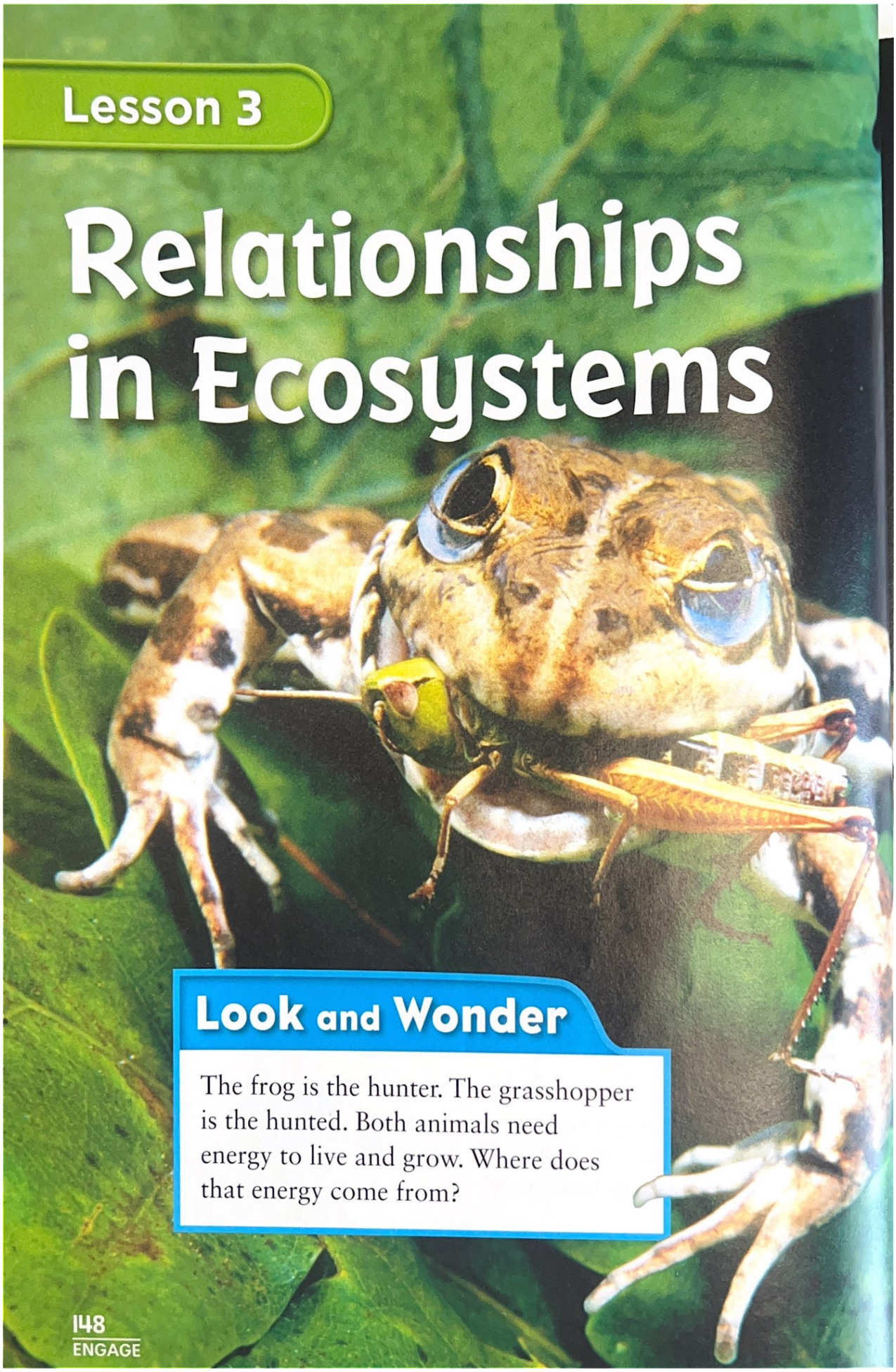
Lesson 3

Relationships in Ecosystems



Look and Wonder

The frog is the hunter. The grasshopper is the hunted. Both animals need energy to live and grow. Where does that energy come from?

Explore

Inquiry Activity

How much energy do living things use?

Purpose

Model how energy passes from one organism to another in an ecosystem.

