of plants.

Think about any plants you have in your home or yard. Think about the plants you see outside. Write a question that you will investigate as you conduct your investigation.

Students should write a question concerning the growth of plants in relation to the amount and quality of light that a plant gets.

**Materials**

Think about how you will conduct your investigation. What materials will you need?

Materials can include baby plants, soil, planting containers or cups, gloves, water, watering cups, desk lamps, light bulbs (fluorescent, LED, and incandescent), and an apron. Optional: camera to take before and after pictures of the progression of the plant's growth

To conduct your investigation, choose the type of light bulbs you will use to experiment with. Which kinds of light will you use?

Possible response: Our team is going to use fluorescent light bulbs.





UNIT 3 PROJECT

# The Best Light

## DCI PS3.D Energy in Chemical Processes and Everyday Life

Before students begin the task, check their understanding of key concepts.

**Ask: What is photosynthesis?** the process of transforming light energy into food energy

**Ask: What do plants need to grow?** They need air, water, and light.

Refer students to Lesson 3, Exploration 2, *Getting Energy from Food,* for concept support.

**ESSENTIAL QUESTIONS** Ask the following questions before students begin to plan their activity.

- How does light affect plants?
- Why is it important to control variables in an investigation?
- How is energy transferred?

Describe the types of plants and light bulbs available for students to investigate.

## CCC Energy and Matter

Have students review Lesson 1, and explain the importance of light in the process of photosynthesis and energy transfer. Make sure they cover these points:

- Light energy is needed by plants to grow.
- Plants use light and water to grow and change carbon dioxide and water into oxygen and sugar through photosynthesis.
- The food plants make contains energy stored as matter.
- Plant food is the source of energy for all living things.

## Plan and Design

Have students decide on a procedure that will ensure a fair test.

**Ask: How will you set up your investigation?** **Possible answer: Each team has a different type of light bulb but has the same type of plants set up the same distance from the light and will water the plants the same amount at the same time. Each team will record its data in the same way.**

## Finding a Solution

### SEP Planning and Carrying Out an Investigation

Have students agree on the controlled variables and develop procedures for each team to conduct the investigation, including watering, recording data, distance from the light source, and establishing the length of time for the investigation to ensure a fair test before they set up the investigation.

**Plan and Design**

Make a plan for the research you will need to do and how you will conduct your investigation. As you make your plan, consider the following:

- the distance between the light and the plant
- controlling all other factors, such as the amount of water each plant gets and when the plants are watered
- the kind of heat generated from each type of bulb; Are some light bulbs stronger than others?
- how much light the plant will receive each day
- whether there are constraints or criteria to work with

Students should describe their investigations by discussing how they will carry them out and what the controlled variables will be.

Possible response: Incandescent lights are hot, but because we only want to test the variable of the kind of light, the plant will be placed at the same distance. All plants will be watered on a daily basis and will receive half a cup of water each day. For this type of plant, it should not be watered more often, or with more water, or else it could damage and drown the plant. The main constraint is that the plant will be planted in a container and kept inside, so these conditions might affect plant growth, too.

Review your plant station. Make sure the plant was planted properly into the container and that the light is set up. Are there any modifications you need to make?

Accept all reasonable responses.

Possible response: No, everything is set up properly.



3-2

**Analyze Your Results**

Check with your teacher about how often you should observe and record data on your plant's growth. As you collect data, look for patterns in it. Make two observations about your plant.

Possible responses: The plant seems to be drooping over to the side; the plant is growing toward the light.

**Restate Your Question**

Write the question you investigated.

Students should identify the question created at the beginning of the project.

**Claims, Evidence, and Reasoning**

Make a claim that answers your question.

Possible answers: The plants that grew under the fluorescent light bulbs did the best. Although nothing is better than or as good as natural sunlight, the fluorescent lights were better than the incandescent and LED lights.

Review the evidence you collected during your investigation. What evidence supports your claim?

Students should cite evidence from their observations of their plants.

Discuss your reasoning with a partner.





## Analyze Your Results

### SEP Engaging in Argument from Evidence

At the end of the observation period, have students analyze their team results. Then have teams that used the same type of bulb compare their results. As a class, compare the results from the different groups of teams that used different light bulbs. Have students draw conclusions based on their evidence regarding how the different types of light affected plant growth.

## Claims, Evidence, and Reasoning

Review with students what it means to make a claim. Guide them to understand that they will use the evidence from their research to support their claim.

Students should claim that different types of light affect plants in different ways.

**Ask: What claim can you make?** **Possible answer: Plants grew best under the fluorescent light. They grew worst under the LED light.**

**How does your evidence support your claim?** **Our evidence supports this because we controlled variables and recorded the plant growth. Different teams got similar results.**

Encourage students to discuss their reasoning.

| Scoring Rubric for Hands-On Activity | |
|---|---|
| **3** | states a claim supported with ample, detailed evidence that different types of light affect plant growth in different ways. |
| **2** | states a claim that is somewhat supported with evidence that different types of light affect plant growth in different ways. |
| **1** | states a claim that is not supported by evidence. |
| **0** | does not state a claim. |

LESSON 1

# How Does Energy Get Transformed by Plants?

## Building to the Performance Expectation

The learning experiences in this lesson prepare students for mastery of:

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

**Trace Tool to the NGSS**
Go online to view the complete coverage of these standards across this lesson, unit, and time.

### SEP Science & Engineering Practices

**Developing and Using Models**
Use models to describe phenomena.

VIDEO Developing and Using Models

**Engaging in Argument from Evidence**
Support an argument with evidence, data, and/or a model.

### DCI Disciplinary Core Ideas

**PS3.D Energy in Chemical Processes and Everyday Life**
The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).

**LS1.C Organization for Matter and Energy Flow in Organisms**
Plants acquire their material for growth chiefly from air and water.

### CCC Crosscutting Concepts

**Energy and Matter**
Energy can be transferred in various ways and between objects.

VIDEO Energy

Matter is transported into, out of, and within systems.

VIDEO Matter

### CONNECTIONS TO MATH

**MP.5** Use appropriate tools strategically.

**5.MD.A.1** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to .05 m), and use these conversions in solving multi-step, real world problems.

### CONNECTIONS TO ENGLISH LANGUAGE ARTS

**RI.4.7** Interpret information presented... and explain how the information contributes to an understanding of the text in which it appears.

**RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

**W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

**W.5.4** Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.

**SL.5.5** Include multimedia components... and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

# Supporting All Students, All Standards

## Integrating the Three Dimensions of Learning

In this lesson, students will gather evidence that plants use energy from the sun and obtain materials for growth from water and air **(DCI PS3.D and LS1.C).** They will use this evidence to construct an argument **(SEP Engaging in Argument from Evidence)** for how matter is transported into, out of, and within an ecosystem **(CCC Matter is transported into, out of, and within systems).** Students also model **(SEP Developing and Using Models)** how well plants grow, with or without water and in and out of a light source.

**Professional Development**

Go online to view **Professional Development videos** with strategies to integrate CCCs and SEPs, including the ones used in this lesson.

## Extra Hands-On Activity: Sun's Out, Green's Out

**What Happens to Sunlight That Strikes Plants?**

Small groups
30 minutes on Day 1, 5 minutes a day for Days 2–5 to observe and record

For this activity, students will need a leafy green plant, foil, two clear plastic bags, tape, and a sunny area. The activity can be done over five days; however, you may wish to extend it as weather and class time allow.

Have students cover part of one or two leaves with foil, and seal one or two leaves in plastic bags, using tape. Every day for five days, have students record their observations, checking under the foil and noting the similarities and differences from the previous day.

After five days, have the class compare notes on how the plants changed. Students' results should show that the foil covered leaves turn yellower, because they could not receive sunlight to convert into chlorophyll. The leaves sealed in plastic bags should show some signs of moisture, indicating that the plant released water vapor.

SEP **This activity can support mastery of this SEP concept: Use models to describe phenomena.**

## Preassessment

Have students complete the unit pretest online or see the Assessment Guide.

## Build on Prior Knowledge

Students should already know and be prepared to build on the following concepts:

- All organisms have systems that they use to perform daily functions. *(Grade 4, Unit 5, Lesson 2)*
- Plants depend on energy and matter to grow. *(Grade 4, Unit 4, Lesson 1)*

## Differentiate Instruction

### Lesson Vocabulary

- photosynthesis

Write the word *photosynthesis* on the board, and discuss the definition: the process by which green plants transform light, water, and carbon dioxide into food. Explain that the word is from the Greek *photo,* "light", and *synthesis,* "putting together." Point out that the root word *photo* is often used as a prefix, then have students work in pairs to find and list at least three words with the same prefix. Allow them to use dictionaries. Ask pairs to share their results with the class.

### ELL/ELD Strategy

To help students develop fluency and familiarity with English syntax, give them sentence frames to guide responses to questions.

**Ask: What do plants need?**

Then ask students to complete the following sentence, using their prior knowledge: Three things plants need are _____, _____, and _____. **in any order: light, water, air**

# ENGAGE: Lesson Phenomenon

## Lesson Objective

To develop and use models to support an argument that plants acquire material for growth mainly from air and water.

## About This Image

Vietnam's Son Doong cave is the world's largest cave, about 8.8 km long and 200 m wide. The cave was created 2–5 million years ago when river water eroded limestone under a mountain, creating huge holes that acted as skylights. The skylight-like holes allow sunlight through to help plants grow. The cave has its own lake, river, and jungle. The only way into the cave is to repel by rope, 260 ft down through one of the skylight.

**SEP Engaging in Argument from Evidence**

## Alternative Engage Strategy

**What Do Plants Need?**

Whole class
10 min

Assess prior knowledge by having students do a fast write.
**Say:** Think of plants you've seen, from tiny flowers to giant trees. Now, in one minute, write what you think plants need in order to survive and grow.

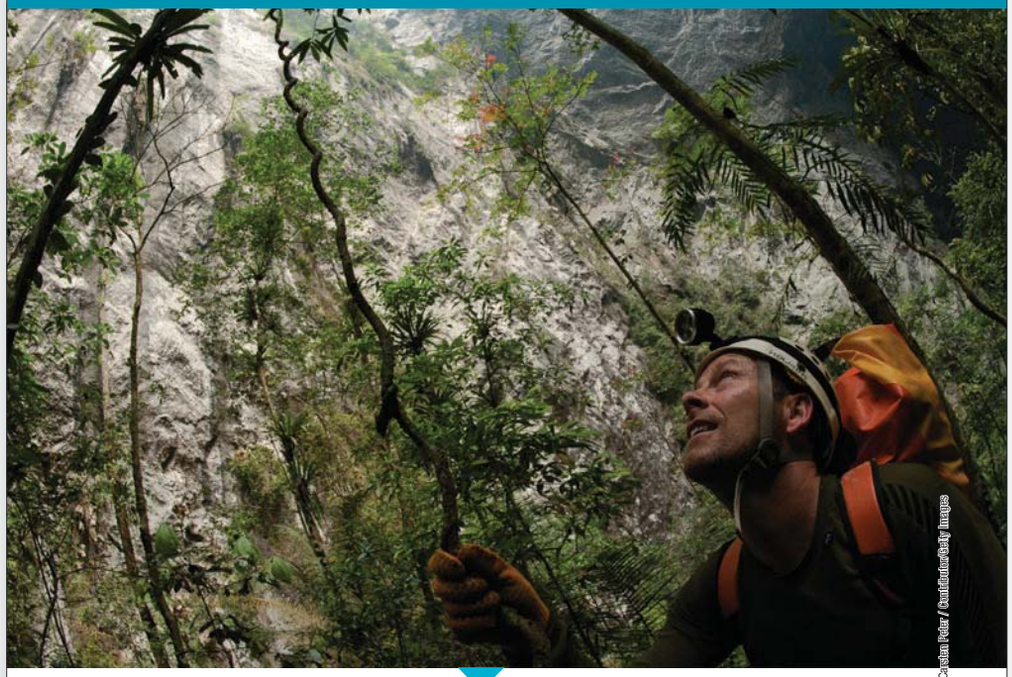
After one minute, stop students. Encourage them to share their fast write with the class, and explain why they believe plants need the items listed.

Have students keep their fast write to revisit at the end of the lesson.

**Ask: Do you still think plants need these items to survive and grow? Why or why not?** Students should discuss their ideas with their classmates.

LESSON 1

# How Does Energy Get Transformed by Plants?





You may not think that plants can grow in a cave. But this forest is in a cave in Vietnam! As long as plants have what they need to grow, they can thrive in even the most unexpected places.

**By the end of this lesson . . .**
you'll be able to explain that plants get the materials they need to grow mostly from air and water.

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**Explore Online** Students can explore the lesson phenomenon online.

## Can You Explain It?

**Explore Online**

When you think about plants growing in a garden, what do you expect to see? Look at the plants in this photo. They are growing out of tubes. Think about how and where they are growing. Is this different from what you would expect?

**1.** You know that you need at least food and water to grow and stay healthy. What do you think plants need to grow? How are the plants in the picture able to grow without soil?

Students should respond based on the preliminary observations they can make of the images.

**Tip**

Learn more about how matter changes in How Does Matter Change?

**EVIDENCE NOTEBOOK** Look for this icon to help you gather evidence to answer the questions above.

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## Can You Explain It?

Students are asked to record their initial thoughts about plants growing not in a normal garden but a hydroponic one. To do so, students must think about what plants need to grow. Encourage students to record the first thoughts that come into their minds. Point out that their ideas might change as they work through the Explorations and Hands-On Activities. Explain that they will have another opportunity to answer the same questions at the end of the lesson.

## Collaboration

**Build on Prior Knowledge** You may wish to have students discuss the image as a whole-class activity. In this way, you can more accurately gauge students' prior ability to make sense of the phenomenon by applying knowledge gained through previous experiences related to the materials that plants need to grow.

### EVIDENCE NOTEBOOK

Encourage students to use an appropriate graphic organizer, such as main idea and supporting details, to set up their notebook for this lesson.

Find more strategies in the online ELA handbook.

## Support for Unit Project and Performance Task

The Unit Project **The Best Light** and Unit Performance Task **Business Has Bean Bad** supports content in this lesson.

# EXPLORATION 1 Plant Growth

## 3D Learning Objective

Students will gather evidence of where plants get the materials they need **for growth** from **matter** and from **models** of how plants grow, with or without air or water.

### DCI LS1.C Organization for Matter and Energy Flow in Organisms

Explain that like all living things, plants have basic needs that must be met by the resources in their environment.

**Ask: How is one of the plant's needs being met in the first photograph?** It is getting water that all living things need.

### SEP Engaging in Argument from Evidence

Have students use evidence to answer the questions.

**Ask: What do you think will happen if a plant's needs aren't met?** If a plant's needs aren't met, it will wilt and die.

## Collaboration

**Feedback** Have student pairs share their answers to the questions and explain their reasoning. Encourage discussion to come to a consensus of opinion.

## Differentiate Instruction

**ELL: Read Aloud** To support English-language learners, read the questions aloud, and allow students to reply in their native language. Then write their answers in English on the board in complete sentences, and have students read them aloud: 2. The plant is getting water; 3. The plant is not getting air; 4. The plant gets nutrients from insects; 5. The plants will die.



EXPLORATION 1

## Plant Growth

### Can It Grow?

Under each caption, finish the sentence by writing what the plant is getting to meet its needs, or what it is lacking to meet its needs.

**2.** These plants are being

Possible answer: watered.

**3.** This plant is in a vacuum-sealed container that does not contain any

Possible answer: air.

**4.** Some plants, such as this Venus Flytrap, grow in soil that does not have a lot of nutrients. The Venus Flytrap gets nutrients from consuming

Possible answer: insects.

**5.** Think about plants that are not getting what they need to grow. What do you think will happen to these plants?

Possible answer: The plants will die.

HANDS-ON Apply What You Know

## What Do Plants Need to Grow?

**6.** Think about what you've learned about what plants need to grow. Work with your group to plan an experiment. Your group might plan to test how a plant grows with no water, some water, or a lot of water. Or you might plan an experiment to compare how a plant grows with and without air. Your plan should identify the variable being tested. Include a procedure that includes a control group and an experimental group. Give directions on how to collect data, and list the materials needed.

Record your plan. Be sure to include the variable being tested, the procedure (including the control and experimental groups), the materials needed, and how data would be collected. Predict the results.

Possible answer:

1. The variable to test is whether a plant can survive without water.

2. We need a control group of plants watered every other day and an experimental group of the plants that were never watered.

3. We will measure growth and observe changes in the plant leaves and stem.

4. Materials could include several of the same type of plant, planted in small plastic cups, gloves, soil, water, metric ruler, paper towels, window or light source, and an apron.

5. We predict that the plants that did not get water would not grow and the plants that were watered would grow.





### HANDS-ON Apply What You Know
### What Do Plants Need to Grow?

**SEP Developing and Using Models**

Have students work in small groups and present their finished plans to the class. Encourage classmates to ask questions and suggest possible improvements. If time permits, allow groups to do their experiments. Approve plans and provide the materials.

**Scoring Guideline**

An excellent score consists of the student participating in the experimental design and accurately describing how to record data.

## Connection to Earth Science

Point out that Earth's major systems include the hydrosphere (water), the atmosphere (air), and the biosphere (living things). These systems interact in many ways.

**Ask: How would Earth's systems interact in your experiment?** **Possible answer: The atmosphere (air) is required for the biosphere's (the plant, or all living things) growth.**

**ESS2.A** Earth Materials and Systems

Additionally, students can further build on their understanding of the Crosscutting Concept Systems and System Models through the exploration of this phenomenon. Have students determine how Earth's systems would need to change for their experiment to work.

**Crosscutting Concept:** Systems and System Models

## Connection to English Language Arts

Remind students that it is important to provide clear steps to follow in sequence when planning an experiment.

**Ask: What would happen if someone wrote steps for an experiment in the wrong order?** **The experiment may not work because you have to follow a plan step by step.**

**W.5.4** Produce. . . writing in which the development and organization are appropriate to task, purpose, and audience.

## Engineer It!
# What's the Right Amount?

### DCI LS1.C Organization for Matter and Energy Flow in Organisms

As students read about irrigation, make sure they understand how the system works. Lead a discussion to clear up any misunderstandings. Then, as students sketch their designs, remind them to include labels and callouts.

**Ask: How did you make sure the device would bring water to dry areas and not flood already wet areas?** Answers will vary depending on the system design.

## Collaboration

**Feedback** Have students work as a group to discuss and analyze each other's irrigation designs. Remind designers to back up their designs with evidence of how it would help plants. Encourage classmates to critique each design by asking questions about how it will function and suggesting possible improvements.

### CCC Matter and Energy

The text provides information about how engineers design devices to transport water to help plants that need it.

**Ask: What else might engineers design a device to transport to help plants grow?** Possible answers: a device to provide extra nutrients or light; a device to protect plants from too much light, harmful matter, or consumers (insects)

Find more support in the online **Crosscutting Concepts Handbook**.



Engineer It!
## What's the Right Amount?

Imagine that you were trying to grow roses in an area where it doesn't rain very often. How would you make sure the plants got enough water between rainstorms? You would probably water them with a sprinkler system or hand water them with water collected in rain barrels.

Some areas do not have a lot of water. In these areas, machines may be used to irrigate plants in the most efficient way possible so that no water is wasted.

Some areas have a lot of water. If these places are hilly or mountainous, fields may be designed to look like steps to reduce soil loss. This also allows plants that need a lot of water, like rice, to grow.

