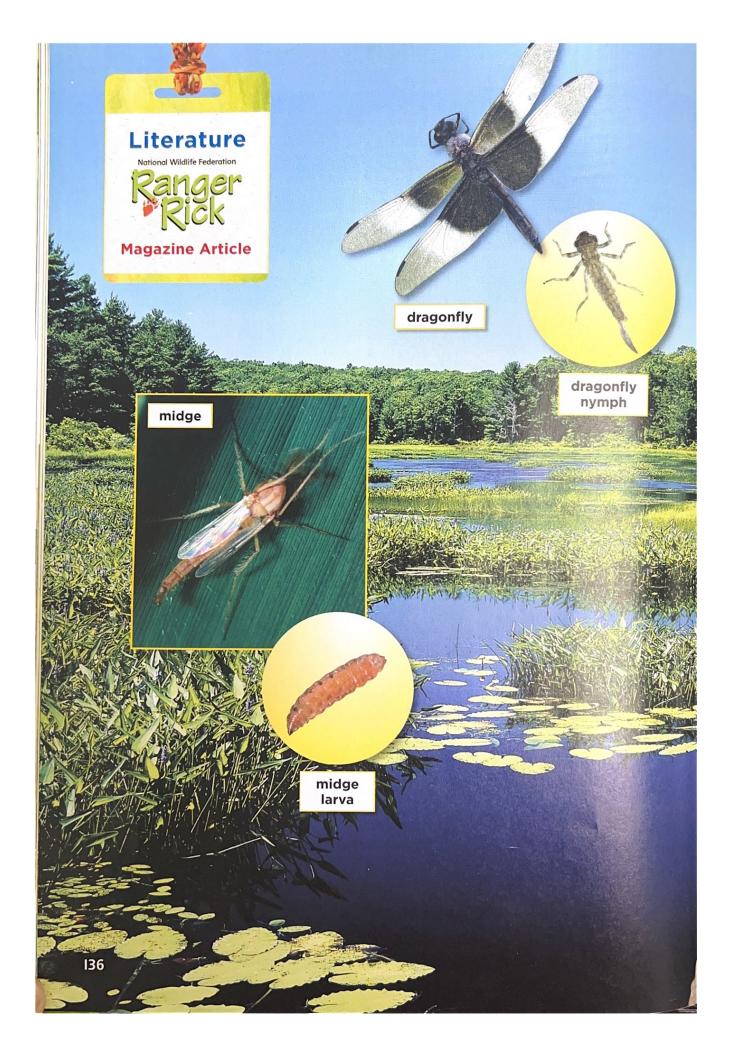


Ecosystems

Desert adder in Namibia, Africa

Watch out! This snake is hiding in the sand and waiting for its next meal.





THE CASE FOR CLEAN WATER

People, plants, and animals all need clean water. How do we know if a body of water is clean and healthy?

Clue 1. How does it look?

Begin your investigation with obvious evidence. What does the water look like? How does it smell? Even if water looks clear and clean, it might not be.

Clue 2. What is in it?

Use equipment to do some tests. Testing the pH and chemistry of the water are ways to check its health.

Clue 3. Who lives there?