Procedure

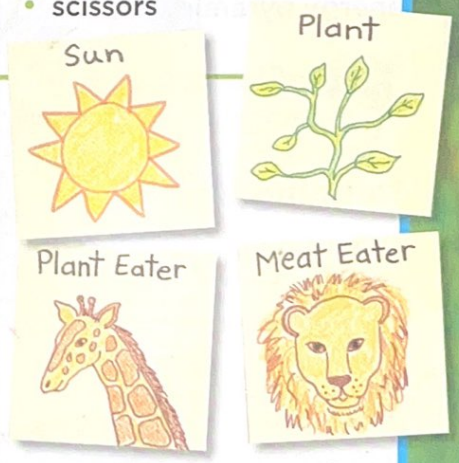
1. Work in groups of four. Make labels for *Sun*, *plant*, *plant eater*, and *meat eater*.
2. **Measure** Cut a 1-m strip of butcher paper. This represents energy that living things can use. Make a mark every 10 cm along the strip.
3. **Make a Model** Each student takes a label. *Sun* begins by passing the energy strip to *plant*.
4. *Plant* cuts off 10 cm from the strip. *Plant* holds the larger section and passes the smaller section to *plant eater*.
5. *Plant eater* cuts off 1 cm and passes the smaller section to *meat eater*.

Draw Conclusions

6. **Infer** Why do you think the energy strip gets cut before it gets passed on?
7. **Use Numbers** How much energy is available to the meat eater compared to the plant? Compared to the plant eater?

Materials

- markers
- label paper
- butcher paper
- meter stick
- scissors



Explore More

What might happen if the plant could not make its own food energy? Design a test to find out.

Read and Learn

Main Idea

Energy is passed from producers to consumers to decomposers in an ecosystem.

Vocabulary

producer, p. 150

consumer, p. 151

decomposer, p. 151

food chain, p. 152

food web, p. 154

competition, p. 155

energy pyramid, p. 156

LOG ON e-Glossary
at www.macmillanmh.com

Reading Skill

Draw Conclusions

Text Clues	Conclusions

Technology

SCIENCE QUEST

Explore relationships in ecosystems on Science Island.

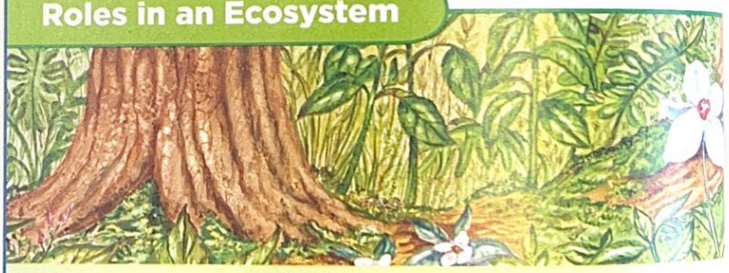
How do organisms depend on one another?

To understand an ecosystem, scientists look at the relationships and roles of organisms within a community.

Producers

Every organism in an ecosystem relies on producers. **Producers** are organisms that make their own food using the energy in sunlight. Producers on land include green plants, such as grasses and trees. In lakes and oceans, the main producers are algae. Many other protists are producers, too.

Roles in an Ecosystem



Producers make food using sunlight.

Consumers eat producers.

Decomposers break down dead and decaying organisms.

Consumers

Organisms who cannot make their own food are called **consumers**. Birds, mammals, and other consumers get energy from the food made by other organisms.

We can classify consumers by the kinds of food they eat. *Herbivores* (UR•buh•vorz) eat only producers. Porcupines and most other rodents are herbivores. So are rabbits and deer.

Some animals eat producers and consumers. These are *omnivores* (OM•nuh•vorz). Opossums, raccoons, and bears are all omnivores. *Carnivores* (KAHR•nuh•vorz) are animals that eat herbivores and omnivores. Ospreys and other birds of prey are carnivores. So are cats, tigers, and lions. Sharks are carnivores, too.

Decomposers

Some organisms break down dead and decaying matter into wastes and simpler substances. These organisms are **decomposers**. Worms, bacteria, fungi, and other decomposers get energy this way. They return the substances to the ecosystem as nutrients. In other words, decomposers are recyclers.

Quick Check

Draw Conclusions What would happen if producers disappeared?

Critical Thinking Do consumers get energy from the Sun? Explain.

Quick Lab

Observe a Decomposer

1. Moisten four food samples. Place each one in a plastic bag.
2. Seal the bags. Put them in a warm, dark place.

Be Careful! Do not open the bags after you seal them.