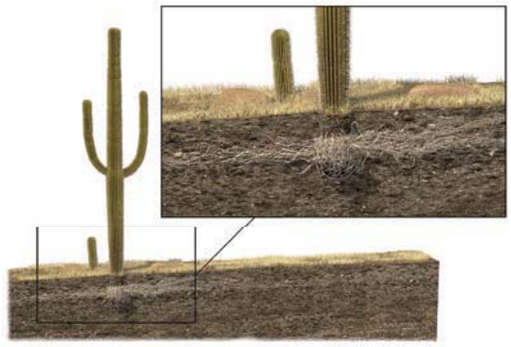
Irrigation engineers design structures to water, or irrigate, plants. One way to do this is to water plant roots. This type of system is made by burying plastic pipes with holes in them along rows of plants. These systems can be run on a timer so that irrigation occurs during cooler parts of the day. This reduces water loss due to evaporation.

**7.** In the space below, draw a model of an irrigation system that optimizes water use in a dry area or in a wet area.

Students may draw a system that uses buried plastic pipes for dry areas or that runs on a timer for wet areas. Accept all reasonable designs.

## What's Needed?

Think about two kinds of plants you've seen, such as a maple tree and a dandelion. How are these plants similar? Both have leaves and a stem and produce flowers. But how do a maple tree and a dandelion differ? The stem of a maple tree is the trunk, while a dandelion has a soft stem. Plants have similar structures that also have differences.



Saguaro cactuses live in the Sonoran Desert in the Southwest United States. Their roots are shallow, and they spread out over a large area. This helps them absorb as much water as possible when it rains. The roots only grow about 12 cm deep. They spread out to a length that is equal to the height of the plant.

The roots of this pecan tree are much larger. They grow deep into the ground and spread out over a large area compared to the diameter of the trunk. They can absorb water from deep in the ground, even when it hasn't rained for a long time. The roots of a mature pecan tree can take in between 570 and 950 L of water a day!



**8. Language SmArts** Research more about how too much water can affect plant growth. Use more than one print or digital source to find information. Write your findings below.

Possible answer: Too much water can cause plant roots to rot and leaves to wilt, turn yellow or brown, or make it easier for plants to be infected with diseases, such as fungi. Too much water may cause brown spots to appear on leaves as well. Too much water can kill a plant.



## DCI LS1.C Organization for Matter and Energy Flow in Organisms

Have students work in pairs, using Venn diagrams to compare and contrast the Saguaro cactus and pecan tree.

**Ask: What are two ways the saguaro cactus and pecan tree are alike?** Both are plants; both have roots.

## Differentiate Instruction

**RTI/Extra Support** Students may need extra help doing the research project. Provide them a list of sources to start their research. Encourage students to draw illustrations of the effects of over-watering to clarify understanding.

## SEP Engaging in Argument from Evidence

**Ask: What evidence could you use to support a claim that over-watering harms plants?** Over-watered plants may die because their roots can't absorb the nutrients they need to function.

Have students write a summary of what they learned. Remind them that summarizing uses the main idea and a few details.

**Ask: What is the main idea you get from your research?** Over-watering harms plants.

**Ask: What is one detail that supports that main idea?** Leaves turn yellow and fall off.

Find more support in the online **Science and Engineering Practices Handbook**.

## Language SmArts

**RI.5.9 Integrate information from several texts.**

As students research what happens to over-watered plants, reinforce the importance of using valid evidence to support a claim.

## Do the Math
### Thirsty Trees

**5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real world problems.**

Allow time for student pairs to come up with a method for finding which plant takes in the most water. Then have students share their methods as you lead a class discussion on converting standard measurements. Encourage pairs to revise their methods to correct any errors.

Find more support in the online **Math Handbook**.

## Differentiate Instruction

**RTI/Extra Support** If students have difficulty doing the math, write the answers on the board as students discuss them. Help students understand that they must convert the units before the numbers can be compared.

## EVIDENCE NOTEBOOK

Students' entries will be varied, depending on whether their area's plants need a lot of water or not.

### FORMATIVE ASSESSMENT

### DCI Organization for Matter and Energy Flow in Organisms

Make certain students understand the concept of how plants would fare in outer space.

**Ask: Would plants be able to meet their needs in space?** No; plants need oxygen and water. Astronauts are helping the plants meet their needs. But if the plants were released in space, those needs wouldn't be met.



## Do the Math
### Thirsty Trees

**9.** A saguaro cactus can absorb 760 L of water during a heavy storm. A pecan tree can absorb 570,000 mL per day. Convert the units to determine which plant absorbs the larger amount of water.

760 x 1,000 mL/L = 760,000 mL;

570,000 mL ÷ 1,000 mL/L = 570 L

Next, circle the plant that correctly completes the sentence.

The saguaro cactus/pecan tree takes in the most water at a time.

The saguaro lives in places that are very dry but have rare, heavy rainstorms that may occur once a month. It absorbs 760 L of water during one such storm. The pecan tree takes in the 570,000 mL it needs each day during its growing season. Which plant requires more water over time? Explain your reasoning.

Possible asnwer: The pecan tree requires much more water because it must take in 570 L per day as opposed to once in a while during a rare storm.

**EVIDENCE NOTEBOOK** In your Evidence Notebook, identify whether plants that do not need a lot of water or plants that do need a lot of water would grow better in your area. Explain your answer. Suppose the type of plant best suited to your area is a plant that does not need a lot of water. What could you do to grow such a plant in your area?

### Putting It Together

**10.** These plants are growing on the International Space Station! How are the plants getting what they need to grow? What do you think would happen if the plants were released into space?

Possible answer: The plants are getting water because the astronauts are watering them. The plants are getting air from inside the space station, just like the astronauts. If the plants were released into space, they would die because the plants could not get the water or air that they need.

HANDS-ON ACTIVITY

# Lights Out!

You have learned that plants need water and air to survive. Plants also need nutrients. What else do plants need to survive and grow?

**Materials**
- 2 small potted plants
- masking tape
- marker
- measuring cup
- water
- metric ruler
- graph paper
- colored pencils

## Objective

**Collaborate** to collect data about how light is related to plant growth and survival.

What question will you investigate to meet this objective?

Possible answer: What happens when plants are grown with no light?

## Procedure

**STEP 1** Use the tape and marker to label one plant "Regular Light" and one plant "No Light."


Why is it important to label the plants?

Possible answer: labeling the plants helps to reduce experimental error because we will not mix up the plants if they are labeled.

**STEP 2** Place one plant in front of a window getting regular light. Place the other plant in a cabinet 24 hours a day for the length of the experiment.


Why did you put the plants in different places?

Possible answer: Putting the plants in different places allows us to test variables and compare results.





Student Lab Worksheet and complete Teacher Support are available online.

HANDS-ON ACTIVITY Small groups 1 class period/2 weeks

# Lights Out!

### 3D Learning Objective

**DCI PS3.D. Energy in Chemical Processes and Everyday Life**

Students will model what happens when one key element of what plants need (energy from light) is restricted and how it affects plant growth and survival.

### Materials

The materials listed in the Student Edition are a starting point. You may wish to add a camera to document plant growth. Also, make sure that both plants used by a group are the same kind and about the same size.

### Preparation

Plan a space by windows where the in-the-light plants can be kept out for this time period. Prepare a cabinet to house the in-the-dark plants; you may wish to line the shelves with newspaper. Make sure it will be readily accessible to students. Finally, make sure that each group has an area in which to assemble or track its plants.

### Procedure

**STEP 1** Circulate as groups label their plants to make sure they understand why the labeling process is important. Also, remind groups not to put the labels where they could be damaged by water.

## Support the Unit Project

This activity supports student understanding of how plants need energy from light. Students can use the understanding derived from the activity to determine how to develop an investigation to determine how light type affects the growth of plants.

**STEP 3** Remind groups to water the plants at the same time of day each time, with exactly the same amount of water. Have group members take turns measuring the amount of water to use. Stress that too much water can be a bad thing.

**STEP 4** Set a schedule for measuring and recording plant growth and plant changes every other day. Circulate to observe and assist students as needed. If possible, let students record photographically as well.

## Connection to Math

As students perform this experiment, they use appropriate tools to arrive at a sound mathematical conclusion: a measuring cup and a metric ruler. Both measuring tools help students gather accurate information for making scientific comparisons of plant growth with or without light.

**Ask: Why should you always use a measuring cup?** to make sure each plant gets exactly the same amount of water.

**Ask: How can you be sure you are accurately measuring plant growth?** Always start with the ruler's zero mark at the bottom of the plant in the soil.

**MP.5** Use appropriate tools strategically.

## Differentiate Instruction

**RTI/Extra Support** Model how to water and measure a plant. Talk about the need for measuring the water and height carefully. Remind students that the plants must be measured more than once to gather data.


**STEP 3** Water both plants every three days. Use the same amount of water for each plant.

Why is it important to give all the plants the same amount of water?

Possible answer: Giving the plants the same amount of water allows us to control for the amount of water since we only want to test for the effects of light.

**STEP 4** Use the metric ruler to measure the height of each plant every other day. Make observations about the appearance of the plants' stem and leaves as well.

Complete the data table as you carry out the experiment.

| Day | Regular Light | | No Light | |
|---|---|---|---|---|
| | Height (cm) | Observations | Height (cm) | Observations |
| 1 | Student data will vary, but students should find that the | | | |
| 3 | plant that received regular light was healthier than the | | | |
| 5 | plant that received no light. | | | |
| 7 | | | | |
| 9 | | | | |
| 11 | | | | |

**STEP 5** At the end of the experiment, clean up as instructed by your teacher.

Why is it important to dispose of or recycle the plants properly?

Possible answer: Disposing of the plants or recycling them properly reduces safety and health risks and also promotes conservation by reducing the waste stream.



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### Analyze Your Results

**STEP 6** Make a graph of your results on graph paper. Label the x-axis "Time (Days)" and the "y-axis Growth (cm)." Use two different color pencils to graph the results for each plant on the graph. Be sure to include a key and a title for your graph. Then submit your completed graph to your teacher.

**STEP 7** What variable did you test in this experiment? Which plant was the control plant?

Possible answer: We were testing the effect of light on plant growth. The control plant was the plant that was left in front of the window and exposed to regular light.

**STEP 8** Collaborate with other teams. Compare your results to those of your classmates. Were your results similar to those of other groups? Why or why not?

Possible answer: The results were similar because plants need light in order to survive.

**STEP 9** What differences in growth did you observe?

Possible answer: The plants in regular light grew the best. The plants left in total darkness did not grow and eventually died.

**STEP 10** What other differences did you observe among the plants?

Possible answer: The leaves of the plant in regular light grew and stayed green and increased in number. The leaves of the plant in total darkness turned yellow, then brown, and possibly died.

### Draw Conclusions

**STEP 11** Make a claim about the effect of light on plants. Cite evidence to support your claim.

Possible answer: Plants need light to grow and cannot survive without it. Plants that did not have light died.

**STEP 12** What is one question you still have about how light affects plant growth?

Possible question: Can too much light kill a plant?





### Analyze Your Results

**STEP 6** Make sure students include a title, labels for the time and growth axes, and a key. Observe how they graph their results.

**Ask: What, if anything, surprised you about your results?** Responses should be based on student results.

**STEP 8** Make sure students understand that they are collaborating with other teams in order to increase their sample size.

**Ask: Why would you want to have a sample size greater than one tested plant?** If you only have one plant that was tested, you may have mistakes that are unaccounted for.

### Draw Conclusions

**STEP 10** Students should be able to conclude that plants need light to grow and should include evidence.

**Ask: What is your main conclusion?** Plants don't do well without light.

## Claims, Evidence, and Reasoning

Have group members agree on a claim, based on their results. Then allow time for groups to compare and contrast results, looking for variables that might explain differences, such as one group using more or less water.

| Scoring Rubric for Hands-On Activity | |
|---|---|
| **3** | follows procedure, records accurate data, analysis reflects results, makes a logical claim with supporting evidence |
| **2** | investigation and recording done correctly, but analysis insufficient, weak claim |
| **1** | follows some procedures, but data incomplete, analysis inconsistent with results |
| **0** | does not follow procedure, data is missing |

# EXPLORATION 2 Getting Energy from Food

## 3D Learning Objective

Students discover how a plant store energy from the sun **through a chemical process**, using **matter transported into and within** parts of the plant. Then, students **model** the plant parts involved in the photosynthesis process.

## Collaboration

**Write, Pair, Share** Have student pairs explore online to learn more about how plants get energy. Ask each pair to prepare a short TV interview: one student plays the interviewer, and the other a scientist who will explain photosynthesis to kids, as simply as possible. Have pairs write a script and then act it out for the class.

## DCI PS3D. Energy in Chemical Processes and Everyday Life

The text and images on the page explain the chemical process of photosynthesis. Remind students that all of the necessary elements must be available; if one element is missing, photosynthesis cannot take place.

**Ask: Could photosynthesis be done in the dark? Why or why not?** No, photosynthesis requires the use of light.

## Differentiate Instruction

**ELL: Cognates** Point out cognates of key terms in this lesson, *photosynthesis/fotosíntesis, oxygen/oxígeno, carbon dioxide/ dióxido de carbon, stomata/estomas, and microscope/ microscopio*, to bridge understanding. Pronounce each word in English, and have students repeat it. Ask other students to share the same words in their home languages.





## Getting Energy from Food

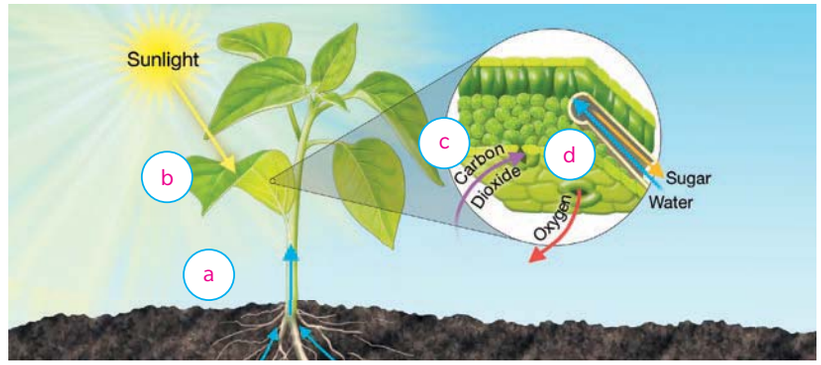
### Who Needs Food?

So far, you've learned that plants need water, air, and light to grow and survive. But how do they use the water, air, and light? Well, plants need food, but they don't eat other plants to get food. So how do plants get the food they need?

### Making Food

**11.** The lettered captions show each step in this process. Study the picture and the captions, then match each caption to the step it describes in the picture.

Explore Online




**a.** Plants absorb water through their roots. The water then moves up into the stem and leaves of a plant.

**b.** Plant have structures that capture light energy from the sun.

**c.** Plants get carbon dioxide from the air.

**d.** Using light energy, plants then change carbon dioxide and water into sugar and oxygen.

Plants change carbon dioxide and water into oxygen and sugar through a process called photosynthesis. Light energy from the sun is needed for photosynthesis to take place.

Plants make the food they need to survive and grow by carrying out photosynthesis. This food contains energy stored as matter. The matter in the food is made up of sugars and comes from the carbon dioxide in the air and water. The energy stored in the sugars was once light energy from the sun. Oxygen is released as a waste material into the air.

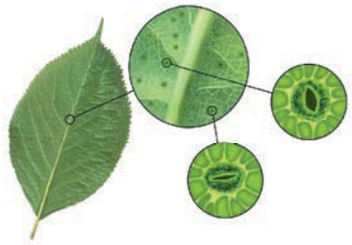
Explore Online

Have students explore online to learn more about photosynthesis.

HANDS-ON Apply What You Know

## In and Out

Plants need to take in carbon dioxide from air. They also need to release oxygen into the air. How do they do this? To find out, look at this picture of a plant leaf under a microscope. The underside of a leaf has openings called *stomata*. Carbon dioxide and oxygen move into and out of a plant through stomata when they are open.



There are structures on the sides of the stomata. The structures control whether the stomata are open or not. When these structures are swollen, the stomata are open. When they are shriveled, the stomata are closed.

**12.** You have learned that a plant needs carbon dioxide, water, and light to carry out photosynthesis. You've explored the plant parts that take in each of these. Now, apply what you've learned to make a model that shows all of the parts of a plant that are involved in photosynthesis. Don't forget to include parts that are too small to see without a microscope. Sketch your model in the space below.

Student models will vary. Assess student models for accuracy and creativity.





### HANDS-ON Apply What You Know

In and Out

### DCI LS2.A Interdependent Relationships in Ecosystems

For this activity, have a microscope and leaves available, or let students use hand lenses to get a close look at the illustrations. After reading the text, have students speculate about the exchange of gases before sketching their models.

**Scoring Guideline**

Excellent scores involve an accurate and creative sketch model.

## Connection to English Language Arts

The illustration of a leaf has pullouts showing close-ups of important parts used in photosynthesize.

**Ask: How do the close-ups help you better understand what you read in the text?** They show me exactly what the text tells.

**RI.4.7** Integration of Knowledge and Ideas

### SEP Developing and Using Models

Have students review and critique each other's models and consider the following questions: Does each sketch show all the parts necessary for photosynthesis? Are there labels or callouts to identify each part?

Allow students to change their own sketches if they forgot something.

## Support the Performance Task

This activity supports student understanding of the components plants need to grow. Students can use the understanding derived from the activity to determine what factors need to be included when testing solutions for their plants.

## DCI LS1.C Organization for Matter and Energy Flow in Organisms

Allow students to look back at the information and diagram on page 170.

**Ask: What are the products of photosynthesis?** sugar and oxygen

## SEP Engage in Argument from Evidence

Invite students to give their answer to Item 14 in the form of a claim. Then have them provide evidence that indeed those two things are necessary for photosynthesis.

**Ask: What evidence can you use to support your claim?** Possible answer: the diagrams on pages 170 and 172

## EVIDENCE NOTEBOOK

Students should record that the stomata opens and closes to all carbon dioxide in and oxygen out; without stomata, a plant would die.

### FORMATIVE ASSESSMENT

**Language SmArts**

**Use Visual Displays**

**SL.5.5 Include multimedia components**

As students explain how plants get what they need to make food, encourage them to make sketches to accompany their written descriptions. Point out that the visuals can assist with clarifying information and help readers better understand what they read.

### Picture This!

**13.** Study the diagram below. It shows the things a plant needs to carry out photosynthesis, as well as the things produced by photosynthesis. Write the terms in the correct places on the diagram.

**sugar** **carbon dioxide** **oxygen** **water**


**14.** Which two things do all plants need for photosynthesis? Choose the correct answer.

**a.** carbon dioxide and soil
**b.** water and carbon dioxide
**c.** insects and water
**d.** soil and sugar

**EVIDENCE NOTEBOOK** Look at the illustration of the stomata again. In your Evidence Notebook, explain how stomata help a plant get the materials it needs to grow. Describe what would happen if a plant did not have stomata.

**Language SmArts**

**Use Visual Displays**

**15.** You've learned that plants need air, water, and energy from the sun to make food to grow and survive. Explain how plants get each of these. Then explain how plants use these to make food.