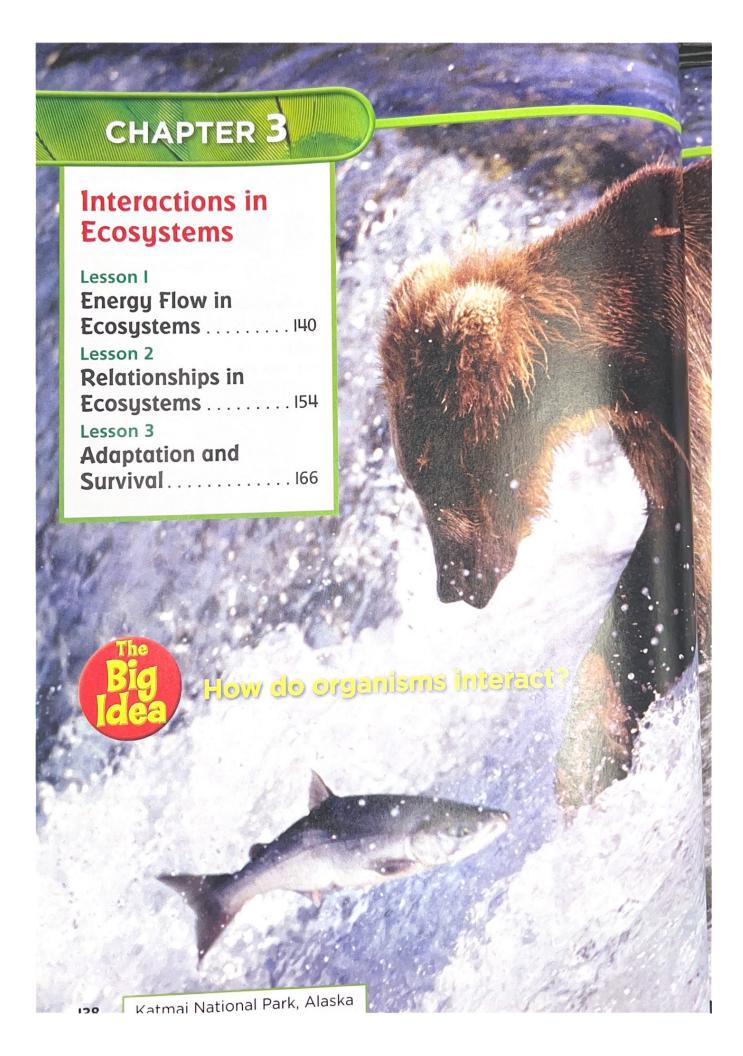
Look for insects that spend part or all of their life living in the water you are investigating. Dragonfly nymphs like to live in clean water, but if necessary they can live in polluted water. Therefore you cannot know whether or not the water is clean if you see dragonfly nymphs. Midge larvae can live in polluted water until they hatch into adult midges. If you notice many midge larvae and not much else, it is a sign that the water is in trouble. Some insects, including caddisfly larvae, mayfly nymphs, and stonefly nymphs, cannot live in polluted water. If you find these insects, you know the water must be clean.



Write About It

Response to Literature This article tells how to find out if a body of water is clean. Research additional information about the insect larvae mentioned in the article. Write a report about the effects of pollution on these insects. Include facts and details from the article and from your research.





Key Vocabulary



ecosystem

all the living and nonliving things in an environment, including their interactions with each other (p. 142)



food web

the overlapping food chains in an ecosystem (p. 146)



energy pyramid

a diagram that shows the amount of energy available at each level of an ecosystem (p. 148)



carrying capacity

the maximum population size that an area can support (p. 157)



commensalism

relationship between two kinds of organisms that benefits one without harming the other (p. 161)



camouflage

an adaptation in which an animal protects itself against predators by blending in with the environment (p. 173)