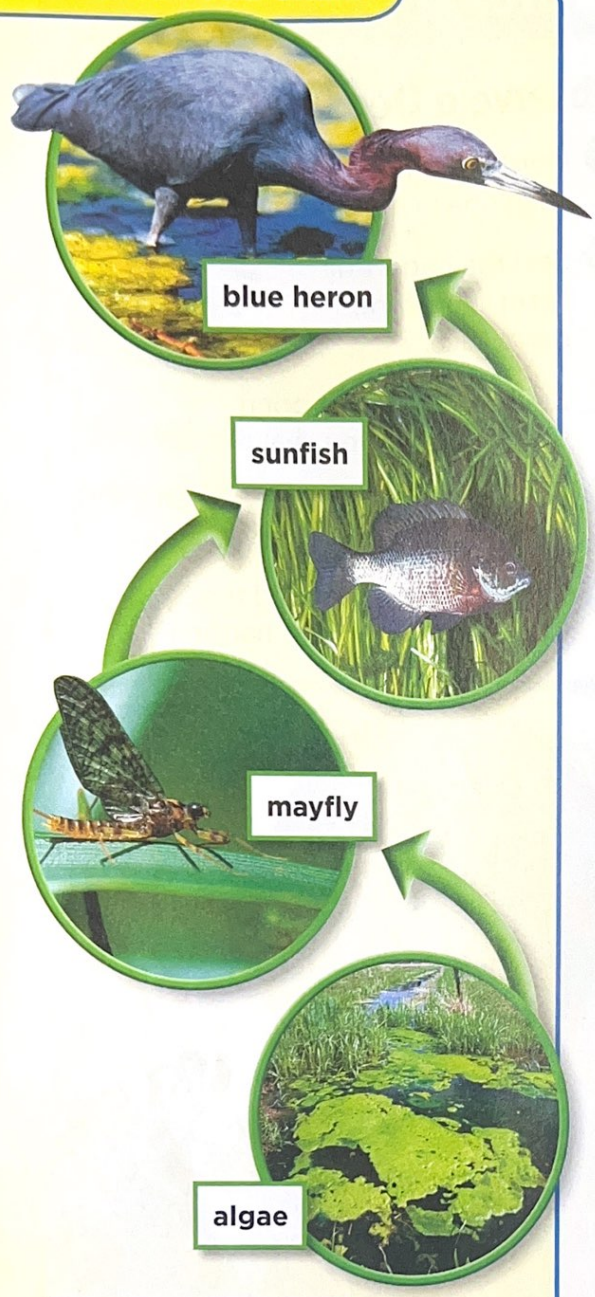
3. **Observe** Check the bags each day. Record your observations.
4. **Communicate** How did the foods change? Why did this happen?

herbivore

omnivore

carnivore

Pond Food Chain



Read a Diagram

How does food travel in a pond?

Clue: The arrows in a food chain point to the next consumer.

LOG ON *Science in Motion* Watch decomposers in action at www.macmillanmh.com

What is a food chain?

Every organism needs energy to live and grow. The energy in an ecosystem comes from the Sun.

Look at the animals shown on these pages. None of them can use the Sun's energy directly. The energy of the Sun is stored in food. That energy passes from one organism to another in a **food chain**. The energy in a food chain moves from producers to consumers to decomposers.

A Pond Food Chain

Algae and green plants are first in the pond food chain. Algae capture the Sun's energy during photosynthesis. They store it in their cells as sugars.

What happens when a plant eater, such as a mayfly, eats the algae? The insect uses oxygen to release the energy stored in the algae it ate. It uses some of that energy to move, grow, eat, and reproduce. It stores some of the energy in its tissues.

A meat eater like the sunfish might snap up the mayfly. A blue heron may then eat the sunfish. As you can see, even the heron gets some of the Sun's energy that was passed along the chain.

All the plants and animals in the pond become food for decomposers after they die. Bacteria and other decomposers break down the dead tissues into simple nutrients that other living things can use.