Possible answer: Plants get water by absorbing it through their roots. They get carbon dioxide from the air, which enters the plant through stomata. Energy from the sun is captured by structures in plant cells. Using energy from the sun, plants change carbon dioxide and water into oxygen and sugar. Plants use the sugar as food.

**Tip**

The English Language Arts Handbook can provide help with understanding how to use visual displays to demonstrate information about main ideas.

# TAKE IT FURTHER Discover More

**Explore Online** Students can explore all three Take It Further paths online.

TAKE IT FURTHER

## Discover More

**Check out this path . . . or go online to choose one of these other paths.**

**People in Science & Engineering**

- **Not Only Plants!**
- **Design Your Own Hydroponics System**

### A Moss-Powered Radio

Fabienne Felder is a designer. Dr. Paolo Bombelli, Dr. Chris Howe, and Ross Dennis are scientists. These four people have worked together to make fuel cells—using plants to generate electricity!

Dr. Chris Howe is a biochemist at the University of Cambridge. His science lab is leading the way on research for moss-powered radios.

Fabienne Felder is a designer from Switzerland. She originated the concept and design of the radio using Howe's technology.

Dr. Paolo Bombelli, a biochemist at the University of Cambridge, is the leading researcher on the science team.

Ross Dennis, a plant scientist at the University of Cambridge, is a key collaborator on the project.

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## Collaboration

You may choose to assign this activity or to direct student pairs to the Interactive Online Student Edition where they can explore and choose from all three paths. Have pairs share their findings with the class.

## People in Science & Engineering: A Moss-Powered Radio

Students learn about a team of scientists whose work focuses on new ways to use the biological processes of plants. Biochemists such Ms. Felder and her team at Cambridge have proved that the energy produced in plants can generate power for everyday items, such as a radio powered by moss. Encourage students to go online to view the video and learn more about the project. *(No outside research required.)*

**PS3.D Energy in Chemical Processes and Everyday Life**

**Ask: What is an everyday object you use that you would like engineers to figure out how to power by a plant?** Accept any reasonable response.

## Differentiate Instruction

**ELL: Reading** Students learning English may struggle with reading and comprehending the information in this section. Partner English language learners to read with students proficient in English. Then, have each student verbally share a sentence about one of the scientists or the project.

## SEP Developing and Using Models

As students read about the project, point out that answering one question often leads to more questions, a need for more study, and the building of more models.

**Ask: How do you think the team might answer the question about which kinds of plants to use?** Build a series of models, each using a different kind of plant, to see which works best.

## Collaboration

**Think, Pair, Share** Have student pairs work together to answer Items 16–17. Then have pairs share their responses as you lead a whole-class discussion. Encourage pairs to revise or update their responses to correct errors.

## Differentiate Instruction

**Extension** Challenge student pairs to find out more about generating electricity with plants. Have each pair plan a presentation for classmates, complete with visuals.

## Explore Online

Students can explore these additional topics online

### Not Only Plants!

Students discover that plants are not the only organisms that can carry out photosynthesis. Kelp and a strange-looking slug are among the other living things that can make their own food! *(No outside research required.)*

### Design Your Own Hydroponics System

Students learn about hydroponics: the process of growing plants in water instead of soil. *(Outside research required.)*



By using the electrical power generated when plants carry out photosynthesis, they can make a radio work in the same way as if it were plugged into a socket in the wall. The team hopes to be able to design systems that generate enough power to charge cell phones or provide electricity to the part of an airplane where the passengers sit.

After working with moss, the team discovered some of its limitations. For example, it cannot get too much light and it does not grow well in cold temperatures. This has led them to more questions, such as the following:

- Which are the best types of plants to use?
- How much light do the plants need?
- What are the best conditions in which the plants grow?
- What are the best types of materials that can be used to conduct electricity?
- How can the plants be cared for and kept healthy while still having the overall system provide a steady stream of electricity?

**Moss-powered radio**

**16.** Think about the issues the scientists encountered. Their vision for the future is to have plants cover large surfaces, and the system will provide electricity. How do you think some of these issues can be solved? Is the type or size of the plant important? Why or why not?

Possible answer: The size and type of plant is important, especially if the plants will cover large surfaces. Larger plants would take up more space and resources than smaller plants, such as mosses. Also, the conditions in which plants grow best are important. Certain plants will grow best in different areas of the world. The team should experiment to find out which plants grow best and produce the most electricity for different regions of the world based on climate.

**17.** Why is it important to consider the care and health of the plants? Why is it important that the electricity is produced in the most efficient way possible? How could the team answer some of these questions?

Possible answer: The care and health of the plants is important because if they are not healthy, they may not produce as much electricity. The team needs to determine the most efficient way to keep the plants healthy so that they provide electricity consistently.

# LESSON CHECK

**Explore Online** Students can revisit the lesson phenomenon online.

LESSON 1

## Lesson Check

Name _____

### Can You Explain It?

1. Now that you've learned more about what plants need to grow and survive, explain how the plants in the image are so healthy. Be sure to do the following:
   - Describe what plants need to survive.
   - Explain how plants make their own food.
   - Explain how these plants are growing even though they aren't being grown in soil.

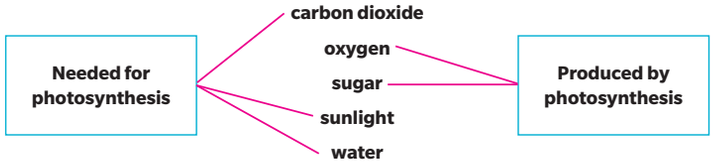

**EVIDENCE NOTEBOOK** Use the information you've collected in your Evidence Notebook to help you answer these questions.

Possible answers:

- Plants need air, water, and sunlight to survive. The plants can grow with no soil because they are getting everything they need to survive.
- Plants transform the energy from the sun into food energy.
- Nutrients that help the plants stay healthy and grow are probably being added to the water.

### Checkpoints

2. Draw a line matching each term to whether it is needed for photosynthesis or produced by photosynthesis.

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**Formal Assessment** Go online for student self-checks and other assessments.

## Can You Explain It?

### Collaboration

**Cultivating New Questions** As students complete this lesson and prepare for the next lesson, ask them to identify additional questions they have about how plants use energy and matter.

**Ask: What happens when a plant is given too much of one of its needs?** Possible answer: Plants that get too much water may die.

As students continue to the next lesson, they will apply concepts about how energy is stored as matter to how energy and matter are used by other organisms.

### EVIDENCE NOTEBOOK

Have students reread their answers to the Evidence Notebook prompts and then use this evidence to justify their reasoning as they respond to the Can You Explain It question. Make sure students understand that a complete response must address all bulleted points.

### CCC Matter and Energy

Focus students on the hydroponics photo by having them reread the caption under the image in the Engage.

### SUMMATIVE ASSESSMENT

### SEP Engaging in Argument from Evidence

2. This question asks students to match the terms to show whether they are needed for photosynthesis or are products of the process. Check that students reason through each term. If necessary, have them revisit the information in Exploration 2.

## Using Representations to Assess Proficiency

**3.** In Exploration 1, students discovered that not enough water and/or too much water can harm a plant. Allow students to revisit the information to refresh their memories.

**4.** This concept was covered most directly in the Hands-On Activity. If students have difficulty with the question, have them go back and reread information relating to plants and sunlight.

**5.** This concept was covered in Exploration 1. Let students having difficulty check their Evidence Notebook and the Exploration for clues.

**6.** Plant structures and functions were covered in Exploration 2. Students can check the photos and text for clues to the answers for the diagram.

**Use the illustration below to answer the questions.**

**3.** Suppose the two plants in the photograph are getting the same amount of sunlight, air, and nutrients. What could cause the first plant to look the way it does? Choose all that apply.

**a.** It is getting too much sun.

**b.** It is not getting enough air.

**c.** It is getting too much water.

**d.** It is not getting enough water.

**4.** Suppose one of the plants is only getting 2 hours of sunlight every 24 hours. Which plant is that? Assume that all other conditions are the same for each plant. Choose the best answer.

**a.** The first plant, because it is not getting enough light to make enough food

**b.** The first plant,, because it is not getting enough air to make enough food

**c.** The second plant, because it is not getting enough light to make enough food

**d.** The second plant, because it is not getting enough air to make enough food.

**5.** What is true of maple trees and saguaro cactuses? Choose all that apply.

**a.** They are the same size.

**b.** They grow in different climates.

**c.** They have different root systems.

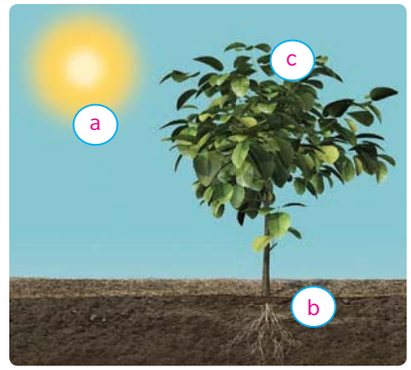
**d.** They need the same amount of water.

**6.** Match each sentence to the step it describes on the illustration shown here.

**a.** Light energy from the sun is captured by structures in leaves.

**b.** Roots absorb water from soil.

**c.** Stomata allow the plant to take in carbon dioxide and release oxygen.



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LESSON 1

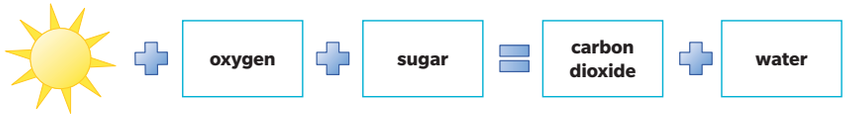
# Lesson Roundup

**A.** Choose the words that correctly complete the sentences.

| | | |
|---|---|---|
| **air** | **soil** | **water** |
| **sunlight** | **die** | **leaves** |

Plants need air, which they take in through stomata. Plants also need water, which they absorb through their roots. If plants do not get enough water, their leaves will wilt. If plants do not get any air, they will die.

**B.** Study the diagram below. It shows the things needed for photosynthesis and the things produced by photosynthesis in the wrong order. Redraw the diagram, placing the items in correct order.




Students should show that light, carbon dioxide, and water are used to make sugar and oxygen.

**C.** Write anything else you learned about how plants use energy from the sun to change matter that isn't food into matter that is food!

Possible answer: Plants need energy from sunlight to carry out photosynthesis. Photosynthesis changes carbon dioxide and water into sugars and water. Plants use the sugars as food to grow and survive.





## Lesson Roundup

**DCI PS3D. Energy in Chemical Processes and Everyday Life**

This lesson summary enables students to quickly revisit key points and prepare for tests.

**A.** To clarify students' understanding of key terms, have them revisit Exploration 2. Although some fill-in-the-blanks may seem to have more than one answer, instruct students to find the best answer given the complete paragraph. You can also remind students that they can only use each word from the word bank once. **PS3.D**

**B.** Students may wish to scan Exploration 2 before responding. If students need support, begin by reminding them that some things are needed for photosynthesis to take place and some are the end product of the process itself. If students have difficulty understanding the diagram, recreate it step by step on the front board. **PS3.D**

**C.** Give students an opportunity to skim the text and images in Explorations 1 and 2, as well as the entries in their Evidence Notebooks, to find evidence of other concepts they have learned. **PS3.D**

LESSON 2

# How Do Organisms Use Matter and Energy?

## Building to the Performance Expectation

The learning experiences in this lesson prepare students for mastery of:

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

**Trace Tool to the NGSS**
Go online to view the complete coverage of these standards across this lesson, unit, and time.

### SEP Science & Engineering Practices

**Developing and Using Models**
Use models to describe phenomena.
VIDEO Developing and Using Models

**Evaluating, Obtaining, and Communicating Information**
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
VIDEO Obtaining, Evaluating, and Communicating Information

**Planning and Carrying Out an Investigation**
Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
VIDEO Planning and Carrying Out Investigations

### DCI Disciplinary Core Ideas

**PS3.D Energy in Chemical Processes and Everyday Life**
The energy released by food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).

**LS1.C Organization for Matter and Energy Flow in Organisms**
Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.

**LS2.B Cycles of Matter and Energy Transfer in Ecosystems**
Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment and release waste matter (gas, liquid, or solid) back into the environment.

### CCC Crosscutting Concepts

**Energy and Matter**
Energy can be transferred in various ways and between objects.

Matter is transported into, out of, and within systems.
VIDEO Energy
VIDEO Matter

**Systems and System Models**
A system can be described in terms of its components and their interactions.
VIDEO System Models

### CONNECTIONS TO MATH

**MP.2** Reason abstractly and quantitatively.

**MP.4** Model with mathematics.

### CONNECTIONS TO ENGLISH LANGUAGE ARTS

**RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

**SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

# Supporting All Students, All Standards

## Integrating the Three Dimensions of Learning

In this lesson, students will understand that animals need food **(DCI PS3.D)** for the materials necessary for body growth and repair **(DCI LS1C)** and that they obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment **(DCI LS2.B).** Students will develop and use a model to explore the fact that the energy animals need for body warmth and motion comes from the food animals eat **(SEP Developing and Using Models)**; they will describe how energy in the food that organisms eat was once energy from the sun **(CCC Energy and Matter).**

***Professional Development*** Go online to view **Professional Development videos** with strategies to integrate CCCs and SEPs, including the ones used in this lesson.

## Extra Hands-On Activity: A Full Meal

**How Much Food Does a Consumer Need to Eat?**

Small groups
35 minutes

Have students research and choose a predator and its prey. Students should then research the number of calories each animal needs daily to live, as well as the number of calories in the kind of food it eats. Explain to students that not all energy in the prey is transferred to the predator when it consumes the prey.

Starting with the predator, students should calculate how many calories that consumer will need to acquire from the prey. They should also determine how many calories the prey animal needs to consume on a daily basis. They should then use the information they gather to calculate how many prey organisms would need to be eaten by the predator over a specific time period (a month, week, or day). Students should use the information they gather to develop a presentation that they will share with the class.

CCC **This activity can support mastery of this Crosscutting Concept: Energy and Matter**

## Preassessment

Have students complete the unit pretest online or see the Assessment Guide.

## Build on Prior Knowledge

Students should already know and be prepared to build on the following concepts:

- Energy can be transferred from place to place. *(Grade 4, Unit 2)*
- Plants depend on energy and matter to grow. *(Grade 4, Unit 4, Lesson 1)*
- Energy from the sun is captured by plants and is stored in matter. *(Grade 5, Unit 3, Lesson 1)*

## Differentiate Instruction

### Lesson Vocabulary

- consumer
- producer

Before students begin the lesson, write the key terms on the board, and discuss their definitions. Then have students work in pairs to write sentences using the words, striving to use two or more of the words in each sentence. Provide an example: A *consumer* is an organism that may eat *producers*. Ask pairs to share their sentences with the group.

### ELL/ELD Strategy

Point out cognates of key terms from students' home languages—for example, *consumer/consumidor*—to help bridge understanding of pertinent lesson vocabulary. Pronounce each word, and spotlight the similarities. Ask other students to share the same words in their home languages.

# ENGAGE: Lesson Phenomenon

## Build on Prior Lessons

**In Lesson 1,** students explored what plants need to grow, supporting the understanding of DCI PS3.D Energy in Chemical Processes and Everyday Life. Lesson 2 builds on DCI PS3.D Energy in Chemical Processes and Everyday Life, LS1.C Organization for Matter and Energy Flow in Organisms, and LS2.B Cycles of Matter and Energy Transfer in Ecosystems to explore how Energy and Matter are required by organism Systems and System Models.

**Ask: What are some things made of matter you need everyday?** food, water, air

Indicate to the students that in order to grow and undergo bodily processes they need to consume matter.

## Lesson Objective

Understand that animals need food for the materials necessary for body growth and repair, and that they obtain gases and water from the environment and release waste matter back into the environment. Students model to explore how energy animals need for body warmth and motion comes from food.

## About This Image

This image is a part of the life cycle of a monarch butterfly.

**SEP Developing and Using Models**

## Alternative Engage Activity

| **Leaf Me Alone** | Whole class<br>15 min |
|---|---|

Have students coat a leaf on a tree or other plant with petroleum jelly. Have them observe the leaf over several days.

**Ask: How did the leaf change over time?** Students may say that the edges of the leaf curled up.



LESSON 2

# How Do Organisms Use Matter and Energy?



This monarch butterfly changes throughout its lifetime. What does it need from its environment to change and develop?

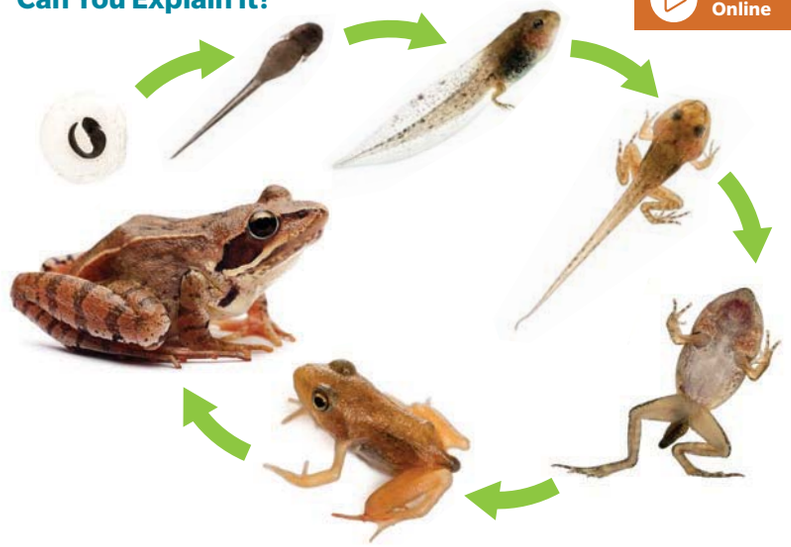
**By the end of this lesson . . .**
you'll be able to explain how organisms use matter and energy obtained from their environments.

Explore Online

Students can view the lesson phenomenon online.

## Can You Explain It?

Explore Online



A frog starts out as an egg. It then hatches into a legless larva that lives in water. It swims with a tail and breathes with gills. As it grows, legs develop. The tail is absorbed by its body, and it gradually loses its gills. Eventually, the frog is able to live and breathe on land.

**1.** What is this frog made of? How do you think it gets the raw materials that make its body and fuel its activities?

Students should respond based on the preliminary observations they can make of the image.

**Tip**

Learn more about how energy from the sun is captured in How Does Energy Get Transformed by Plants?

**EVIDENCE NOTEBOOK** Look for this icon to help you gather evidence to answer the questions above.





## Can You Explain It?

Students are asked to list the raw materials and fuel that a frog needs to grow, develop, and live. To answer this question, students should understand that all organisms are made of matter. A brief discussion about what they are made up of and use for fuel may help students that are struggling with the question to make a connection. Urge students not to worry about whether their answers are correct. They should expect their ideas to change as they progress through the Explorations. They will have an opportunity to revise their answers when they revisit these questions at the end of the lesson.

## Collaboration

**Build on Prior Knowledge** You may wish to have students discuss the images as a whole-class activity. In this way, you can more accurately gauge students' prior ability to make sense of the phenomenon by applying knowledge gained through previous experiences related to energy, ecosystems, and matter.

### EVIDENCE NOTEBOOK

Encourage students to use an appropriate graphic organizer, such as a Venn diagram, to set up their notebook for this lesson. Find more strategies in the online ELA handbook.