More Vocabulary

population, p. 143

community, p. 143

food chain, p. 144

predator, p. 147

prey, p. 147

limiting factor, p. 156

habitat, p. 158

niche, p. 158

symbiosis, p. 160

mutualism, p. 160

parasitism, p. 162

adaptation, p. 168

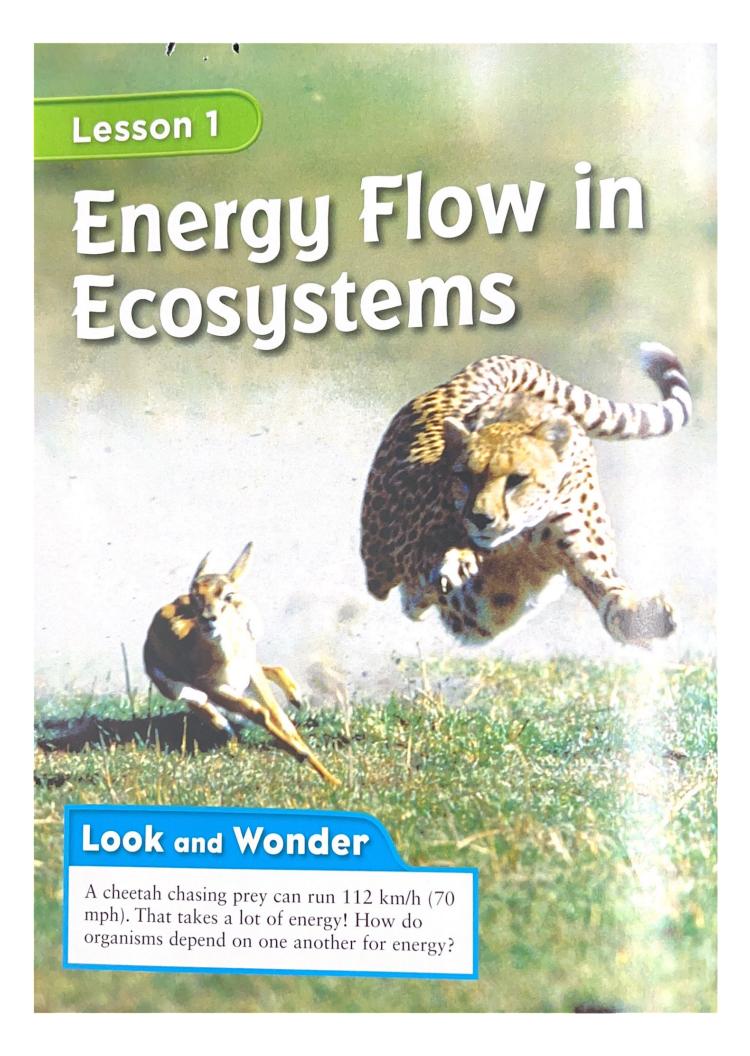
protective coloration,

p. 173

protective resemblance,

p. 173

mimicry, p. 174



Explore

Inquiry Activity

How do organisms in a food chain interact?

Purpose

A food chain models how food energy is transferred from one organism to another. Producers make their own food. Herbivores consume producers. Carnivores consume herbivores. Create food chains using the list below.

PRODUCERS	HERBIVORES	CARNIVORES
algae	grasshopper	wolf
berries, flowering plants	deer	otter
shrubs	chipmunk	hawk
seeds, grass	squirrel	robin
acorn, oak tree	fish	owl

Materials



- blank note cards
- construction paper
- glue stick
- magazines
- markers
- scissors

Procedure

- 1 Make cards for the organisms listed in the chart above. Draw or glue a picture of an organism on each card.
- 2 Create a three-column chart on the paper. Label the columns as shown.
- 3 Use your organism cards to make five food chains. Place the organism cards on your chart under the correct columns.

First Second Third Level 1. Acorn Squirrel Owl

Draw Conclusions

- 4 Communicate Compare your food chains with a classmate's food chains. Explain how they compared.
- 5 Infer Can food chains overlap? How does this affect the ecosystem?

Explore More

Research one of your food chains. What ecosystem is it part of? What other organisms are part of this ecosystem? How are these organisms connected to your food chain?

Read and Learn

Main Idea

Food chains, food webs, and energy pyramids show the energy flow between organisms in an ecosystem.

Vocabulary

ecosystem, p.142
population, p.143
community, p.143
food chain, p.144
food web, p.146
predator, p.147
prey, p.147
energy pyramid, p.148

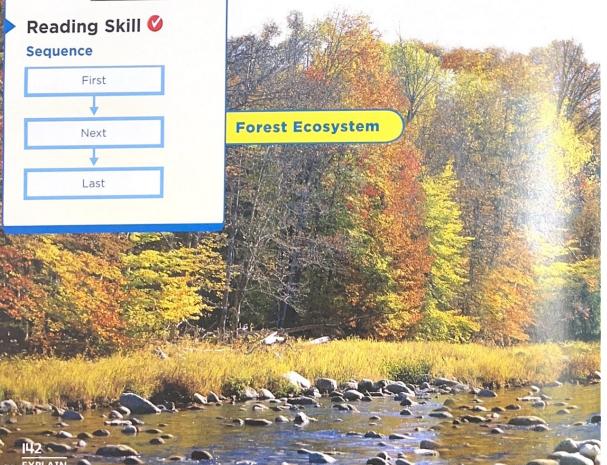


What is in an ecosystem?