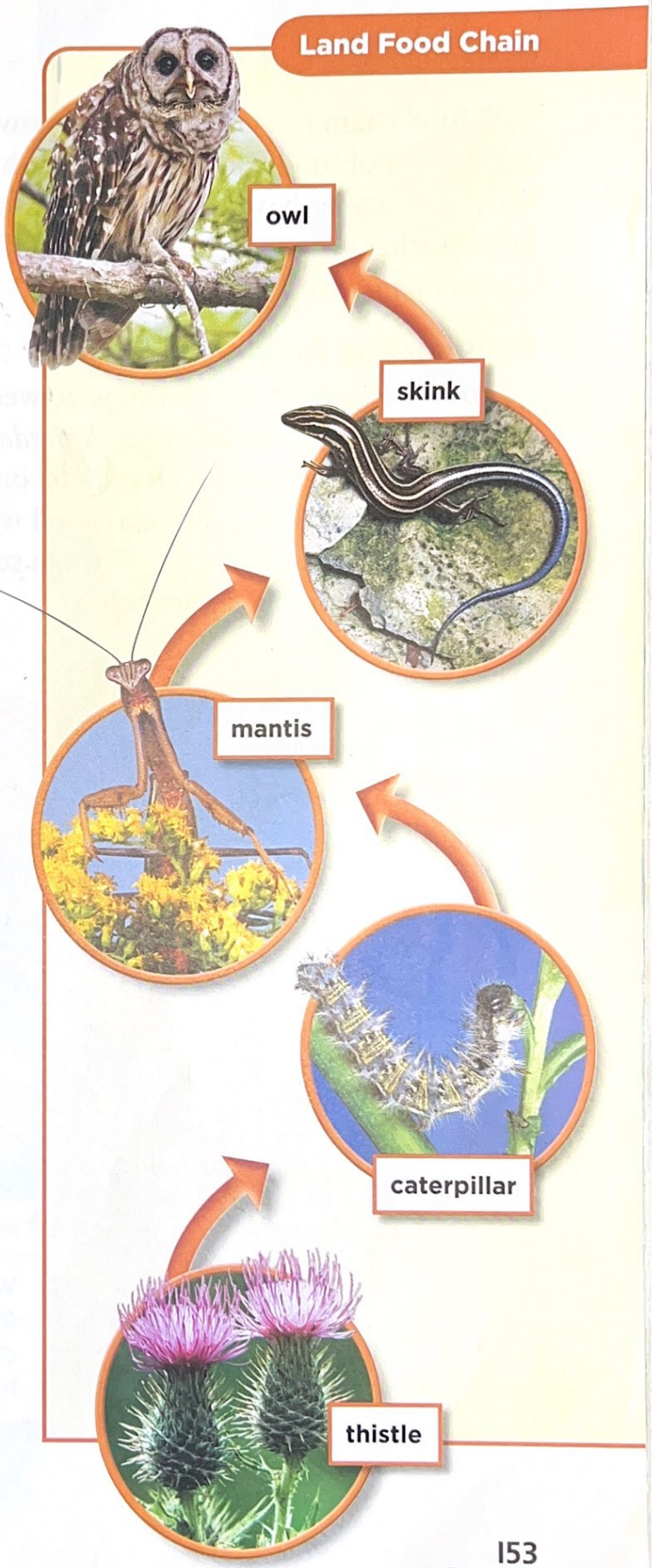
A Land Food Chain

A food chain on land is similar to a pond food chain. On land the food chain usually starts with grasses, trees, and other green plants.

In the example on the right, the spear thistle is the producer. The painted lady caterpillar is the herbivore that munches on its leaves. The Chinese mantis, skink, and barred owl are the consumers, in that order.

Where are the decomposers in both food chains? Decomposers are often left out of food chain diagrams. This is because they take part in every step of every food chain. Every time you see a food chain, remember the importance of decomposers.

Notice the arrows shown in the diagrams. The direction of the arrows is important. Each arrow in a food chain points away from the organism that is eaten. The arrow always points to the organism that eats it.



Quick Check

Draw Conclusions How is a food chain a good example of recycling in an ecosystem?