# EXPLORATION 1 Growth, Change, and Regrowth

## 3D Learning Objective

Make observations to demonstrate that **animal growth depends on energy and matter obtained from food,** such as plants, and matter from other sources. **Collect data to obtain information** from each observation to identify **the sources of matter and energy that animals need to grow.**

### DCI PS3.D Energy in Chemical Processes and Everyday Life

This page discusses the growth of a foal into a horse. It focuses on the foal's needs in order to grow into an adult horse.

**Ask: How does the foal use the air, water, food, and nutrients it needs to grow?** The foal uses these as sources of matter and energy that it needs to grow.

### CCC Energy and Matter

**Ask: Where does the energy come from that is needed by the foal?** It comes from matter that is broken down from the food the foal consumes, or eats.

Find more support in the online **Crosscutting Concepts Handbook**.

### Language SmArts

**RI.4.1 Refer to details in a text.**

Students are asked to predict the outcome of an animal denied its sources of matter.

**Ask: What would happen to you without these necessities? How is that similar to the foal?** If I did not have the basic necessities, such as matter I need for energy or other body functions, I would not survive. The foal would not survive or grow either.





## Growth, Change, and Regrowth

### Body Building

A baby horse, or foal, is small and not yet very strong. If the foal gets what it needs, it will grow and develop into a large, muscular, adult horse with a strong body.

**foal**

**adult horse**

Select all that apply.

**2.** What do you think a foal needs to grow into an adult horse?

- **a.** air
- **b.** water
- **c.** a barn
- **d.** nutrients
- **e.** hay for bedding
- **f.** food
- **g.** grooming
- **h.** a saddle

Growth and repair of body parts requires matter, which for animals are raw materials. When food is eaten, matter is broken down into simpler forms. These can be used to build or repair an animal's body.

Growth, repair, and other life processes also require energy. When food matter is broken down, energy is released. The animal's body can then use the energy.

**3. Language SmArts** Animals require matter, such as oxygen, food, and water, to survive. Why do they need matter? What do you think might happen if an animal cannot access one of them?

Possible answer: Animals need oxygen, water, and food because they provide the matter and energy that are needed for life processes. If an animal does not have access to one of these things, it will not survive.

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## Taking It All In

**4.** Although animals come in different shapes and sizes, they all need matter and energy for growth and repair. Look at the images of different animals getting what they need from their environments. Use the words in the word bank to complete the descriptions.

Explore Online

| air | water | food |
|---|---|---|

All animals need to exchange gases with their surroundings. Different animals have different structures for gas exchange. A mammal, such as this polar bear, has lungs for taking in oxygen from the _____air_____ and breathing out carbon dioxide as waste. An animal's circulatory system carries oxygen throughout its body.

Birds, like all animals, have ways of getting _____water_____ from the environment. Without water, animals cannot survive. In fact, most animal bodies have a great deal of water in them. Once used, the water an organism consumes is released back into the environment as waste.

As this lizard feeds on the plant, its body breaks down the plant matter. The matter is digested into raw materials that are used to build structures and repair damaged body parts. The breakdown of _____food_____ also releases energy that can be used for life processes, such as motion to find more things to eat.





## CCC Energy and Matter

**Content Background** All energy used by living things comes from the sun. Energy from the sun is transformed by plants into matter (sugars) that allow the energy to be stored. Whenever an animal eats a plant, it absorbs that matter and uses some of the matter for energy. The rest is stored in the animal's body or used to grow. Organisms also take in matter from non-food sources, such as air and water, and while air and water are necessary for most animals to function, this matter is not energy.

**Ask: Do you take in matter like any of these animals?** We take in air with our lungs like the polar bear. We are partly made up of water, like the bird. We eat matter, such as vegetables, and convert them into energy, like the lizard.

## SEP Obtaining, Evaluating, and Communicating Information

Students are asked to fill in the blank using a word bank. The text describes several ways that organisms take in matter. This page will be a great resource for students to revisit for review and test prep.

**Ask: What other animals take in matter like the polar bear, bird, or lizard?** Possible answer: Many other animals have lungs; some examples are dogs, cats, bears, and lions. All animals consume food as a source of energy.

Find more support in the online **Science and Engineering Practices Handbook**.

## CCC Energy and Matter

Remind students that this lesson is about how animals take in matter and energy. Energy is taken in as food matter.

**Ask: Does a producer or consumer use photosynthesis to store energy?** A producer uses photosynthesis to store energy from the sun as food matter. Plants are producers.

## DCI LS2.B Cycles of Matter and Energy Transfer in Ecosystems

Not all matter taken in by consumers is converted into energy. Some matter is converted into waste.

**Ask: What is a common waste product released by animals?** carbon dioxide

## Differentiate Instruction

**ELL: Support New Vocabulary** New vocabulary is introduced on this page: ***producer/productor*** and ***consumer/consumidor***. Have students create picture cards of common producers (grass, trees) and consumers (animals). Students can write the vocabulary word underneath and a short sentence to show how it is used.

## EVIDENCE NOTEBOOK

Students are asked to create a list of food sources for animals. Have students think about where their food comes from before it gets to the grocery store. Remind students that animals do not have the luxury of going to a grocery store!

### Producers to Consumers

Animals drink and eat food to obtain the matter and energy they need for their life processes. Some organisms, such as plants, can make their own food. An organism that makes its own food is called a **producer.** Plants are able to use the energy from sunlight to produce sugars, which are a source of energy and matter.

On the other hand, an animal cannot make its own food. An animal is a **consumer,** an organism that obtains energy and matter by feeding on other organisms. Animals are consumers and get what they need from the environment.

A bird may obtain matter and energy by eating fruits, seeds, insects, or other small animals. It drinks water it can find and obtains oxygen from the environment, too. Wastes are released back into the environment.

**5.** Which of the following do you think an animal can live without?

**a.** air **c.** water

**b.** food **d.** none of the above

While animals take in matter from the environment, they also release wastes into the environment. Wastes are produced when matter is converted into materials that are not used by the body. Some wastes are from the breakdown of food. Others may be by-products from life processes. Wastes are then released into the environment.

For example, carbon dioxide gas is a waste product released when an animal breathes out. Animals also eliminate the remains of digested food out of the body as waste.

**6.** What happens to materials that are taken in but not used by the body?

**a.** They are changed into materials that are needed.

**b.** They are stored forever in the body.

**c.** They are released into the environment as waste.

Snails use the matter they obtain from food in many ways. Unused matter is released from the body.



**EVIDENCE NOTEBOOK** In your Evidence Notebook, make a list of some ways animals get their food. What are some sources of food for an animal?

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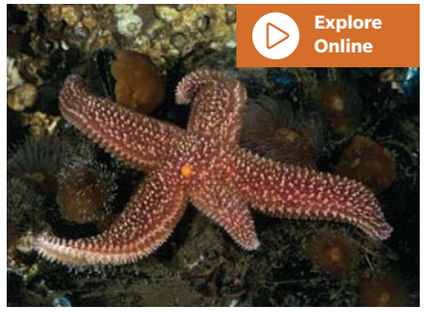
## Do the Math
### Growing Anew

Some animals can regenerate, or regrow, body parts. Regenerating body parts requires energy and matter. Food is important to an animal not only for growth but also for body repair.

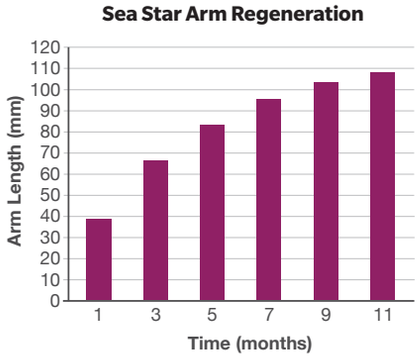
Although only a few animals have the ability to regrow limbs, all animals perform body repair. Body repair can be as simple as producing substances to help a cut heal or as complex as repairing a broken bone.




When a sea star's arm is damaged or lost, it can grow a new one! In some cases, a sea star can even regrow its entire body.

**7.** Using the graph, find the average rate of regrowth of a sea star's arm. Is this average rate a good indicator of its arm length after 4 months?

Possible answer: The average rate of regrowth is about 4 mm per month. This is not a good indicator because 4 (mm) × 5 (months) would equal 20 mm, but the graph shows that it is at about 82 mm after 5 months.




### Putting It Together

You've learned that animals need food to supply materials for body growth and repair. You've also learned that animals obtain gases and water from the environment and release waste matter back into the environment.

**8.** Name two reasons why animals need food to live, and explain your answers.

Possible answer: Animals need food to grow and replace old matter and new matter. Animals also need energy for motion.





## SEP Obtaining, Evaluating, and Communicating Information

Some organisms use energy released from food matter they have consumed to regenerate themselves. Sea stars can regrow their limbs. Some worms can also regenerate. All organisms complete some type of body repair by using stored energy.

**Ask: How do you use stored energy to repair your body?** We use stored energy to form a scab when we have a cut or scrape.

## Do the Math
### Growing Anew

**MP.4 Model with mathematics. *(5-ESS3-1)***

Students analyze the graph to determine the regeneration growth rate of the sea star. They are asked to determine whether the growth rate is a good indicator of the sea star's arm after 4 months.

**Ask: What data will we use to determine whether it is a good indicator?** We will compare the average rate of regrowth against how much growth there is in a month.

Find more support in the online **Math Handbook**.

**FORMATIVE ASSESSMENT**

## CCC Energy and Matter

**Ask: Can consumers take in energy without taking in matter?** Most consumers cannot take in energy without taking in matter, because consumers take in energy in the form of food matter.

**Misconception Alert** A common misconception is that there is no relationship between energy and matter. Explain to students that the total energy contained in an object is identified with its mass. Plants store energy as sugars, and sugars are a type of matter. When animals consume plants, or other animals, they take in energy that is stored in that matter.

**HANDS-ON ACTIVITY** Small groups 1 class period

# What Was for Dinner?

### 3D Learning Objective

## SEP Planning and Carrying Out an Investigation

Plan and carry out an investigation to determine which type of fruit provides the most energy.

**Ask: Which fruit do you predict provides the most energy?** **Answers will vary, but explain to students that they do not have to be worried about being correct at this stage. By the end of the activity, they will have a greater understanding of which fruits provide the most energy.**

### Materials

Make sure that there are enough fruits and vegetables so that students are not waiting to participate in the activity. Also, provide students with disposable gloves as these will not have to be cleaned and may be thrown away after the activity.

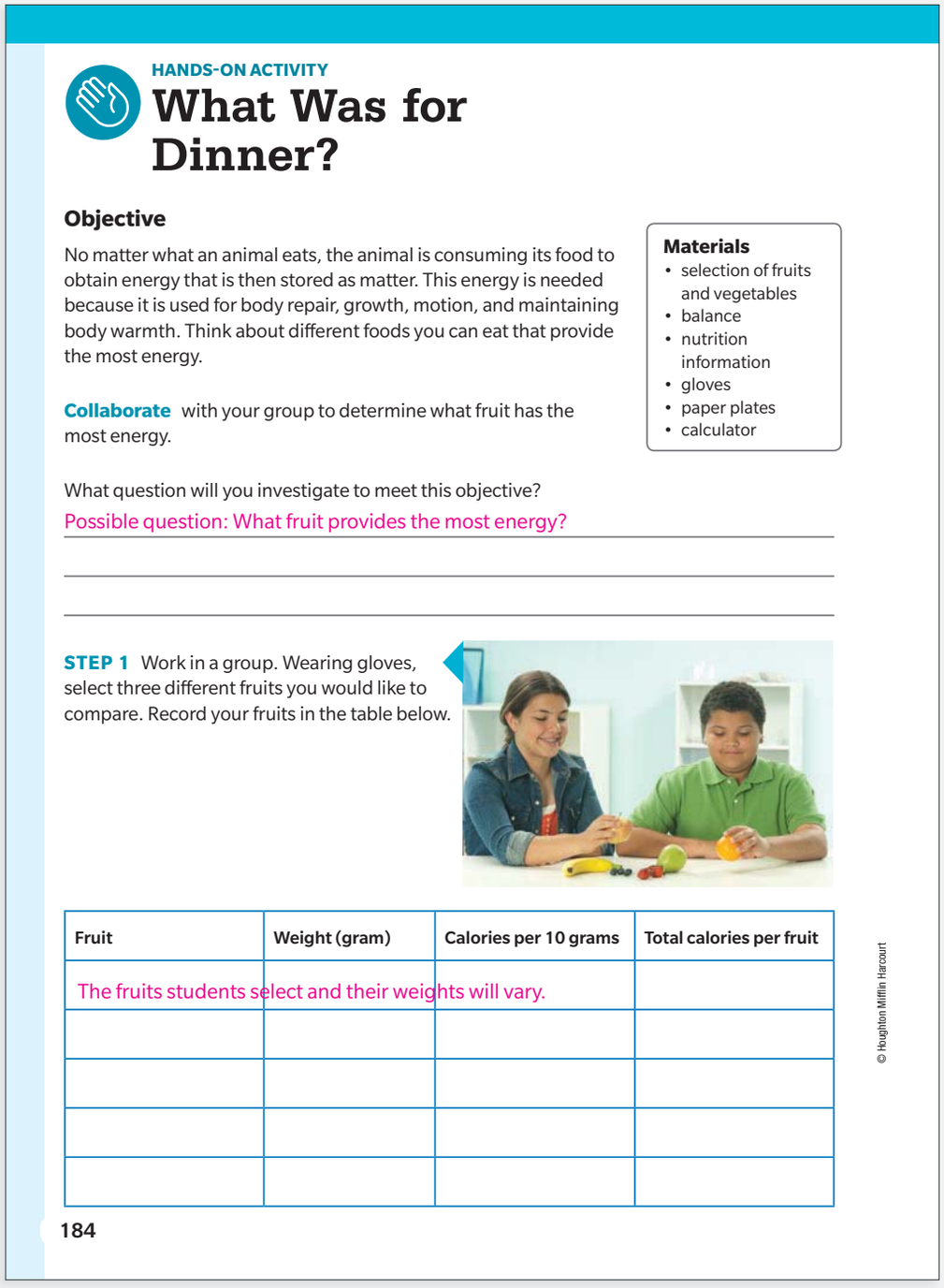
## DCI PS3.D Energy in Chemical Processes and Everyday Life

As students begin the activity, circulate and probe groups for their understanding.

**Ask: How do we use fruit for energy?** **Our bodies break down the sugars in the fruit, and it is changed into energy our body can use.**

## CCC Energy and Matter

The unit of measurement for energy available in food is called a calorie. One way that the body stores energy is as fat. Fat is a kind of material in our bodies that acts as insulation that both protects organs and keeps the body warm when it gets too cold. However, too much body fat can be dangerous, weighing on vital organs and increasing the amount of work they have to do. Fat is made by our bodies from the foods we eat. The more calories and sugars we take in, the more fat our bodies store.



HANDS-ON ACTIVITY

## What Was for Dinner?

### Objective

No matter what an animal eats, the animal is consuming its food to obtain energy that is then stored as matter. This energy is needed because it is used for body repair, growth, motion, and maintaining body warmth. Think about different foods you can eat that provide the most energy.

**Collaborate** with your group to determine what fruit has the most energy.

**Materials**
- selection of fruits and vegetables
- balance
- nutrition information
- gloves
- paper plates
- calculator

What question will you investigate to meet this objective?

Possible question: What fruit provides the most energy?

**STEP 1** Work in a group. Wearing gloves, select three different fruits you would like to compare. Record your fruits in the table below.



| Fruit | Weight (gram) | Calories per 10 grams | Total calories per fruit |
|---|---|---|---|
| The fruits students select and their weights will vary. | | | |
| | | | |
| | | | |
| | | | |
| | | | |

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Student Lab Worksheet and complete Teacher Support are available online.

**STEP 2** Peel any fruits where the peels are not typically eaten.

Why are you peeling some of the fruits but not others before using them?

Possible answer: The skins of some fruits are not usually eaten. The ones that aren't eaten should not be used to calculate the amount of energy in the fruit. The skins of others are eaten, so they should be included.

**STEP 3** Use the balance to determine the weight of the fruit in grams. Make sure to consider the weight of the plate when determining the weight of the fruit. Measure the fruit at least twice for accuracy and record the weights in the table.

A calorie is the unit used to measure food energy. Which fruit do you think has the highest calorie per gram?

Student answers will vary depending on the fruits they chose. Possible answers: avocado, bananas

**STEP 4** Once you've completed Step 3, get the nutrition information from your teacher. Use the nutrition information provided to determine how many calories per gram each of your fruits has.

Which piece of fruit has the most calories in it?

Calories will vary depending on the fruits students chose. Possible answer: avocado





## Procedure

**STEP 1** Students will weigh the fruit and then calculate the number of calories per 10 grams. Provide a table with the necessary information for students to use in their calculations. The table should include a list of the fruits you will make available to students with the number of calories each fruit has per 10 grams. This information is readily available online. Providing this table will save students class time and make the calculations easier for them to complete.

**STEPS 2–3** Make sure students peel any fruits that are typically peeled when eaten. Examples include bananas, kiwi, and oranges. A digital food scale could also be used if a balance in not available.

**Ask: Why do we measure twice for accuracy?** **Scales may not always be consistent. It is best to measure twice to ensure that the scale is weighing accurately.**

**STEP 4** As students are working to answer the question, circulate and provide support with calculations as needed.

**Misconception Alert** Students may be familiar with the phrase "You should always eat the peel. It's the healthiest part." And for the most part, that's true. However, according to scientists at Cornell University, though there may be evidence that banana peels contain nutrients, there's little evidence that the body can break the peels down to obtain those nutrients.

### Analyze Your Results

**CCC Energy and Matter**

Students will take the graph they created and analyze it to determine which fruit provides the most energy. Their data does not give them the amount of energy in each fruit. It gives them the number of calories in each fruit.

**Ask: What is the relationship between the number of calories and the amount of energy in each piece of fruit?** The higher the calories, the more energy the fruit contains.

## Connection to Mathematics

**SEP Planning and Carrying Out an Investigation**

**STEP 7** Students are asked to create a bar graph. They need to include each fruit they weighed and its caloric value. Students could use graph paper or a computer to create the graph. Step 6 encourages students to collaborate with other groups to interpret their results. Students can complete this step again when they have finished creating their graphs. This will help students who are visual learners to analyze their results.

**MP.4** Model with mathematics. *(5-ESS3-1)*

## Differentiate Instruction

**RTI/Extra Support** If students struggle with creating their bar graphs, explain what a bar graph is. Note that there should be one bar for each fruit or vegetable, and the name of each fruit or vegetable should appear below its bar, at the bottom of the page. On the left side of the graph, show them how to list the number of calories from 0 at the bottom to the highest number at the top. (They may want list the numbers in multiples of 10.) Explain how they can use the information they have recorded to then complete their graphs.

### Analyze Your Results

**STEP 5** Which kind of fruit provides the most energy?

Student answers will vary depending on the types of fruits they chose.

Possible answers: avocado, apple

**STEP 6** Collaborate with other groups that selected different fruits to determine which fruits had the most energy. Write the types of fruit and their calories below.

Student answers will vary depending on the types of fruits other groups chose.

**STEP 7** Using the information from Steps 5 and 6, draw a bar graph showing each piece of fruit and the amount of energy per gram that it stores.

Bar graphs will vary based on the fruits students used.



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**STEP 8** What is one thing you notice about fruits that are high energy?

Possible answer: Many of these fruits have skins that cannot be eaten.