You are on a hike in a beautiful forest. Wha you see? Plants, including spruce trees, wildflow and grasses, grow along your path. Chipmunks scurry across the trail and birds fly overhead. The are some of the living things, or biotic factors (bye•OT•ik FAK•tuhrz), of the environment.

Plenty of nonliving things, or abiotic factors (ay•bye•OT•ik), are also in view. Fresh air fills yo lungs. Rocks lie on the trail. Below you hear the gurgle of a nearby stream filled with water. Togothese biotic and abiotic factors make up the fore ecosystem (EK•oh•sis•tuhm). An ecosystem incluall living and nonliving things in an environmen

Biotic and abiotic factors in an ecosystem into and supply the needs of living things. Recall that plants need abiotic factors to survive, including s sunlight, air, and water. Plants, in turn, provide for most of the animals in an ecosystem.



The organisms in an ecosystem can be sorted into different populations (pop•yuh•LAY•shuhnz). A population includes all members of a single species in an area at a given time. For example, all the blue spruce trees in a forest form a population. Each species forms its own population. The monarch, painted lady, and buckeye butterflies all form separate butterfly populations in an ecosystem.

Together, the many different populations make up a community (kuh•MYEW•ni•tee). A community includes all the living things in an ecosystem. In addition to plants and animals, a community also has bacteria, protists, and fungi. For example, the soil of a forest community has huge populations of molds and bacteria living in it. The living community of most ecosystems might include thousands of populations.



This fallen log is part of a tiny ecosystem that includes fungi, moss, and bacteria.

An ecosystem can be local or widespread. An entire forest that covers a huge area can be an ecosystem. But one fallen log in the middle of that forest can also make up an ecosystem.



Quick Check

Sequence List the parts that make up an ecosystem from the smallest to the largest.

Critical Thinking Soil is usually called an abiotic factor in an ecosystem. Why can soil also be considered a biotic factor?

Read a Photo

What biotic and abiotic factors can you see in this photo?

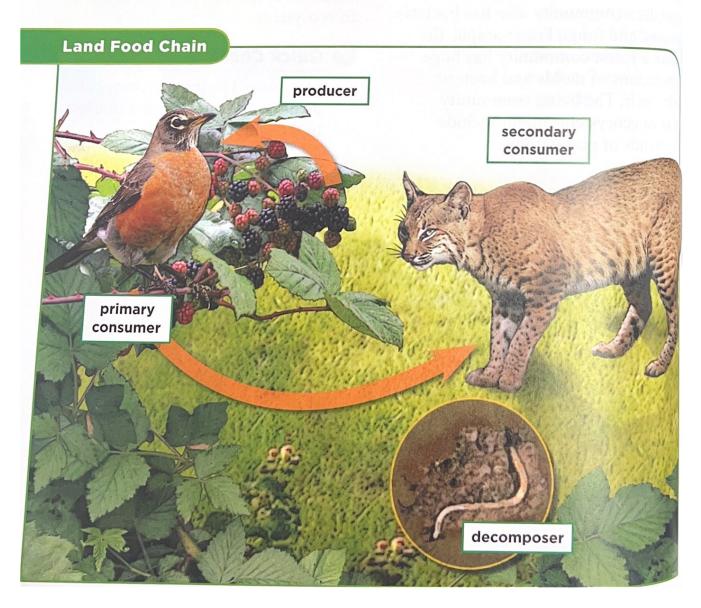
Clue: Make a list of the living and nonliving things.

How are food chains alike?