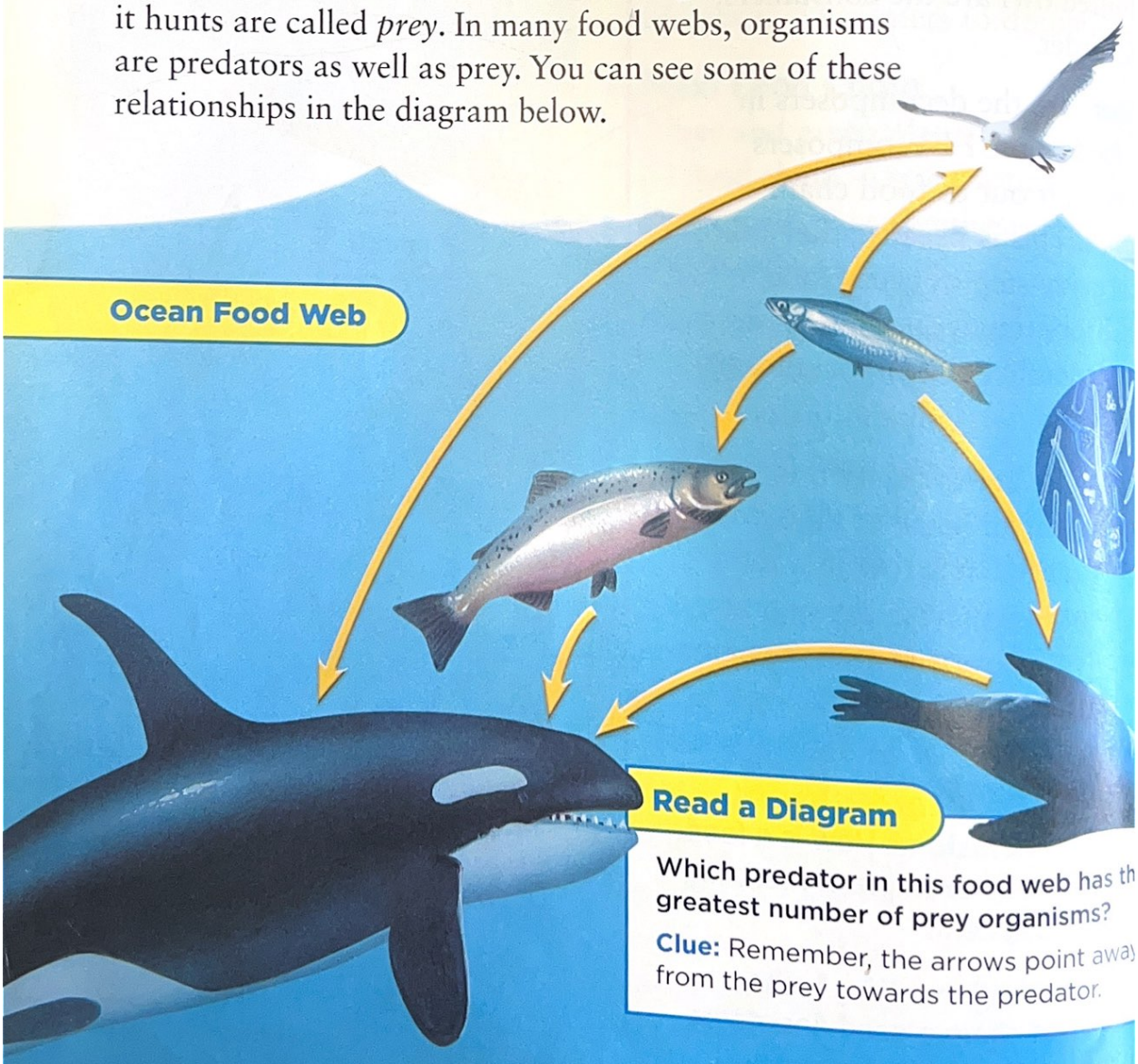
Critical Thinking Why is the term *food chain* a good descriptor of the relationships shown on these pages?

What is a food web?

A food chain is a good model of how energy travels in the form of food. However, it only shows one path. Most ecosystems have many different food chains that link together. A **food web** shows how all the food chains in an ecosystem are connected.

Predator and Prey

Food webs show relationships between predators (PRED•uh•tuhrz) and their prey. A *predator* is a carnivore that hunts for its food. The organisms that it hunts are called *prey*. In many food webs, organisms are predators as well as prey. You can see some of these relationships in the diagram below.



Read a Diagram

Which predator in this food web has th greatest number of prey organisms?

Clue: Remember, the arrows point away from the prey towards the predator.

Competition

A food web shows that a single organism can take part in more than one food chain. When this happens, competition can result. **Competition** is the struggle between organisms for food, water, and other needs.

Look at the land food web. It has different herbivores, such as deer, small birds, and mice. What if they all ate the same plants? The three populations would compete for the food. One population might win out. The other populations would die unless they found a different food or moved to a different place.

Competition is not limited to animals. In the forest, small plants and flowers compete with tall trees for sunlight and nutrients.

Individuals in a population also compete with each other. You may have watched squirrels in a park compete for nuts. With all this competition, all living things on Earth can be considered part of one giant food web.

Quick Check

Draw Conclusions In the ocean food web, what animal competes with the killer whale for fish?

Critical Thinking List four different food chains in the land food web at the right.

What is an energy pyramid?

Plants capture energy from the Sun. When you eat a plant, how much of that energy do you get?

An **energy pyramid** is a model that shows the amount of energy at each level of a food web. Producers are always at the bottom, or base, of the pyramid. They use about $\frac{9}{10}$ of all the energy they produce. They store the other tenth in their cells.

When an herbivore eats a producer, it gets the plant's stored energy. But that amount is only $\frac{1}{10}$ of the original energy from the Sun.