### Draw Conclusions

**STEP 9** While some fruits may have more energy in them, animals may choose to eat other fruits that have less energy. Why do you think they do this?

Students might say that animals eat what fruits are available, fruits they prefer, or they may be adapted to eat certain fruits.

**STEP 10** Make a claim about which fruits are the highest.

Possible answer: Apples have the highest energy.

**STEP 11** Cite evidence to support your claim.

Students may refer to their graphs to show how much energy the fruit they chose contains.

**STEP 12** What other questions do you have about how animals use energy from food?

Possible questions: How much energy is contained in the skin? Can the skins of bananas and oranges be eaten? Which fruits are best to eat after working out?





### Draw Conclusions

**DCI PS3.D Energy in Chemical Processes and Everyday Life**

Animals may not select the fruit that will give the highest amount of energy. This may be due to taste, location, or availability.

**Ask: Do you always choose food that gives you the most energy? Why?** no, because I may not like the way it tastes, it may not be in season, or it may not be affordable

## Claims, Evidence, and Reasoning

Have students work with a partner to critique each other's claims and evidence in Step 10. Ask each pair to be prepared to share one way that they changed or improved their claim or the evidence decided. Discuss responses as a class.

| Scoring Rubric for Hands-On Activity | |
|---|---|
| **3** | Investigation was well planned and carried out. Cites evidence to support claim. |
| **2** | Investigation was well planned and carried out. Does not cite evidence to support claim. |
| **1** | Investigation was not well planned or carried out. Does not cite evidence to support claim. |
| **0** | Investigation was not completed. |

# EXPLORATION 2 Animal Energy

## 3D Learning Objective

**Identify that the energy plants and animals use originated from the sun. Obtain information to understand that energy is transferred between organisms.**

### DCI LS1.C Organization for Matter and Energy Flow in Organisms

Use these images to review concepts from the Hands-On Activity, *What Was For Dinner?* Remind students that animals get energy from food matter.

**Ask: Besides food, where else could these penguins get the matter they need to live?** **The penguins get matter from the air they breathe or the water they consume.**

### Do the Math
### Counting Krill Calories

**MP.2 Reason abstractly and quantitatively.**

Students are asked to calculate the amount of energy penguins receive from eating krill. The numbers they are given are based on the food penguins eat in the spring. If time allows, have students calculate the amount of energy a penguin would need to consume in the winter. Penguins eat significantly less in the winter. Therefore, they consume less energy. Tell students that penguins eat approximately 0.45 kg of krill in the winter.



EXPLORATION 2

## Animal Energy

### Brrr! It's cold outside!

Animals need food so they have the matter and energy they need for their bodies to grow, develop, and repair themselves. Food helps animals survive in other ways as well. How might food help an animal survive in an extreme environment such as the Antarctic?


It's bitterly cold in the Antarctic, where many penguins make their home. Here, temperatures may be "high" at –20 °C in the summer and dip below –60 °C in the winter! So how do these penguins stay warm? By eating! In addition to providing matter and energy for growth and body repair, food provides energy to keep their bodies warm.

### Do the Math
### Counting Krill Calories

An adult Adélie penguin eats about 0.9 kg of krill each summer day. An individual krill weighs about 2 grams. Each gram of krill has 0.9 calories available for whichever predator eats it. A calorie is the amount of energy available from food.

**9.** Using the data provided, calculate how many calories an Adélie penguin eats in a typical summer day.

810 calories. A single krill has 1.8 calories. 0.9 kg of krill eaten per day equals 900 g, which can be divided by 2 g per krill to find that a penguin eats about 450 krill per day. 450 krill multiplied by 1.8 calories per krill = 810 calories.

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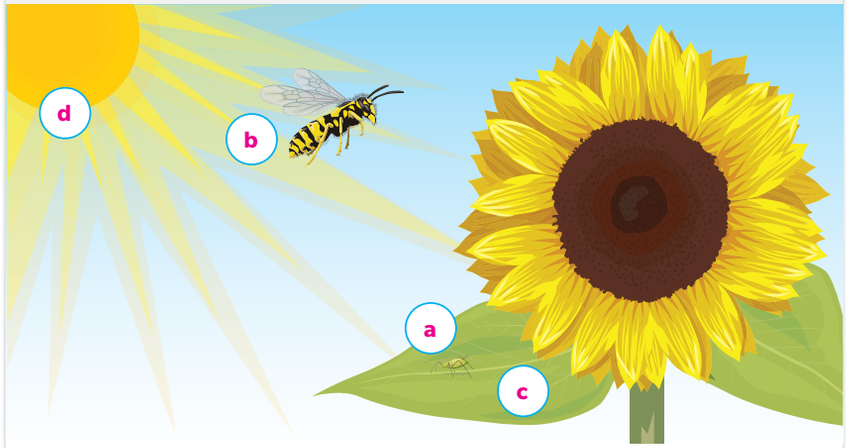
Explore Online

Have students explore online to learn more about how energy moves from the sun to organisms.

## Energy on the Move

**10.** The sun shines down on a sunflower. Read the captions below the image, and then label the art with the appropriate caption letters.

Explore Online




**a.** An *aphid* is an insect that feeds on plant sap with its piercing, sucking mouthparts. They tap directly into the system of tubes that carries water and sugars throughout the plant. Aphids use these sugars as food to fuel their own body functions.

**b.** Whoosh! A *wasp* flies down, catches an aphid, and then munches on it as food. From the aphid, the wasp will obtain matter and energy to fuel its own life processes, including growth and flight.

**c.** *Sunflower* leaves capture the energy from sunlight to power the process of photosynthesis. Energy from sunlight is used by the plant to change carbon dioxide and water into sugars. The plant uses the energy stored in the sugars as fuel for its life processes.

**d.** The *sun* provides the energy that producers, such as plants, need to make their own food. This energy is provided in the form of sunlight, which travels from the sun to Earth as solar energy.

**11.** Where did the wasp's energy *originally* come from?

**a.** aphid
**b.** water
**c.** plant sap
**d.** sunlight

The original source of energy for nearly all organisms on Earth comes from the sun. Some organisms, such as those in dark environments, are able to use energy from sources other than the sun.





## SEP Developing and Using Models

Students are asked to use the model of the sunflower and identify the ways each part uses energy.

**Ask: Which components shown in the model need to consume energy as matter and then break down that matter to release energy?** The aphid and the wasp consume matter that must be broken down to release energy.

## DCI LS1.C Organization for Matter and Energy Flow in Organisms

As students work to answer the question, have them look at the model of the sunflower above.

**Ask: What is the common factor source of energy for all the labels on the model? Where does all the energy that is moved in the model originate from?** the sun

## Collaboration

**Think, Pair, Share** Have students work together to list other ways animals can use energy. This page discusses eating food and sugars to obtain energy. Have them add these to their list and then add to it. If necessary, have them look back to other parts of this lesson. Have each group share its list, and create a class list.

## HANDS-ON Apply What You Know
Where's the Heat?

### SEP Obtaining, Evaluating, and Communicating Information
Students are determining the relationship between heat and energy.

**Ask: When else would your body have to use energy to stay warm?** when going outside in the cold

**Ask: How does your body cool itself?** by perspiring (sweating)

### EVIDENCE NOTEBOOK
Students may want to refer to the information they've obtained in Exploration 1. There are many examples of ways animals store and obtain energy and matter, including food consumption and taking in oxygen.

### FORMATIVE ASSESSMENT
Language SmArts
Use the Internet

**RI 5.7 Draw on information from multiple sources**

Students are asked to complete research online. Begin by discussing how to select a valid Internet resource. Some questions to ask when using Internet resources are:

- Who is the author of the content?
- Is the information primary or secondary?
- What is the purpose of the page?
- How will you cite your resource? Is that information easy to find?

**HANDS-ON Apply What You Know**

## Where's the Heat?

Check the room temperature using a thermometer. Write down your observations. Now use the provided forehead thermometer strips to check your own body temperature. Record your readings. Collaborate with classmates to compare your results.

**12.** What can you conclude about body temperature compared to room temperature? Where do you think the energy that is keeping your body warm comes from?

Students should conclude that body temperature is (usually) higher than room temperature and that it takes energy to keep it that way. They also may have said that the energy, like that used for all other life processes, comes from food.

**EVIDENCE NOTEBOOK** Think about how energy and matter are important for animals. In what ways are energy and matter connected? In your Evidence Notebook, list the sources of energy and the sources of matter for animals.

Language SmArts

## Use the Internet

**13.** You have learned that energy from the sun gets transferred to producers first and then up the food chain through consumers. It might be surprising to think that this applies even to the largest animal on Earth. Use digital resources to research what the largest animal on Earth today is and what it eats. Then, in your own words, describe how the animal relies, ultimately, on the energy of the sun.

Possible answer: Blue whales are the largest animals on Earth. They eat krill, which are tiny animals in the ocean. The krill eat plant-like organisms called phytoplankton, which transform the energy from the sun into food energy.

**Tip**

The English Language Arts Handbook can provide help with understanding how to use the Internet.

# TAKE IT FURTHER Discover More

**Explore Online** Students can explore all three Take It Further paths online.

TAKE IT FURTHER

## Discover More

**Check out this path . . . or go online to choose one of these other paths.**

**Careers in Science**

- **In the Water**
- **Engineer It: Feed Me Now!**

### Animal Nutritionist

**Explore Online**

Animal nutritionists study the food requirements and effects of different nutrients on animals. They may help develop the diet for animals, making sure the animals get what they need. Animal nutritionists work at a variety of places, including universities, pet food companies, zoos, farms, and animal rehabilitation centers.

This nutritionist is bottle feeding a baby squirrel to make sure it gets the nourishment it needs to grow healthy and strong.

Choose an animal you are interested in. Make a list of its characteristics that you are interested in learning more about. Then do research to learn about these characteristics, as well as what and how much the animal eats in the wild.





## Collaboration

You may choose to assign this activity or to direct students online to the Interactive Online Student Edition where they can explore and choose from all three paths. These activities can be assigned individually, to pairs, or to small groups.

## Careers in Science: Animal Nutritionist

**SEP Obtaining, Evaluating, and Communicating Information**

Students read about an animal nutritionist. Then they must select an animal and complete research about that animal.

**Ask: What other careers are similar to an animal nutritionist?**

A zoologist is a person who studies animal biology and classification. A veterinarian is a kind of animal doctor, who takes care of animals when they are sick or injured.

## Differentiate Instruction

**RTI/Extra Support: Stimulate Interest** Provide a short list of high-interest animals for students who are struggling to select an animal to research. Some possible animals to include are bat, capybara, bearded dragon, and honey badger. Try to find animals that students may not have learned about in previous research projects or that are different enough to pique their curiosity.

## CCC Energy and Matter

As students research their animal, have them focus on the needs of the animal.

**Ask: How does your animal create energy?** **Answers will vary depending on the animal the student chooses.**

## DCI LS1.C Organization for Matter and Energy Flow in Organisms

Students are asked to create a menu for their animal. This menu should include several different things their animal would eat.

**Ask: Which food would give your animal the greatest amount of energy? How do you know?** **Answers will vary according to students' research.**

### Collaboration

**Think, Pair, Share** When students are done creating their menus, have them share with a partner. Post each of the menus in the classroom, and have students take turns viewing each one.

### Explore Online

Students can explore these additional topics online.

#### In the Water

Students explore how aquatic and marine animals meet their needs for matter and energy. *(No outside research required)*

#### Engineer It: Feed Me Now!

Students explore designs and functions of automatic pet feeders. *(Outside research required)*

**14.** Which animal did you choose? What are some of its characteristics?

Student answers will vary. Possible answer: I chose a Komodo dragon because it has sharp claws and scaled skin.

**15.** Where does your chosen animal live? What does it eat?

Student answers will vary. Possible answer: Komodo dragons live on a small group of islands in Indonesia and eat pig, deer, and other animals.

**16.** Design a menu such as the ones you see at restaurants for your animal meal plan.

Students should have described the specific components of the meal plan, including how many calories it will provide to the animal each day (or whenever it feeds). The diet should be similar to what the animal would consume in its native habitat.

# LESSON CHECK

**Explore Online** Students can revisit the lesson phenomenon online.

LESSON 2

## Lesson Check

Name _____

### Can You Explain It?

**Explore Online**

1. See how dramatically the frog's body changes! What do frogs—and all animals—need in order for their bodies to grow, develop, and repair themselves? How do they use these materials for bodily processes? Be sure to do the following:
   - Describe the roles of energy and matter in body processes.
   - Explain why animals need food.
   - Identify the source of the energy in food.

**EVIDENCE NOTEBOOK** Use the information you've collected in your Evidence Notebook to help answer these questions.

Possible answer:

- Frogs and other animals need energy to power body processes such as motion, growth, and repair. They need matter as the raw material to build new body parts and for growth.
- Like all animals, frogs need matter and energy to grow, repair their bodies, and to stay warm; they eat food to get the materials they need.
- The energy that is in animals' food was once energy from the sun.

### Checkpoints

2. Study the photo to answer the question. What is the original source of energy used to make the food this horse is eating?
   - **a.** air
   - **b.** water
   - **c.** grass
   - **d.** sun



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**Formal Assessment** Go online for student self-checks and other assessments.

## Can You Explain It?

### Collaboration

**Cultivating New Questions** As students complete this lesson and prepare for the next lesson, ask them to identify additional questions they have about how animals use energy and matter.

**Ask: If an animal is performing a high energy task, which kind of food would be the most beneficial—a high-calorie or low-calorie food?** a high calorie food

As students continue to the next lesson, they will apply concepts about how energy and matter are used by other organisms to concepts about organism interactions.

### EVIDENCE NOTEBOOK

Have students reread their answers to the Evidence Notebook prompts and then use this evidence to justify their reasoning as they respond to the Can You Explain It? question. Make sure students understand that a complete response must address all bulleted points.

### DCI PS3.D Energy in Chemical Processes and Everyday Life

Remind students that organisms obtain energy in different ways. Have them revisit Exploration 1 if necessary.

**Ask: What are some ways that you obtain matter? Would the frog obtain matter in the same way?** We obtain matter by eating food and breathing oxygen. The frog also gets matter this way.

### SUMMATIVE ASSESSMENT

2. Students can draw the correct conclusion by applying information they acquired in the lesson to trace the energy source back to the sun.

3. If students struggle to fill in the chart, remind them that producers get their energy directly from sunlight. Consumers, on the other hand, get their energy by eating producers or other consumers.
4. Allow students to skim the Explorations if they need to, and point to the chart for Item 3 to help them. Ask them where producers get their energy, and explain that this is how each diagram begins. That energy moves through producers and into consumers.
5. Everything an animal's body does requires energy. Have students ask themselves which of the four choices are things the body does.
6. Allow students to revisit the Hands-On Activity. Remind them that energy in food is measured in calories

**3.** Use the words below to fill in the table of producers and consumers.

| | | | |
|---|---|---|---|
| **tree** | **dog** | **lettuce** | **whale** |
| **grass** | **lizard** | **octopus** | **chicken** |

| Producer | Consumer |
|---|---|
| tree | dog |
| lettuce | whale |
| grass | lizard |
| | octopus |
| | chicken |

**4.** Use the words in the word bank to complete three different diagrams depicting the movement of energy. One word will be used more than once.

| | | |
|---|---|---|
| **sunlight** | **aphid** | **sunflower** |
| **rabbit** | **hawk** | **chicken** |
| **corn** | **wasp** | **clover** |

sunlight → corn → chicken

sunlight → sunflower → aphid → wasp

sunlight → clover → rabbit → hawk

**5.** For which of the following do animals use the energy in food?

**a.** growth
**b.** repair
**c.** motion
**d.** photosynthesis

**6.** Which of the following meals would offer the most energy to a consumer?

**a.** 2 bananas at 105 calories each, plus one avocado at 322 calories
**b.** half a coconut at 1,406 calories per whole coconut
**c.** half a watermelon at 1,372 calories per whole melon, plus one cup of cranberries at 46 calories per cup
**d.** two steaks at 345 calories each

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LESSON 2

# Lesson Roundup

**A.** Choose the correct answer for each sentence.

| | | |
|---|---|---|
| **consumers** | **eating other organisms** | **producers** |
| **waste matter** | **drinking water** | **oxygen** |

Animals are consumers that get the materials necessary for body growth and repair by eating other organisms. Animals obtain gases and water from the environment and release waste matter back into the environment.

**B.** Choose the correct answer for each sentence.

| | | |
|---|---|---|
| **consumers** | **sugars** | **sun** |
| **producers** | **water** | **carbon dioxide** |

Plants are producers that can use the sun's energy to make sugars, which they use as food. When an animal eats plants or eats another animal that eats plants, it is getting energy that originally came from the sun.





## Lesson Roundup

**DCI** **LS2.B Cycles of Matter and Energy Transfer in Ecosystems**
**PS3.D Energy in Chemical Processes and Everyday Life**

This lesson summary enables students to quickly revisit key points and prepare for tests.

**A.** Students are asked to complete the sentences in a paragraph using words from a word bank. This paragraph reviews the information presented in Exploration 1. Animals give off waste when they have matter that is not used as energy or incorporated as matter into their bodies. Allow students to revisit the Exploration for a refresher. **LS2.B**

**B.** Students are asked to complete another paragraph using words from a word bank. This paragraph reviews the information presented in Exploration 2. All energy begins with the sun. Plants are producers. They transform energy from the sun into matter that stores energy, sugars, in a process called photosynthesis. Invite students to revisit Exploration 2 if they need to, and answer any questions they may have. **PS3.D**

LESSON 3

# How Do Organisms Interact?

## Building to the Performance Expectation

The learning experiences in this lesson prepare students for mastery of:

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

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

**Trace Tool to the NGSS**
Go online to view the complete coverage of these standards across this lesson, unit, and time.

### SEP Science & Engineering Practices

**Developing and Using Models**
Use models to describe phenomena.

Develop a model to describe phenomena.

VIDEO Developing and Using Models

**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**
Science explanations describe the mechanisms for natural events.

### DCI Disciplinary Core Ideas

**LS2.A Interdependent Relationships in Ecosystems**
…Organisms can survive only in environments in which their particular needs are met…

**LS1.C Organization for Matter and Energy Flow in Organisms**
Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.

### CCC Crosscutting Concepts

**Systems and System Models**
A system can be described in terms of its components and their interactions.

VIDEO System Models

**Energy and Matter**
Energy can be transferred in various ways and between objects.

Matter is transported into, out of, and within systems.

VIDEO Energy

VIDEO Matter

### CONNECTIONS TO MATH

**MP.2** Reason abstractly and quantitatively.

**MP.4** Model with mathematics.

### CONNECTIONS TO ENGLISH LANGUAGE ARTS

**RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

**RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

**SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-PS3-1)

# Supporting All Students, All Standards

## Integrating the Three Dimensions of Learning

Gather evidence about how organisms interact **(DCI LS1.C and LS2.A)** to make models **(SEP Developing and Using Models)** that describe how the interactions drive the movement of energy and matter in an ecosystem **(CCC Systems and System Models; Energy and Matter).** By investigating the similarities and differences of how energy and matter flow in different ecosystems, students will develop a deeper understanding of the interactions and interdependence of organisms that share the environment, and can apply this knowledge to other organisms and ecosystems. Students do so by asking and answering questions, carrying out investigations, and communicating information.

***Professional Development*** Go online to view **Professional Development videos** with strategies to integrate CCCs and SEPs, including the ones used in this lesson.