The path that energy and nutrients follow in an ecosystem is called a **food chain**. Food chains model the feeding relationships between organisms in an ecosystem. Energy flows in one direction in food chains. Once energy is used by an organism, it leaves the organism's body as heat. It becomes unavailable for other organisms in the ecosystem.

The energy in a food chain starts with the Sun. It is the energy source for almost all organisms on Earth. *Producers* are organisms that use the Sun's energy to make sugar and oxygen. Producers are at the base of every food chain.

During photosynthesis, producers, such as plants and algae, build sugar molecules out of carbon dioxide and water. The sugar molecules are the original source of food for consumers. A *consumer* is any animal that eats plants or other animals.



Animals that eat producers directly are called herbivores. These consumers include squirrels, some birds, some insects, and grazing animals. Animals that eat other animals rather than producers are called *carnivores* (KAHR•nuh•vawrz). Bobcats and hawks are carnivores. Animals that eat both plants and other animals are called *omnivores* (OM•nuh•vawrz). Raccoons, woodpeckers, mice, and some crabs are omnivores.

Finally, there are decomposers in a food chain. *Decomposers* break down dead or decaying plant and animal material. Decomposers include fungi,

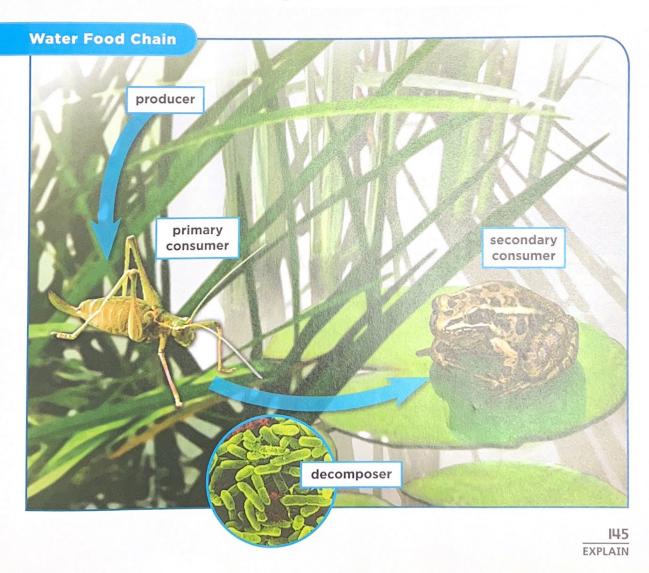
bacteria, termites, and many worm species. *Scavengers* are not included in these food chains. Scavengers are consumers that eat leftover bodies after they have started to rot. Common scavengers include vultures, raccoons, and some crabs.