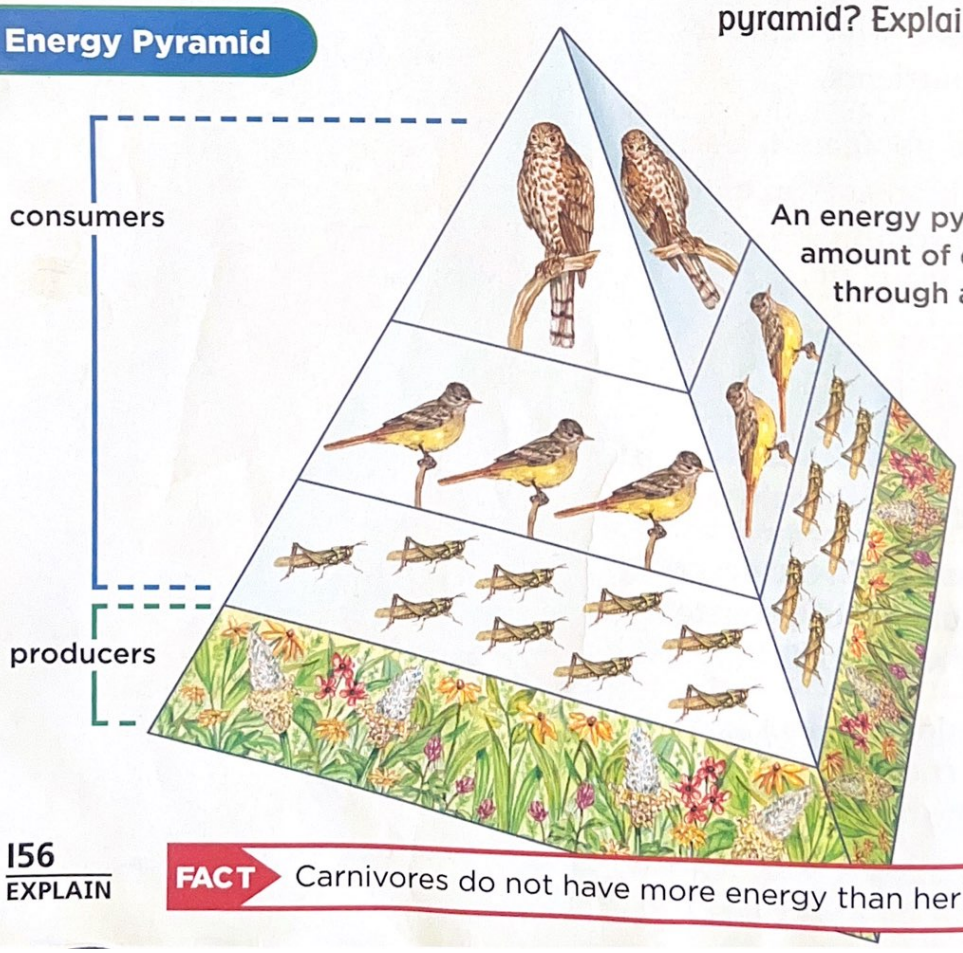
There are fewer and fewer organisms at each level of an energy pyramid. The organisms at each level use $\frac{9}{10}$ of the available food energy. Only $\frac{1}{10}$ of the energy gets passed to the next level. With only $\frac{1}{10}$ of the energy available to them, fewer organisms are able to survive on the level above. The animals at the top get just a tiny fraction of the original energy.

Quick Check

Draw Conclusions Why do food webs have more producers than consumers?

Critical Thinking Is it possible to have an upside-down energy pyramid? Explain.

Energy Pyramid



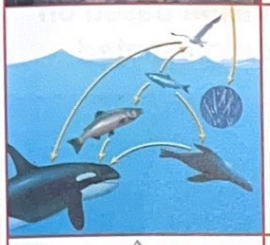
An energy pyramid models the amount of energy moving through a food web.

FACT Carnivores do not have more energy than herbivores.

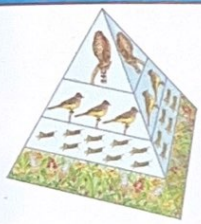
Lesson Review

Visual Summary

In an ecosystem, food is made by **producers**, eaten by **consumers**, and broken down by **decomposers**.



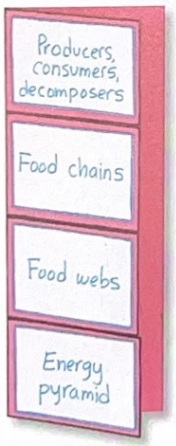
Food chains and **food webs** show the relationships between organisms in an ecosystem.



Energy pyramids show how food energy moves through an ecosystem.

Make a FOLDABLES Study Guide

Make a Four-Tab Book. Use it to summarize what you read about relationships in ecosystems.



Think, Talk, and Write

1. **Main Idea** What roles do producers, consumers, and decomposers have in an ecosystem?