## Extra Hands-On Activity: Today's Meal

**What Does It Eat?**

Small groups
35 minutes

Have students brainstorm different organisms and how they interact. Students may choose to model an animal that interacts with a plant, an animal that interacts with another animal, or two plants that interact. Then have students make a model to depict this interaction, including the biotic and abiotic factors present in the habitat the organisms share.

Allow students to use reference books or the Internet to research interactions. Add that they may make a computer-based model, or use materials such as clay or paper to model their interaction. Finally, have each group communicate to the class what its model represents and how the organisms interact.

DCI This activity can support mastery of this Disciplinary Core Idea: Interdependent Relationships in Ecosystems

## Preassessment

Have students complete the unit pretest online or see the Assessment Guide.

## Build on Prior Knowledge

Students should already know and be prepared to build on the following concepts:

- Living things need components and resources from ecosystems, and they live in places that have the things they need. *(Grade 3, Unit 5)*
- Animals obtain components they need from plants, other animals, and their ecosystems. *(Grade 5, Unit 5, Lesson 2)*
- Energy in the food that organisms eat was once energy from the sun. *(Grade 5, Unit 5, Lesson 2)*
- Plants need water and light. *(Grade 4, Unit 4, Lesson 1)*

## Differentiate Instruction

### Lesson Vocabulary

- environment
- habitat
- population
- predator
- ecosystem
- niche
- community
- prey

Discuss the definitions of the terms *niche* and *habitat*. Ask volunteers to define each word in a sentence that relates to their lives. Give students a few examples: I found my niche in acting; on stage is where I belong. Welcome to my habitat; this is where I live.

### ELL Strategy

Point out cognates of key terms from students' home languages, such as *ecosystem/el ecosistema, habitat/el hábitat, niche/el nicho, population/la población,* and *community/la comunidad,* to bridge understanding of lesson vocabulary. Pronounce each word, and discuss the use of articles with the nouns. Ask other students to share the same words in their home languages.

# ENGAGE: Lesson Phenomenon

## Build on Prior Lessons

In Lesson 2, students explored what plants need to grow, supporting the understanding of **DCI PS3.D Energy in Chemical Processes and Everyday Life LS1.C Organization for Matter and Energy Flow in Organisms,** and **LS2.B Cycles of Matter and Energy Transfer in Ecosystems** to explore how **Energy and Matter** are required **Systems and System Models**. Lesson 3 builds on **DCI LS2.A Interdependent Relationships in Ecosystems** and **LS1.C Organization for Matter and Energy Flow in Organisms** to explore how the **Energy and Matter** move between **Systems and System Models**.

**Ask: What are some things made of matter you need everyday?**
**food, water, air**

Indicate to the students that **in order to grow and undergo bodily processes they need to consume matter**.

## Lesson Objective

Develop and use models to explore how organisms interact and survive in environments where their needs are met.

**SEP Developing and Using Models**

## Alternative Engage Strategy

**How Do We Interact?**

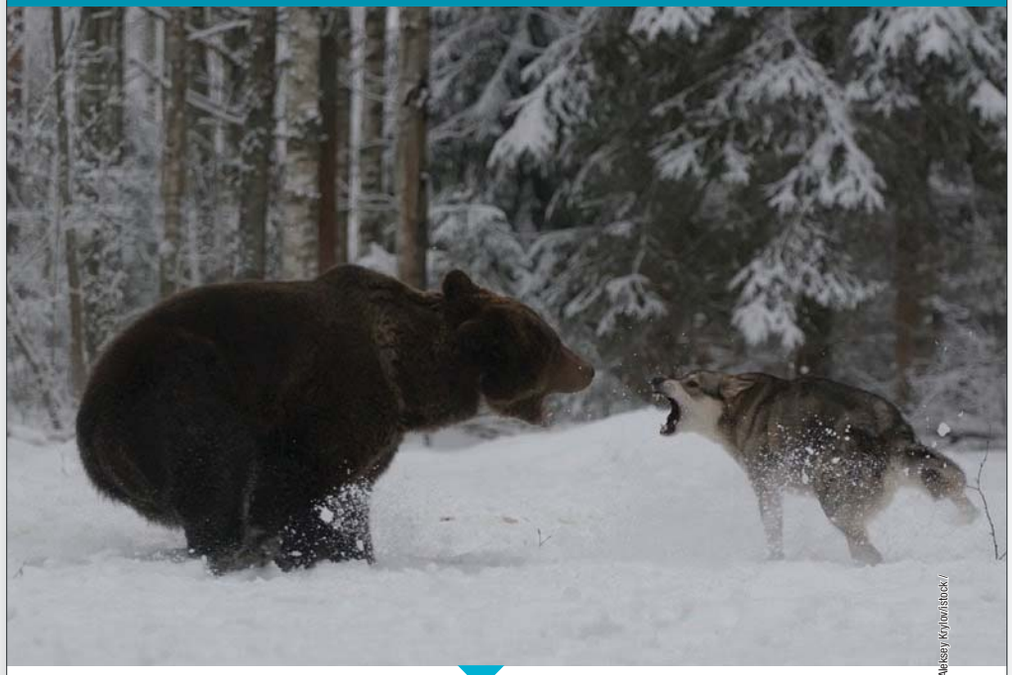
Whole class
10 min

Read the lesson title aloud: How Do Organisms Interact? Clarify that an interaction is the way an organism behaves toward or responds to another. Remind students that we are organisms, too. Then have them brainstorm ways in which we interact with one another and with other living things in our environment. Prompt discussion, if necessary, with a few examples, such as playing competitive sports, sharing food with those in need, planting crops, or building a birdhouse. Then have students work in small groups to create lists of how humans interact with other organisms. Ask a volunteer from each group to share results.



LESSON 3

# How Do Organisms Interact?



In the winter months, resources such as food and shelter may be limited in certain ecosystems. While bears and wolves don't typically consume one another, often times they interact when competing for food.



**By the end of this lesson . . .**
you'll understand how organisms interact.

Explore Online

Students can view the lesson phenomenon online.

## Can You Explain It?

Explore Online

Look at these animals near this dried-out watering hole. How are they interacting with each other and their environment? Will these animals be able to survive if they cannot meet their need for water?

**1.** What do you think will happen to the animals in the photo above? How do you think they can find the resources they need?

Students should respond based on the preliminary observations they can make of the image.

**Tip**

Learn more about what organisms need to survive in How Do Organisms Use Energy?

**EVIDENCE NOTEBOOK** Look for this icon to help you gather evidence to answer the questions above.





## Can You Explain It?

Students are asked to record their initial thoughts about how animals are interacting at a watering hole and how they will survive if the water dries up. To do so, students must begin to think about what every organism needs to survive: food, air, water, sunlight, and space to grow in the right habitat. Encourage students to record the first thoughts that come into their minds. Point out that their ideas might change as they work through the Explorations and Hands-On Activities. Explain that they will have another opportunity to answer the same questions at the end of the lesson.

## Collaboration

**Build on Prior Knowledge** Pair students and have them discuss what is going on at the watering hole. Circulate to gauge students' prior knowledge about interactions between organisms in an ecosystem and how animals compete to meet their needs in their environment. Ask each pair to paraphrase the situation at the watering hole and the impact of a water shortage there to help you identify any possible misconceptions students may have.

### CCC Systems and System Models

The image on this page shows the interactions of components in an ecosystem. Help students understand that the organisms in that system have needs that must be met in order to survive.

**Ask: How would your family handle a water shortage?** Possible answer: collect rainwater, reduce water use

### EVIDENCE NOTEBOOK

Encourage students to use an appropriate graphic organizer, such as main idea and supporting details, to set up their notebook for this lesson.

Find more strategies in the online ELA handbook.

# EXPLORATION 1 Living Things and Their Environment

## 3D Learning Objective

Develop an understanding that **organisms can survive only in environments that meet their needs** and that organisms in an **ecosystem interact** in different ways. **Describe models** that could be used to clean up an ecosystem.

### DCI LS2.A Interdependent Relationships in Ecosystems

This page discusses the relationships between living and nonliving organisms in the same ecosystem. Students should understand that an ecosystem is a kind of system.

**Ask: How do you think the bear interacts with the other living things in the picture?** Possible answer: The insects by the lake might bite the bear, or the bear might chase and eat the turkey.
**Ask: How might the bear interact with the nonliving things?** Possible answers: The bear might climb the tree or the rocks; the bear breathes air, drinks the water, and hunts in the water.

## Collaboration

**Draw, Pair, Share** Have pairs of students explore online to learn more about living and nonliving things in a lake ecosystem. Ask students to draw an ecosystem web, with the ecosystem in the center and its components in the outer circles. Students should then share them with the class.

## Differentiate Instruction

**RTI/Extra Support** Some students may be familiar with word webs but not picture webs. Model how to draw circles connected to a center circle, then draw in one circle and add a one or two word label. Remind students that space for art and labels is limited.



EXPLORATION 1

## Living Things and Their Environment

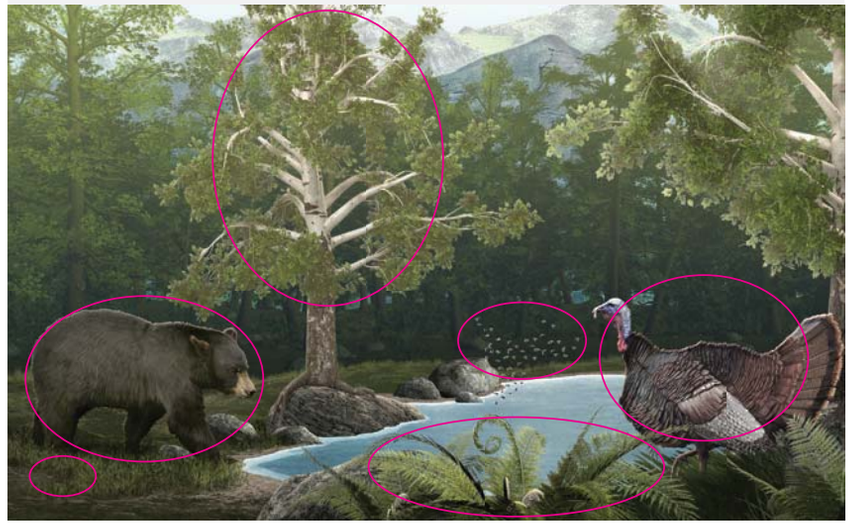
### It's Alive!

There are both living things and nonliving things in nearly every environment. Living things, such as plants an animals, interact with other living things for food and shelter. Living things also depend on the nonliving parts of the environment. Living things, also called *organisms,* include plants, animals, and bacteria. Nonliving things include rocks, water, and air.

**Living Together**

**2.** Study the picture. Circle the living things in this ecosystem.

Explore Online



The living things in the image live in a forest environment. An **environment** is made up of all the living and nonliving things that surround and affect an organism. The black bear is affected by the other living things in the picture. The bear is also affected by nonliving things, such as climate, water, soil, light, air, and nutrients. This forest is an ecosystem. An **ecosystem** is a community of organisms and the environment in which they live.



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**Explore Online** Have students explore online to learn more about the interaction of living and nonliving things in a lake ecosystem.

**HANDS-ON Apply What You Know**

## What's in Your Environment?

**3.** Develop three interview questions that you could use to find out more about your classmates' environments. Be sure to ask about both living and nonliving parts of the environment. Use your questions to interview several classmates. Then, summarize what you have learned about your classmates' environments. How are the environments similar? How are they different? Submit your findings to your teacher.

Engineer It!

## Let's Clean Up!

Have you ever noticed trash or other wastes outside? Animals can be affected when human pollution or wastes change an environment. Pollution can affect water, air, and land. Select one specific place or environment that is affected by pollution. Research the place to learn more about the impact of pollution on the living things and nonliving things there. Find out about the kinds of pollution that are found in this place.

Then, brainstorm ideas for a device that could be used to clean up pollution in the place you researched. Design a model of the device. When you are finished, turn your model in to your teacher.

**4.** Do you think your device would do a good job of cleaning up pollution in the real world? Why or why not?

Possible answer: I think my device would do a good job because it would pick up a lot of litter quickly, and it is inexpensive to make.

**EVIDENCE NOTEBOOK** You've learned about the ways that living things interact with one another and with other parts of their environment. In your Evidence Notebook, identify factors that all species need in a healthy ecosystem. Be sure to consider plants as well as animals as you think about characteristics of a healthy ecosystem.





### HANDS-ON Apply What You Know
### What's In Your Environment?

Guide students as they work to help them develop appropriate interview questions. A good answer will show that different environments may contain similar components.

## Connection to English Language Arts

Have students share summaries of interviewees' environments.

**Ask: What is one difference that showed up in several summaries?** Possible answer: one person has her own room while another shares with his brother.

**Ask: What is one likeness you noted in the summaries?** Possible answer: Many students have pets with whom they interact.

**CCSS. RI.5.** Analyze multiple accounts of the same topic.

### Engineer It!
### Lets Clean Up!

Allow time for students to research places impacted by pollution. Explain that students do not have to actually build a model of their design; they just need to make a sketch with labels and callouts to explain how it would work.

**Ask: What place did you choose, and how does pollution impact the area?** Answers will vary depending on place. Possible answer: Polluted water and floating plastic kill fish and wildlife.

### EVIDENCE NOTEBOOK

Students should have included food, water, air, habitat that meets needs, and room to grow. Some students may add other organisms and the means to reproduce to keep the species going

## DCI LS2.A Organization for Matter and Energy Flow in Organisms

**Misconception Alert** Some students may believe that if one food source disappears, then animals move on to another source. Help students understand that many organisms have specific diets, and if a food source disappears, the animal could disappear as well.

**Ask: What would happen if all eucalyptus trees were infected by a disease and died?** Koalas would likely die or become extinct.

## Differentiate Instruction

**RTI/Extra Support** If students struggle to understand what a *niche* is, name an animal, such as a squirrel, and give an example of its niche (the time it hunts for food—usually daytime; the kind of food it eats—nuts, berries, and seeds; its range—anywhere temperature is above 0 °C; where it builds a home—in a tree; other species it interacts with—is food for owls, coyotes, and other larger animals; interacts with humans, their cars, and their pets). Ask a student to name another animal and describe an aspect of its niche.

**ELL** Pair up strong English-speaking students with students acquiring English as you read and discuss niches. The English-speaking student mimes or draws to convey any unknown word or concept; the student acquiring English responds by miming or drawing while saying the word(s) in English to demonstrate understanding.

## CCC Energy and Matter

The images on this page show animals found in different ecosystems.

**Ask: What would happen to raccoons if all the prairies in the world were replaced by forests or cities?** Raccoons would adapt to the new habitats.

Find more support in the online **Crosscutting Concepts Handbook.**

### Wide or Narrow?

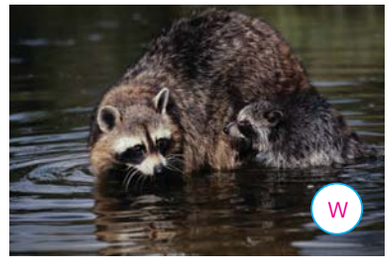
How would you describe an animal? You might talk about how it looks or moves. Another way to describe an animal is to tell where it lives, what it eats, and other ways it interacts with its environment. A **habitat** is the place where an organism lives and can find everything it needs to survive. Organisms also have a **niche** (NICH), which is the role a plant or an animal plays in its habitat.

Some organisms have a wide niche. They can live in a variety of places, eat many foods, and be a part of many different ecosystems. Other organisms have a narrow niche. They can live only in very specific places and eat one or two kinds of food.

#### Which Niche Is Which?

**5.** Study the pictures, and read the captions. Afterwards, write a *W* on the pictures of organisms with wide niches. Write an *N* on the pictures of organisms with narrow niches.


Tiger salamanders are found in many places in North America. They eat many different foods, such as frogs, worms, insects, and small mammals.




Raccoons live in a great variety of habitats, including prairies, forests, marshes, and large cities. They eat all kinds of food, ranging from frogs to fruit. Raccoons will even eat garbage!


Many kinds of cockroaches are found in different places around the world. They live in forests or even in people's homes. They will eat anything, including wallpaper paste!


Eucalyptus trees produce sugars and oxygen through photosynthesis. They grow in limited areas, and because they can be toxic, provide food and a home for only a few animals.

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## The Difference Is Night and Day

Animals that live in the same habitat usually have different niches. This allows each animal to get what it needs from the environment. What do you think would happen if the animals had the same niche?

Red-shouldered hawks are hunters. They live in forest habitats and catch prey such as snakes, frogs, and mice to eat. Red-shouldered hawks mostly hunt and catch their prey during the day.

The barred owl also lives in forest habitats. It hunts and eats the same types of prey that the red-shouldered hawk eats. Owls hunt at night and at dawn and dusk.

**6. Language SmArts** You have discovered that red-shouldered hawks and barred owls share the same habitat. They hunt for the same kinds of food. Apply what you have learned about niches to explain how these organisms can both get what they need from their shared habitat.

Possible answer: These animals have different niches, because they hunt at different times of day. In that way, both kinds of animals can get what they need.

### Putting It Together

**7.** The natural habitat of black bears is a forest. As humans have cleared forests for construction and homes, bears have changed their diets. How do you think the bears' niche has changed as its habitat has been changed by humans?

Possible answer: As humans have changed the habitat of the black bear, the black bear has had to find new sources of food. The niche of the bear has widened because its interactions with its environment have changed.





## SEP Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

The evidence on the page explains why several animals that eat the same food source can survive together in the same ecosystem.

**Ask: What would happen if both animals hunted the same snake at the same time of day?** Possible answer: They may need to fight to see which of them got the food.

**Ask: What do you think would happen if they always competed for the food?** Possible answers: One or the other would not have enough food to survive; one or the other would move to another habitat.

Find more support in the online **Science and Engineering Practices Handbook**.

### Language SmArts

**RI.5.9 Integrate Information.**

As students write their responses, remind them that when you summarize, you tell what's most important: the main idea and a few details. Usually you can do this in just a few sentences, and sometimes in just one.

**Ask: What is the main idea you get from both captions?** The hawk hunts by day; the owl hunts at night.

**Ask: What does that mean?** They have different niches.

### FORMATIVE ASSESSMENT

## DCI LS1.C Organization for Matter and Energy Flow in Organisms

Discuss human impacts on ecosystems.

**Ask: Why would a loss of trees in a forest impact the survival of bears?** Possible answer: Bears climb trees for food and for safety; they eat tiny insects in fallen logs; trees offer shade, and bears can hide in the shadows. They wouldn't be able to do these things if the forest lost its trees.

**HANDS-ON ACTIVITY** Groups 1 class period

# What's Out There?

### 3D Learning Objective

**SEP Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**

Develop a research-based model of a one-square-meter area to find which kinds of organisms interact in that small ecosystem.

## Connection to Math

Review the idea of estimation. Remind students that when there are many items, it may be difficult and impractical to count each item. Therefore, they can estimate, or make a logical guess. Give groups of students a paper cup and some paper clips. Have them estimate how many clips it will take to fill the cup. Then have groups actually fill their cup and remove and count the clips.

**MP.2 Reason abstractly and quantitatively.**

### Preparation

Select a safe area outside in which each group can survey a one-square-meter section without bumping into each other. Review rules for field investigations. Remind students to wear gloves, and caution them not to handle living things without your approval.

### Materials

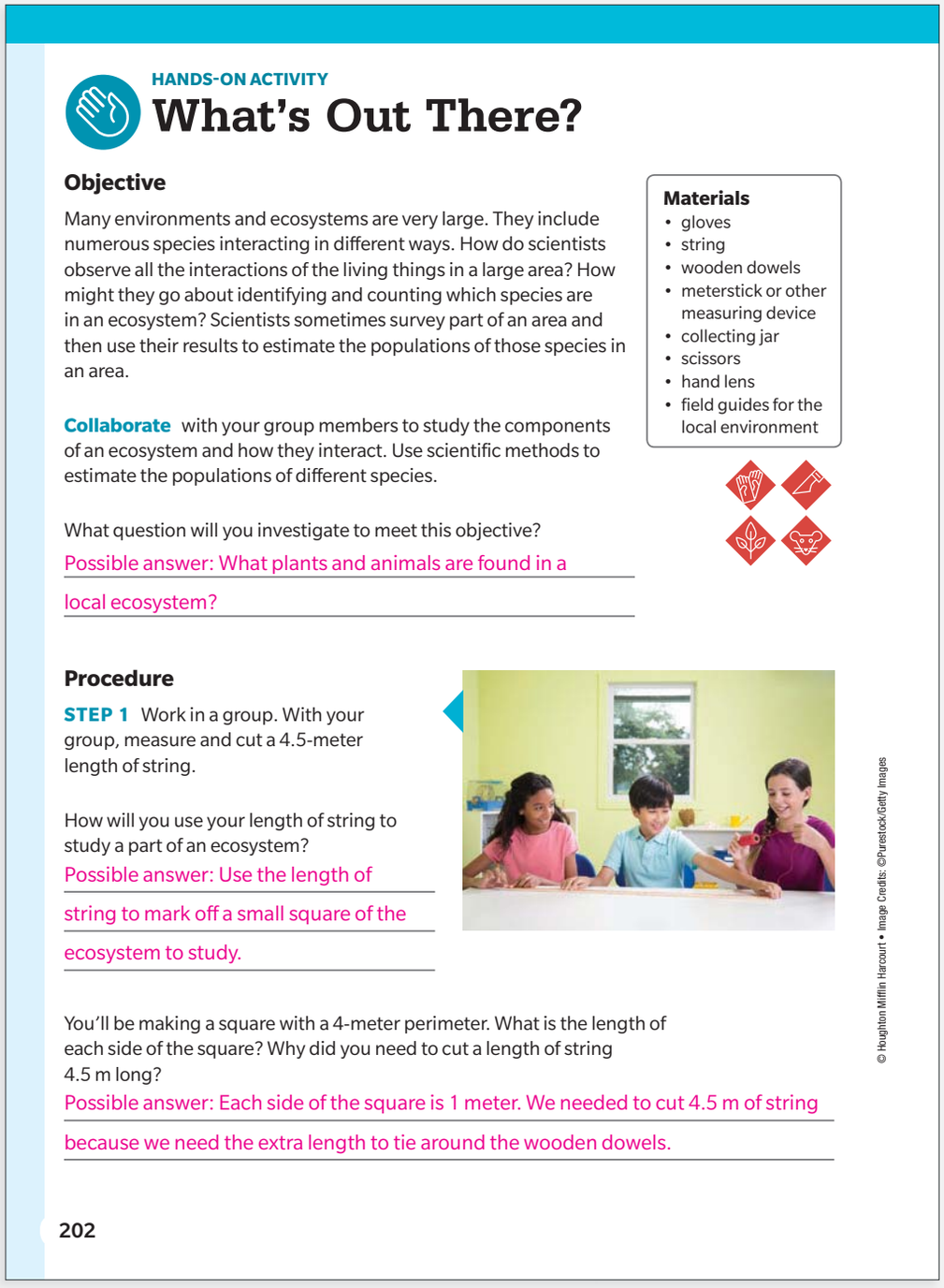
You may wish to take a camera to photograph students' areas. If you don't wish to take students' books outside, provide a copy of the procedure for each group and pencils for recording data.

### CCC Systems and System Models

Clarify that each group will survey just one small part of the ecosystem. Discuss how the string will be used with the dowels.

**Ask: Why is it a good idea for you to survey just a small area?**

**Possible response: It would take too long for our group to investigate the whole area.**



HANDS-ON ACTIVITY

## What's Out There?

### Objective

Many environments and ecosystems are very large. They include numerous species interacting in different ways. How do scientists observe all the interactions of the living things in a large area? How might they go about identifying and counting which species are in an ecosystem? Scientists sometimes survey part of an area and then use their results to estimate the populations of those species in an area.

**Collaborate** with your group members to study the components of an ecosystem and how they interact. Use scientific methods to estimate the populations of different species.

What question will you investigate to meet this objective?

Possible answer: What plants and animals are found in a local ecosystem?

### Materials

- gloves
- string
- wooden dowels
- meterstick or other measuring device
- collecting jar
- scissors
- hand lens
- field guides for the local environment

### Procedure

**STEP 1** Work in a group. With your group, measure and cut a 4.5-meter length of string.

How will you use your length of string to study a part of an ecosystem?

Possible answer: Use the length of string to mark off a small square of the ecosystem to study.



You'll be making a square with a 4-meter perimeter. What is the length of each side of the square? Why did you need to cut a length of string 4.5 m long?

Possible answer: Each side of the square is 1 meter. We needed to cut 4.5 m of string because we need the extra length to tie around the wooden dowels.

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PDF Student Lab Worksheet and complete Teacher Support are available online.

**STEP 2** Take your equipment, including the measured string, to a place specified by your teacher. Wearing gloves, use the meterstick to measure out a square meter. Put a wooden post in the ground at each corner of the square. Wrap the string around each post to make the sides of square on the ground. Tie a knot at the end.

Each group in your class will study a different square, but all the squares will be the same size. Why is it important that they are all the same size?

Possible answer: We are controlling variables by keeping the squares the same size.

**STEP 3** Observe and record the number and types of living things in your group's square. Use the hand lens and collecting jar to observe very small organisms. Use the field guide or the Internet to help identify unknown plants and animals.

What are some living things you observe in your square?

Answers might include animals such as ants, earthworms, and grasshoppers and plants such as grasses and wildflowers.

| | |
|---|---|
| **Total number of organisms observed** | Check student results. |
| **Number of producers observed** | |
| **Number of consumers observed** | |





## Procedure

**STEP 2** As pairs work to form their squares, circulate to make sure their area dimensions are exact and all marked areas are the same size.

### Differentiate Instruction

**RTI/Extra Support** Model how to put together the materials to form a square. Talk about the need for accuracy so that every group's area is the same. Then monitor as students complete their setup.

**STEP 3** Circulate and remind students to handle materials with care when putting them in the collecting jar and when returning them to their original environment. Help any students who cannot identify a specimen in the field guide.

**Ask: Are you surprised by the number of organisms you observe?** Possible answer: Yes. There were more than I thought.
**Ask: How are the organisms interacting in their environment?** Answers will vary depending on observations.

Circulate to observe and assist students as needed as they record their results. Review what makes an organism a producer (uses the sun to make its own food) and a consumer (eats producers and other consumers). Make sure students remove the stakes and repair the area once they have completed their observations.

### Differentiate Instruction

**Extension** Challenge students to repeat the activity in another, unused area and compare results. Encourage students to make graphs showing the comparison of statistics they find and to share their graphs with the class.

## Analyze Your Results

**STEP 4–6** Have the group return to the classroom. Make sure students return all materials. Then have groups compare results.

**Ask: What, if anything, surprised you about this exploration?** Answers will vary.

**Ask: Do you think you would find the same diversity of organisms if you repeated the activity in a desert?** Possible answer: No. There would be even fewer organisms in sand.

## Draw Conclusions

Call on different groups to share their conclusions and further questions. Encourage students to think about how different ecosystems might produce different results.

## Claims, Evidence, and Reasoning

Have pairs of students critique each other's hypothesis and evidence from Step 6, about results being similar or different if every living thing in a whole ecosystem were counted. Ask each pair to be prepared to share one way they could improve their claim. Discuss responses as a class.

**Ask: What are some other ways to collect this kind of evidence?** Possible answers: Observe the area over a longer period of time; make a video.

| Scoring Rubric for Hands-On Activity | |
|---|---|
| **3** | follows procedure and records accurate data, analysis and conclusions reflect the results, makes a logical hypothesis with supporting details |
| **2** | investigation and recording done correctly, but analysis and conclusions are insufficient |
| **1** | follows some procedures but data is incomplete, analysis is inconsistent with results |
| **0** | did not participate or follow the procedure as described |



### Analyze Your Results

**STEP 4** Did your group observe more producers or more consumers?

Possible answer: We observed more producers than consumers.

**STEP 5** Compare your results to the results of other groups. Describe any similarities or differences you notice.

Possible answer: Some groups saw more organisms than our group. Other groups saw fewer types of organisms. Most groups observed the same kinds of organisms.

**STEP 6** In this activity, you observed and counted the living things in a one-square-meter part of the ecosystem. How do you think your results would be similar or different if you tried to count every living thing in the whole ecosystem? Why wouldn't you count all the living things? Cite evidence.

Possible answer: We would count more organisms if we counted all the organisms in the ecosystem. Our results might be similar in that we would still observe more producers. It would take too long to count all the living things in the ecosystem.

### Draw Conclusions

**STEP 7** Make a claim about why scientists study ecosystems in sections.

Possible answer: Studying a small section of an ecosystem can provide information about the whole ecosystem.

Cite evidence to support your claim.

Possible answer: Since a smaller part of an ecosystem is still part of the larger ecosystem, it should still have the same organisms in it.

**STEP 8** What other questions do you have about the ways in which scientists study ecosystems?

Possible answer: How do scientists study aquatic ecosystems, which would be much harder to divide into small sections?

EXPLORATION 2

# Relationships in an Ecosystem

## What Group Are You In?

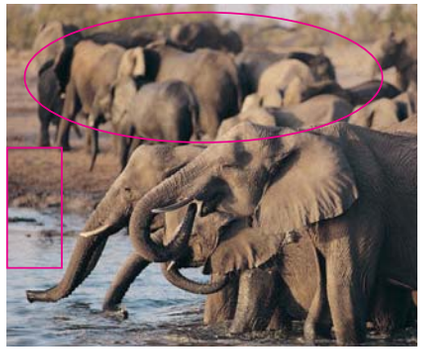
The living things in an ecosystem interact with one another. Living things live with other organisms and nonliving things in the ecosystem.

### Populations and Communities

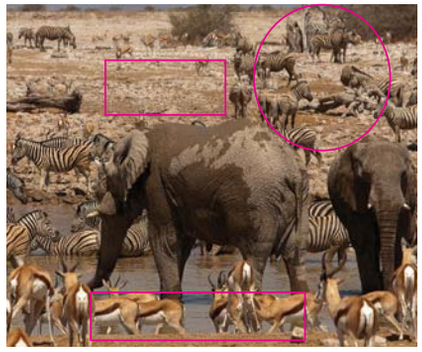
**8.** Study the pictures and read the captions below. Then circle the living things and draw squares around the nonliving things in the images.

Explore Online

Check student answers as they may vary.



A group of organisms of the same kind in an ecosystem, like this herd of elephants, is called a **population**. The members of a population interact with one another. They have very similar needs. They eat the same kind of food and need the same kind of shelter. They all need water and space to grow and find food. The members of a population interact as they meet their needs.



The different populations that share an ecosystem make up a community. A **community** consists of all the populations that live and can interact in an area. The living things in a community might not have all of the same needs. Even if they have different needs, the populations in a community interact.





## 3D Learning Objective

**Develop a research-based model** of a **community of animals,** according to the amount of resources available, so that **all animals have their needs met**.

### DCI LS2.A Interdependent Relationships in Ecosystems

The text and images on the page are about populations and communities. Discuss the vocabulary and images with students.

**Ask: How is the elephant herd interacting with other populations in this community?** sharing water resources

## Collaboration

**Write, Pair, Share** Have pairs of students explore online to learn more about the elephant and zebra community. Ask each pair to prepare a short TV interview about how the two populations interact. One student portrays the interviewer and the other a science expert. Have students write their script and then act out their interview for the class.

**Misconception Alert** Some students may think that all animals survive better in groups. Explain there are some animals, such as tigers and giant pandas, that survive better on their own. Clarify, however, that mothers stay with their cubs until the young are ready to go off and live alone.

### CCC Energy and Matter

Discuss the transport of matter between the organisms and their environment.

**Ask: What kinds of matter are transported within a community such as the one shown?** Possible answer: water, air, heat, food, and waste

## Do the Math
### Calculate Energy Units

**MP.2 Reason abstractly and quantitatively.**

**MP.4 Model with mathematics correctly.**

Review the process of finding answers to word problems such as this. Circulate to make sure students set up equations, such as $(200 \times 2) + (60 \times \frac{1}{2}) = x$.

**Ask: How does knowing how much land is necessary for an animal to fill its needs help wildlife preserve planners?** They know how much land to set aside for the animals.

**Ask: What will happen if new animals are born?** Possible answers: If additional animals are born, this will increase the herd's needs. They will require more space.

Find more support in the online **Math Handbook**.

## SEP Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Remind students of what they learned in Lesson 2 about what animals need for growth and repair, other than space, and the difference between producers and consumers.

**Ask: What are zebra and antelope—producers or consumers?** consumers

**Ask: What producers are available as food for the zebra and antelope?** grass and other plants that make their own food

## Differentiate Instruction

**RTI/Extra Support** If students have difficulty doing the math, write the answers to the questions on the board as students discuss them. Help them understand that they must multiply the number of animals by the amount of space each needs to find out how much land is required (430 acres). The answer proves that there is not enough land and that 10 more acres would be required. Discuss remedies: get more land or have fewer animals.



## Do the Math
### Calculate Energy Units

**9.** You have been asked to help the owners of a nature preserve decide if they have enough land to support a community of zebra and antelope. In order for the animals to get what they need, 2 acres of land are needed for each zebra, and $\frac{1}{2}$ acre of land is needed for each antelope. The preserve is 420 acres in size. The preserve owners would like to have 200 zebra and 60 antelope in the preserve.
Will the preserve have enough space to accommodate all of these animals? If not, how many more acres of land will they need? If they do have enough land, could additional zebra and antelope be added?

There will not be enough land for these animals, because 200 zebra and 60 antelope will require 430 acres of land. The preserve will need to be 10 acres larger for all of the animals to meet their needs.

**10.** What will happen in an ecosystem if there are not enough resources to support all of the populations of living things found there? Choose all that apply.

- **a.** Some living things might move to a new ecosystem.
- **b.** Many more living things will move into the ecosystem.
- **c.** Some living things might die.
- **d.** More resources will be produced to meet the demands of the living things.
- **e.** Some living things will struggle to get what they need.

Resources in any ecosystem are limited. There is only so much space available in an ecosystem. There are limited amounts of water and of food. Since space, water, and food are limited, they may be *limiting factors*. Limiting factors limit how many living things of a particular population an ecosystem can support.

## Limited Supply

The living things in an ecosystem often have to compete with one another to get what they need to survive. Individuals and populations that compete successfully will get the resources they need. They will survive. Individuals and populations that do not compete successfully cannot get what they need. They will not survive unless they move.

Food is a resource that all animals need to survive. Look at the pictures to see how some animals get the food they need.

### Snack Time!

**11.** Study the pictures, and read the captions. Underline the name of the animal that hunts, and circle the name of the animal that is hunted in each caption.

Grizzly bears eat many types of food. It isn't uncommon to find them catching and eating salmon in the rivers.

Some insects eat other animals. This dragonfly is getting food by catching and eating a wasp.

Snakes need to hunt for their food. This snake gets the food it needs by catching and eating mice.





## Connection to Earth Science

As students read *Limited Supply*, remind them that humans also use water, air, land, and other natural resources. Some natural resources are renewable, others are nonrenewable — or limited —resources.

**ESS3.A** Natural Resources

Additionally, students can further build on their understanding of the Science and Engineering Practice Developing and Using Models through the exploration of this phenomenon. Have small groups of students research limited resources, such as fossil fuels, and design models of technologies that humans may use to address the problems associated with limited resources. Allow time for groups to share their findings with the class.

**Science and Engineering Practices:** Developing and Using Models

## Differentiate Instruction

**ELL: Use Realia** Students learning English may struggle with the abstract use of limited supply. Gather a few chairs together—at least two fewer than the group—and announce "there is limited seating" for a discussion. Ask students to find a seat so that they can discover that a limited amount means competition for the seating.

**Ask: Can the problem be resolved?** No. Someone will have to leave or remain standing because there are no chairs left.

## CCC Energy and Matter

The images and text for Snack Time express the transfer of matter and energy between objects. Remind students that all the animals shown are consumers. Stress that they all look for matter that can give them the energy to survive.

**Ask: How do matter and energy move together in each ecosystem shown?** as food

## DCI LS2.A Interdependent Relationships in Ecosystems

Relate predators and prey to relationships students may be more familiar with.

**Ask: Imagine there is a cat and a mouse: which is the predator and which is the prey?** Cat is predator; mouse is prey.
**Ask: Now imagine a fly and a spider. How does the predator catch its prey?** Predator (spider) catches the prey (fly) in a spiderweb.

## SEP Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Explain how the idea of Eat or Be Eaten maintains ecosystem balance.

**Ask: What would happen in an ecosystem if there were too many predators and not enough prey?** Possible answer: The predator population would die off.

## EVIDENCE NOTEBOOK

Entries will depend on which two living things with similar niches the student researched. Students may need to reread the information about limiting factors before deciding how they impact the two populations.

### FORMATIVE ASSESSMENT

Language SmArts
Making Inferences
**RI.5.7 Use Multiple Sources**

**Comparing Populations** As students research to compare and infer how populations compete, remind them that it's important to accurately reflect information from multiple sources. If they cite an example, they should give credit to the original writer. Stress the importance of credible evidence in science writing.

## Eat or Be Eaten

You've read that the living things in an ecosystem interact. You've seen that competition for resources is one way populations interact. The pictures on the previous page showed another kind of interaction—the interaction between predators and prey.

**Predators** are animals that hunt, catch, and eat other animals to get the food they need. **Prey** are the animals they catch and eat. In an ecosystem, predator and prey populations interact.

**12.** Which organisms are predators? Choose all that apply.

- **a.** a wolf that eats a moose
- **b.** a rabbit that eats grass
- **c.** a mouse that eats seeds
- **d.** a bird that eats worms

**EVIDENCE NOTEBOOK** Research two living things that have similar niches in the same environment. In your Evidence Notebook, explain how limiting factors affect and control the sizes of the populations of these living things.

Language SmArts
### Making Inferences

**13.** Research and compare two populations that compete in an ecosystem. Identify the resource or resources for which the populations compete.

Possible answer: I researched birds and monkeys that compete for food in the rain forest. They both eat fruit, but they look for fruit in different parts of the rain forest canopy.

**Tip**

The English Language Arts Handbook can provide help with understanding how to conduct research and using multiple resources.



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# TAKE IT FURTHER Discover More

**Explore Online** Students can explore all three Take It Further paths online.

TAKE IT FURTHER

## Discover More

**Check out this path . . . or go online to choose one of these other paths.**

**People in Science & Engineering**

- **Engineer It! Tiny Ecosystems**
- **Animal Atlas**

### It's All Fun and Games

Dr. John Weishampel is a researcher and professor at the University of Central Florida. He studies how the nonliving and living parts of ecosystems interact. He often uses scientific models to explore interactions in different ecosystems. These models, called simulations, are based on collected data.