2. **Vocabulary** What is an omnivore? Give three examples.

3. **Draw Conclusions** Scientists are doing a survey of an ecosystem. So far, they have counted more carnivores than herbivores. Is the survey complete? Why or why not?

Text Clues	Conclusions

4. **Critical Thinking** Why do carnivores usually have sharper teeth than herbivores?

5. **Test Prep** Two food chains can combine to form a(n) _____
   - A ecosystem.
   - B food web.
   - C energy pyramid.
   - D food chain.

Math Link

Figure the Number of Carnivores
A normal ecosystem has 10 times as many herbivores as carnivores. How many carnivores would you expect to find if there are 4,250 herbivores?

Art Link

Show a Food Web
Find out about the organisms in your local environment. Make a poster showing each organism and the food web that connects them.

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Writing in Science

The Moth That Needed the Tree

The yucca moth of the Mojave Desert spreads the pollen of yucca trees. It also does something very unusual. When the moth visits a flower on the yucca tree, it pokes a hole in the flower's ovary. Then it places its own eggs in the flower! The moth leaves pollen on the flower as well. This helps the plant reproduce.

The moth's eggs and the tree's seeds grow at the same time. The seeds become food for the moth's offspring. All of this happens inside the flower! The young moths get the food they need. They also stay safe from predators. The yucca moth and yucca tree depend on each other.

yucca flower

Expository Writing

Good expository writing

- supports the main idea with facts and details
- organizes facts and detail to show causes and effect
- draws a conclusion based the information presente

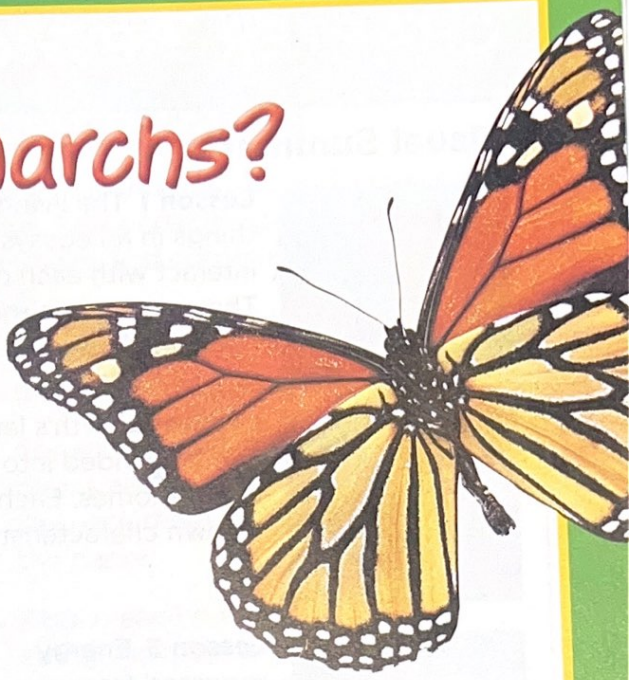
Write About It

Expository Writing Research another example of how insects and plants depend on each other. Write a report with facts and details from your research.

LOG ON e-Journal Research and write about it online at www.macmillanmh.com

Math in Science

How Many Monarchs?



Each winter, about 180 to 280 million Monarch butterflies travel from the north toward Mexico. There the climate is warmer and the butterflies can survive.

The milkweed plant is the Monarch's main source of food. Today, people are building in places where milkweed grows. Monarchs are having trouble finding enough food for their journey south. This change in the food chain means that fewer butterflies make the trip each year. Their numbers have been reduced by many millions.

Place Value

A place-value chart can help you understand the values of large whole numbers.

hundred millions	ten millions	millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones
1	0	5,	8	3	7,	5	0	9

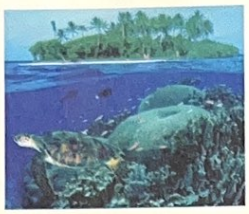
▲ **Read this number as one hundred five million, eight hundred thirty-seven thousand, five hundred nine.**

Solve It

An average population of Monarch butterflies is one million, nine hundred fifty-eight thousand, thirty-three. Write this number in a place-value chart.