**Dr. John Weishampel**

The GAMES Lab at the University of Central Florida sounds like a place to go to play games and have fun. But, the letters in the word *GAMES* stand for the Geospatial Analysis and Modeling of Ecological Systems laboratory. It's a place where data are used to make models of ecosystems. These models help researchers better understand how the parts of an ecosystem interact.

Dr. Tanya Berger-Wolf also uses data and computers to model the interactions in ecosystems. She uses both computer science and life science in her work. The models are developed at the Laboratory for Computational Population Biology at the University of Illinois at Chicago. In this lab, models are developed for processes that are hard to observe in person, such as the movement of baboons through their habitat.

**Dr. Tanya Berger-Wolf**



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## Collaboration

You may choose to assign this activity or to direct student pairs to the Interactive Online Student Edition where they can explore and choose from all three paths. These activities can be assigned individually, to pairs, or to small groups.

## People in Science and Engineering: It's All Fun and Games

### CCC Systems and System Models

Dr. Weishampel's research explores how interaction of abiotic and biotic processes affect the behavior of plants and animals in an ecosystem. He uses models interfaced with remote sensing from satellites and airborne instruments to study land and marine ecosystems to better understand the composition, structure, and biodiversity. For example, he researched sea turtle nesting patterns vis-a-vis satellite-derived measures of artificial lighting.

As part of Dr. Berger-Wolf's research, she gets to fly in a superlight airplane over nature preserves, taking hyper-stereo video of zebra populations. She is also a board director for IBEIS (**I**mage-**B**ased **E**cological **I**nformation **S**ystem), a conservation software nonprofit organization that answers questions about population sizes, species interactions, and movement patterns. *(Outside research required.)*

### DCI LS2.A Interdependent Relationships in Ecosystems

Remind students that scientists develop and make models to study problems in the natural world and look for solutions to those problems. The evidence on this page tells how two different scientists develop and use models to explore ecosystems.

**Ask: What do both Dr. Weishampel and Dr. Berger-Wolf use to explore interactions in ecosystems?** computer models

**Ask: How does this help the researchers?** Possible answer: They can work in a lab without having to go to the ecosystem in question.

## SEP Developing and Using Models

Allow time for students to work together to obtain information about a computer simulation. Offer guidance if needed and check students' selections. Have pairs work together to create the directions. Remind them that functional text, such as directions, is written to tell a reader how to do something. Directions should be short, to the point, and precise (in words that clearly explain what to do). It helps to list directions step by step in sequence. A bulleted or numbered list makes it easy for a reader to follow the steps and complete the task. Finally have students share directions.

### Explore Online

Students can explore these additional topics online.

#### Engineer It! Tiny Ecosystems

Students explore life in a terrarium—a tiny ecosystem in a container with living and nonliving components that interact—then build their own. *(Outside research required.)*

#### Animal Atlas

Students investigate an animal atlas—a book with information and maps about the habitats and niches of different animals in a given ecosystem—then make their own. Students might be unfamiliar with an atlas, so provide examples for students to look at before they begin the project. *(Outside research required.)*

Research an ecology simulation game that is available online. Use your teacher's guidelines for research, and have your teacher approve the game you find. Then, explore the simulation. Use it to find out more about the interactions in ecosystems. After you are familiar with how the simulation works, think about how you could share your knowledge with others.

**14.** Write an instruction manual others could use to carry out a simulation. Make sure to describe the purpose of the simulation and how it is used. Draw a sample of your simulation showing what the screen should look like. Collaborate with classmates, and have them use your manual to carry out a simulation.

Students' instruction manuals should describe the purpose of the simulation they chose and how it is used. Students' drawing should show what the screen should look like at one point during the simulation in the program they selected.

# LESSON CHECK

**Explore Online** Students can revisit the lesson phenomenon online.

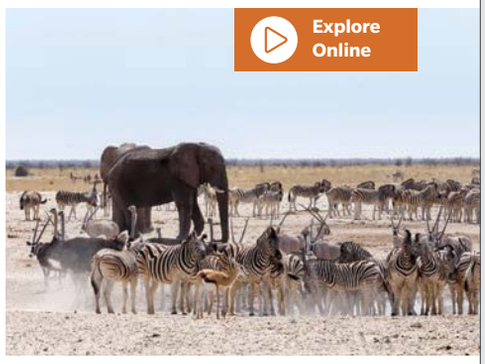
LESSON 3

## Lesson Check

Name _____

### Can You Explain It?

1. Now that you've learned more about interactions of living things, explain what you think will happen to the animals in the photo. Be sure to do the following:
   - Describe how these animals interact with the non-living parts of their environment.
   - Describe how these animals interact with the living parts of their environment.
   - Explain that these organisms can only survive if their needs are met.




**EVIDENCE NOTEBOOK** Use the information you've collected in your Evidence Notebook to help you answer these questions.

Possible answer:

- The living things in the photo all need water, which is a non-living part of the environment. It is a limiting factor in this ecosystem.
- The living things compete with one another for this resource. Competition is the way in which living things interact.
- If the living things cannot get the water and other resources they need, they will not survive in this ecosystem.

### Checkpoints

2. Which of these best describes an animal's habitat?
   - **a.** the role it plays in a community
   - **b.** the resources it doesn't use
   - **c.** the animals it competes with
   - **d.** the place it lives

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**Formal Assessment** Go online for student self-checks and other assessments.

## Can You Explain It?

### Collaboration

**Cultivating New Questions** As students complete this lesson and prepare for the next lesson, ask them to identify additional questions they have about how organisms interact with other organisms.

**Ask: Would a large population of predators survive if there was a small population of prey?** no

As students continue to the next lesson, they will apply concepts about energy and matter to the concepts of food chains and food webs.

### DCI LS2.A Interdependent Relationships in Ecosystems

Focus students on the interactions of the animals by having students reread the caption beneath the image in the Engage.

**Ask: As the weather in the ecosystem changed, what happened to the amount of resources in the area?** Possible answer: As the area got less rain because it was a dry season, there was less water available for the animals.

### EVIDENCE NOTEBOOK

Have students reread their answers to the Evidence Notebook prompts and then use this evidence to justify their reasoning as they respond to the Can You Explain It! prompt. Make sure students understand that a complete response must address all bulleted points.

### SUMMATIVE ASSESSMENT

2. You may need to prompt students to consider the difference between a habitat and a niche. If necessary, have them revisit the information about habitats in Exploration 1.

3. If necessary, have students revisit the information about living and nonliving things in Exploration 1.
4. Some students might be confused because they consider the community in which they live to be made up of nonliving things as well, such as houses and schools. If necessary, have students revisit the information about communities in Exploration 2.
5. This concept was covered most directly in Exploration 2. If students have difficulty with the question, have them go back and look at photos and captions related to animals hunting for food.
6. This concept was covered most directly in Exploration 2. Remind students of the example of the bear and the wolf hunting for the same food.

**3.** Sort the parts of this ecosystem as non-living or living.

| | | |
|---|---|---|
| **rocks** | **black bear** | **water** |
| **insects** | **air** | **birch tree** |

| Nonliving | Living |
|---|---|
| rocks | black bear |
| water | insects |
| air | birch tree |

**4.** Which of these groups or areas include only living things? Choose all that apply.

**a.** population
**b.** ecosystem
**c.** community
**d.** environment
**e.** habitat

**5.** Circle the correct answer.

Which phrase best describes the way these animals are interacting?

**a.** predator and prey
**b.** sharing a niche
**c.** competition for the same resources

**6.** Which of these describe why living things compete for resources? Circle all that apply.

**a.** All living things need resources to survive.
**b.** Living things can create all the resources they need.
**c.** The resources in an ecosystem are limited.
**d.** Most living things can survive without resources.

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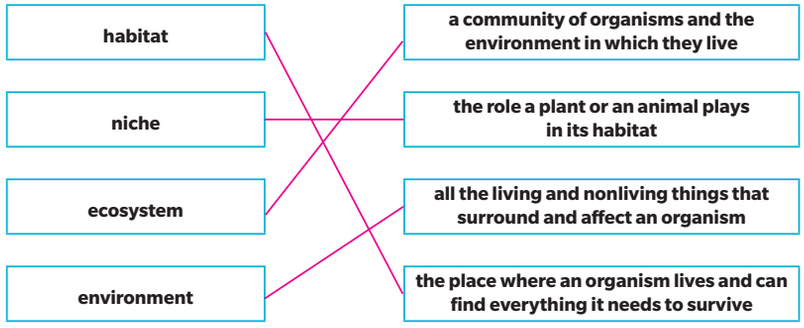
LESSON 3

# Lesson Roundup

**A.** Draw lines to match each term to its definition.




**B.** Choose the correct words to complete each sentence.

| | | |
|---|---|---|
| **predators** | **prey** | **unlimited** |
| **limited** | **cooperate** | **compete** |

Animals that hunt and eat other animals are called predators.

The animals that are eaten are called prey. The resources in an ecosystem are limited, so the populations in an ecosystem compete to get the resources they need to survive.

**C.** What else have you learned about competition and predator-prey relationships?

Possible answer: Individual members of a predator population compete for prey.





## Lesson Roundup

### DCI LS2.A Interdependent Relationships in Ecosystems

This lesson summary enables students to quickly revisit key points and prepare for tests.

**A.** To clarify students' understanding of key terms, have them revisit Exploration 1 to look for definitions. LS2.A

**B.** Students may wish to scan Exploration 2 before responding. If students need scaffolded support, begin by reminding them that they may need to combine information to find the answer. If necessary, ask guiding questions to help students find pertinent information. LS2.A

**C.** If necessary, allow students to refer to their Evidence Notebooks or skim Exploration 2, then paraphrase the information in their own words. However, encourage students to just tell what they remember. LS2.A

# UNIT 3 Performance Task

**ENGINEER IT!** Small groups 2 class periods

## Business Has Bean Bad

### 3D Assessment Goal

Students use their understanding of **systems** to determine why bean plants are not growing properly. They **support evidence and data** to demonstrate the understanding of **LS1.C** in support of **5-LS1-1.**

### Materials

- paper
- pencil
- colored pencils
- chart paper
- number cube

### Preparation

You may want to have a list of things that mix or dissolve in water available for those groups that struggle during the brainstorming section.
Review Lesson 1 to provide for this Unit Performance Task.

### DCI LS1.C Organization for Matter and Energy Flow in Organisms

The things groups choose that dissolve in water will determine which may be toxic for plants when delivered in the water. **Ask: Which things on your list do you think are toxic? Are there any things on your list that could be helpful to plants?**

## Brainstorm

Have students roll a number cube to choose a recorder; highest roll records. Remind students that the brainstorming group is just to come up with ideas. Each of them will be individually responsible for their part of communicating the group's plan.





ENGINEER IT!

## Business Has Bean Bad

You are a botanist (plant scientist) working for a vegetable company. Bean sales have fallen recently because consumers feel that your company's beans are of poor quality. You suspect that the problem lies in the water solution used to irrigate the beans. You and your team are tasked with finding a water solution that will help your bean plants grow tall and strong.

Which solution is best to grow beans?

**FIND A PROBLEM:** What is your team trying to determine?

Possible answer: We are trying to find the type of water solution that is best for irrigating beans.

Examine the checklist at the end of this activity and be sure that you follow it as you proceed.

**BRAINSTORM:** Brainstorm with your team to determine five things that dissolve in or mix with water. List them here. (Do not use *soil* or *dirt*.)

Possible answers: sugar, vinegar, salt, coffee, dish soap, olive oil

**RESEARCH AND ELIMINATE:** Determine whether any substances on your list are toxic. Use that and other suitable criteria to narrow your list to three items. Describe how you arrived at your final list.

Students' list should contain three non-toxic substances that dissolve in water and an explanation as to how items on that list were chosen

Complete the table. Make sure to list one more criteria and two additional constraints.

| Criteria | Constraint |
|---|---|
| ☐ Cannot be toxic | ☐ Will need a controlled environment |
| ☐ Substance must dissolve in water | ☐ _____ |
| ☐ _____ | ☐ _____ |

**MAKE A PLAN:** Use the questions below as a guide for planning your water solution comparison. Discuss your plan on the lines below.

1. Where will we grow our bean plants? What materials will we use?
2. How will we make this a fair test of the different solutions?
3. What are the procedures that we will follow? How will we determine the results.

These students are designing their experiment

Student should summarize the project with a complete list of needed materials and a thorough description of planned procedures. Student should also mention how he/she plans to record the project's results.

**COMMUNICATE:** When complete, present your project to your class. Use visuals, including charts, to describe your project's purpose, procedures, and results. State conclusions and interpretations that you have drawn from your data. Ask for thoughts, ideas, and observations from your audience as you present your material.

## Checklist

**Review your project and check off each completed item.**

_____ Includes a list of all the materials used and explanations as to why they were needed.

_____ Includes a description of the procedures and explanations as to why each was necessary.

_____ Includes conclusions based on your own observations.

_____ Includes a presentation with an exchange of ideas and observations between you and your class.





# Make a Plan

## SEP Support a Plan with Evidence

Remind students that engineers need to have a claim that they build their plan around. **Ask: What evidence or data can you use to support your plan?**

# Communicate

Students may have limited ideas for improvements. Consider having student partners critique each other's plans and reasoning. Use sentence frames to guide their discussions:

- I don't understand why you chose _____.
- How will _____ interact with _____?

| Scoring Rubric for Performance Task | |
|---|---|
| **3** | • all materials are listed and include clear explanations<br>• procedures and explanations are precise<br>• conclusions are supported with evidence and data<br>• presentation is engaging |
| **2** | • most materials are listed and include explanations<br>• procedures and explanations lack specifics<br>• conclusions are included, but support is lacking<br>• presents plan |
| **1** | • materials and explanations are missing or incomplete<br>• procedures and explanations are incomplete or missing<br>• conclusions are incomplete or missing<br>• presentation is incomplete |
| **0** | • materials and explanations are missing<br>• procedures and explanations are missing<br>• conclusions are missing<br>• presentation was not finished |

# UNIT 3 Review

## SUMMATIVE ASSESSMENT

1. For students to answer this question, they will need to know the needs of plants and decipher what need the plant is receiving by consuming insects. Suggest students review Lesson 1, Exploration 1 on *Plant Growth*.
2. Students should recall the *Can You Explain It?* in Lesson 1. Suggest students go through the list and rule out any answer they know to be incorrect to narrow down the choices.
3. Students should be able to answer this question if they have a strong understanding of photosynthesis. Recommend students to review *Picture This!* in Lesson 1, Exploration 2.



UNIT 3

## Unit Review

1. Some plants have adaptations that allow them to survive in different habitats. This plant consumes insects. What condition is it adapted to? Circle the correct answer.

   **a.** a lack of water
   **b.** a lack of rich soil
   **c.** a surplus of sunshine
   **d.** a damaged ecosystem

2. Which of the following is a necessary part of a hydroponic system? Circle all that apply.
   **a.** air
   **b.** soil
   **c.** water
   **d.** sunlight
   **e.** bacteria
   **f.** nutrients

3. Which of the following are necessary for the process of photosynthesis in a plant to occur? Check all that apply.
   **a.** water
   **b.** sugar
   **c.** oxygen
   **d.** light energy
   **e.** carbon dioxide
   **f.** plant parts to capture the light energy

**4.** Food provides an organism with the matter and ___energy___ needed for the growth and ___repair___ of body parts.

**5.** Using the numbers 1–5, arrange the steps in order to describe how an organism interacts with its environment to maintain itself.

___4___ Building and repairing body parts

___5___ Releasing wastes into the environment

___3___ Moving matter and energy throughout the body

___2___ Processing matter and energy into useful forms

___1___ Taking matter and energy from the environment

**6.** Which phrase **most** clearly describes the process occurring to the boy's arm here? Circle the correct answer.

**a.** body repair

**b.** body growth

**c.** limb regeneration

**d.** energy absorption

**7.** Which of the following are nonliving things found in nature? Circle all that apply.

**a.** air

**b.** sand

**c.** moss

**d.** water

**e.** sharks





**4.** Students explored how organisms use matter and energy in Lesson 2. If they have difficulties answering this question, suggest they go back to Lesson 2, Exploration 1 to review.

**5.** Suggest students carefully read each of the steps and work one part of the sequence at a time. Some students may have an easier time working backwards. If students have difficulties answering this question, have them go back and review Lesson 2.

**6.** To answer this question, students should use process of elimination to cross out any choices that they know are not correct. If they are still having trouble answering the question, suggest they review the section *Do the Math* in Lesson 2, Exploration 1.

**7.** Students will need to know the different parts of an organism's environment to answer this question. They can review living organisms in their environment in Lesson 2, Exploration 1.

**8.** Students can correctly answer this question by knowing the different functions of photosynthesis and where they happen. Photosynthesis can be reviewed in Lesson 1, Exploration 2.

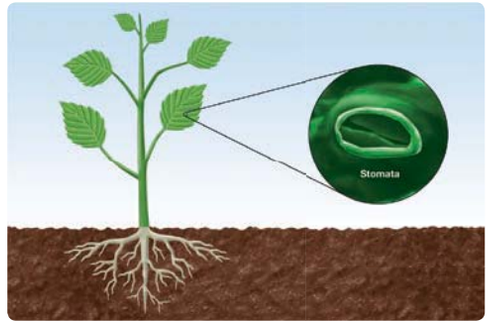
**9.** Students need an understanding of environment niches to answer this question appropriately. They can review environment niches in Lesson 3, Exploration 1, *Wide or Narrow?* section. Remind students to use complete sentences when answering this question.

**10.** Students need a strong understanding of the characteristics of predators to answer this question. Suggest students look back at the Unit image and think about which animal is the predator and which is the prey. Point out that this question is a multi-step question.

| 3D Item Analysis | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **SEP** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena | | | • | | • | • | | • | • | • |
| **DCI** Energy in Chemical Processes and Everyday Life | | | • | • | | | | • | | |
| **DCI** Organization for Matter and Energy Flow in Organisms | • | • | • | • | • | • | | • | | • |
| **DCI** Cycles of Matter and Energy Transfer in Ecosystems | | | • | | | | | • | | • |
| **DCI** Interdependent Relationships in Ecosystems | | | • | | • | | • | | • | • |
| **CCC** Energy and Matter | • | • | • | • | • | | • | • | | • |
| **CCC** Systems and System Models | | | • | | • | | • | | • | • |



**8.** Indicate whether each function is performed by a plant's green structures (G), its stomata (S), or its roots (R).




G Absorbing sunlight

S Releasing oxygen

G Producing sugars

R Absorbing water

R Absorbing nutrients

S Taking in carbon dioxide

**9.** Nearly all environments have animals that have either wide or narrow niches. Think of 3 animals in your neighborhood and list whether each has a wide niche or a narrow niche. Make sure to cite evidence to support your claims.

Students answers will vary, but make sure that they have listed 3 animals and have cited evidence to support their claims.

**10.** Explain the difference between predators and prey. Is a predator more likely to be a producer or consumer? Explain why.

Possible answer: Predators are animals that hunt, catch, and eat other animals while prey are animals that are eaten by predators. Predators are consumers because they are animals that get their energy by eating other animals. Producers are plants.