CHAPTER 3 Review

Visual Summary



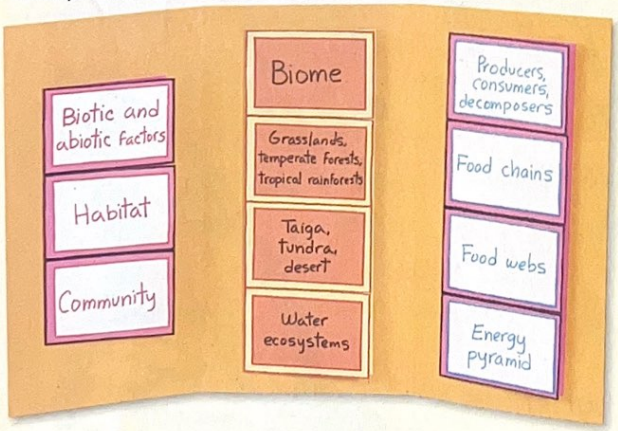
Lesson 1 The living things in an ecosystem interact with each other. They depend on the nonliving things.

Lesson 2 Earth's land can be divided into six major biomes. Each has its own characteristics.

Lesson 3 Energy is passed from one organism to another in an ecosystem.

Make a FOLDABLES™ Study Guide

Tape your lesson study guides to a piece of paper as shown. Use your study guide to review what you have learned in this chapter.



Vocabulary

Fill each blank with the best term from the list.

biome, p. 138

consumer, p. 151

desert, p. 142

ecosystem, p. 131

food web, p. 154

habitat, p. 131

producer, p. 150

taiga, p. 142

1. Two or more food chains that sha links make a(n) _____.
2. The biome that gets the least amount of rainfall is the _____
3. An organism that cannot make its own food is called a(n) _____
4. A large ecosystem with its own k of plants and animals is called a(_____.
5. The place where an organism lives is its _____.
6. An organism that uses energy in sunlight to make food is a(n) _____.
7. Most of the plants found in the _____ stay green all year.
8. The biotic and abiotic factors of an environment make up an entire _____.

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Skills and Concepts

Answer each of the following in complete sentences.

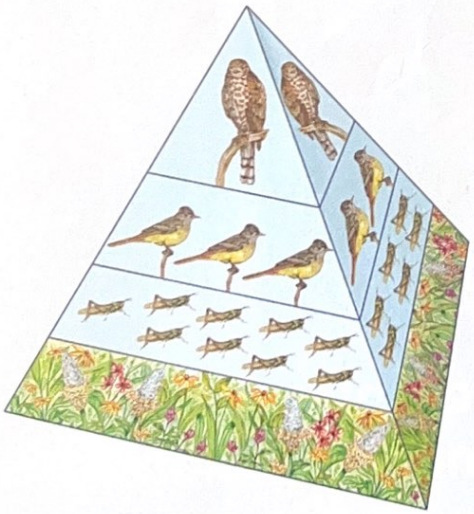
9. **Fact and Opinion** *A desert biome is a bad place for organisms to live.* Is this a fact or an opinion? Explain.

10. **Expository Writing** Explain why abiotic factors are important to an ecosystem. Use details to support your explanation.

11. **Predict** Suppose you are camping in the northeastern United States. What kinds of plants and animals would you expect to see there?

12. **Critical Thinking** Suppose a company started building houses in a grassland. What might happen to the food chain in this area?

13. **Interpret Data** Which organisms in the food pyramid are consumers? Which are producers?



The Big Idea

14. Where do plants and animals live and how do they depend on each other?

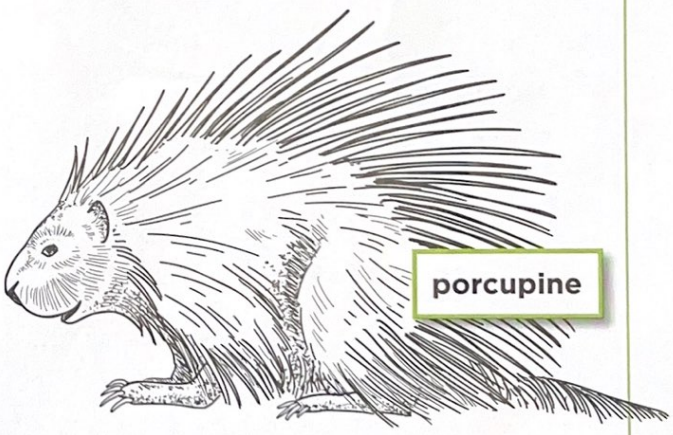
Performance Assessment

Biome Mobile

Make a mobile showing the six major biomes. Use a coat hanger, string, crayons or markers, and construction paper.

1. Cut one sheet of construction paper into six pieces. Write the name of a different biome on each piece.
2. For each biome, list at least four plants and animals that live there. Illustrate them on both sides of the paper.
3. Attach each piece of paper to a string. Tie each string onto the bottom of the hanger.

Test Prep



1. **The animal shown here is an example of a(n)**

   A herbivore.

   B omnivore.

   C predator.

   D decomposer.