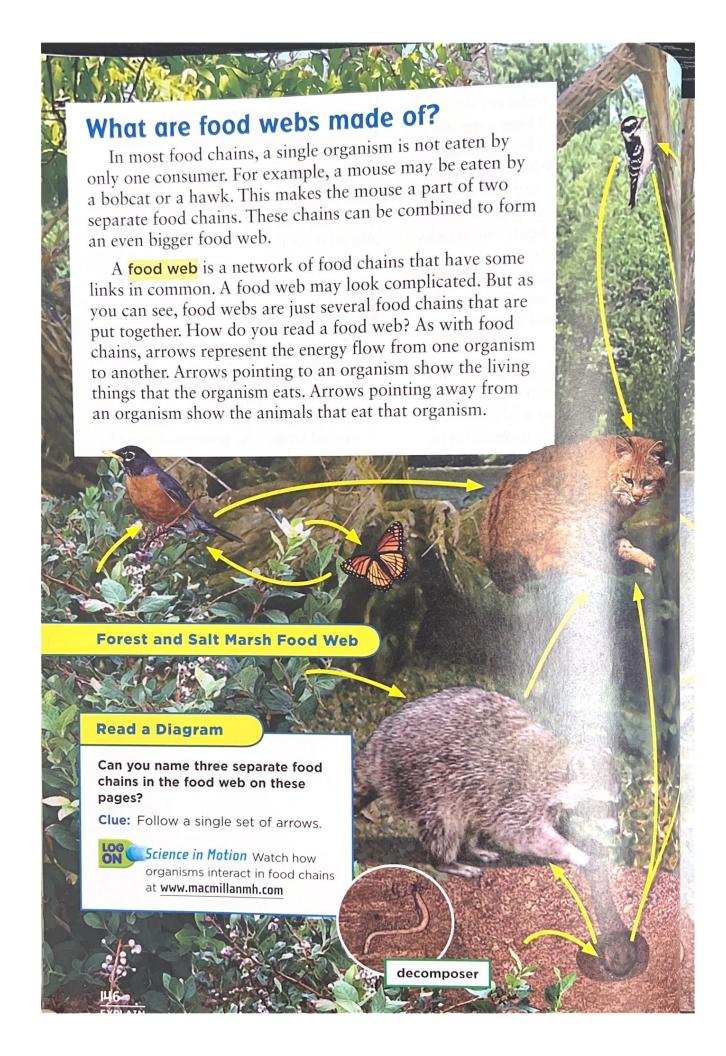


Quick Check

Sequence What general pattern do all food chains follow?

Critical Thinking What is the fewest number of links a food chain could have? The greatest number?







Quick Lab

Energy Transfer

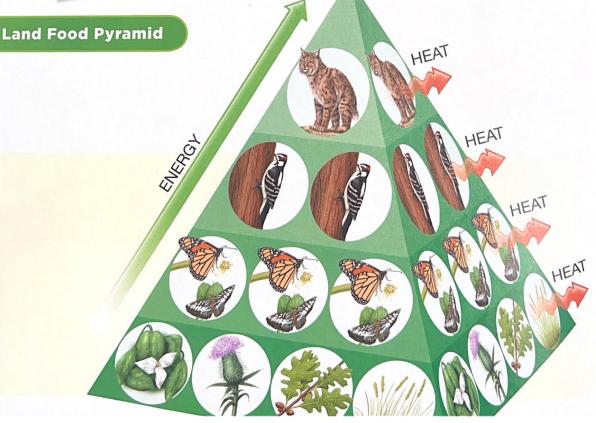
- Make 100 energy cards. Each card represents 100 energy units.
- Make an energy-level poster with four levels: Producers, Herbivores, Carnivores, and Top Carnivore.
- 3 Place 100 cards on the Producers. How many total energy units does this level have?
- Continue to take 10% of the energy units from one level to the next level up to the Top Carnivore level. Use scissors if necessary.
- 5 **Draw Conclusions** How many energy units does the Top Carnivore level have?

How do energy pyramids compare?

An energy pyramid (EN•uhr•jee) is a diagram that shows the amount of energy available at each level of an ecosystem. How much of the Sun's original energy actually gets used duri photosynthesis? In fact, only about 10 percent of the Sun's energy gets turned into food energy by a producer.

When a producer is eaten, only about 10 percent of the food energy it contains gets turned into herbivore or omnivore tissue. The rest is utilized or transferred into heat energy. For example, a butterfly drinks nectar from flowers to obtain energy. The butterfly's body then uses the energy from the nectar to support its life processes, such





energy units

as respiration and digestion. If only 10 percent of plant tissue gets turned into butterfly tissue, 90 percent of the plant's energy is not used by the butterfly! This pattern continues with each level of an energy pyramid. When a bird eats the butterfly, it obtains even less energy. At each stage, about 90 percent of the available energy is not utilized. What does this mean? It means that most feeding patterns are not very efficient.

Energy pyramids illustrate that it takes a huge number of organisms to support an ecosystem. The bottom of the pyramid represents the producers. It is the largest level because it contains the most organisms, and therefore the most energy. There are fewer numbers of organisms and less available energy at each level of the pyramid.

In any ecosystem the number of producers is greater than the number of herbivores. Similarly, there are many more herbivores than carnivores. In a forest, for example, there are more flowers than butterflies. There are many more butterflies and other insects than birds. There are many more birds than bobcats, the top carnivores.

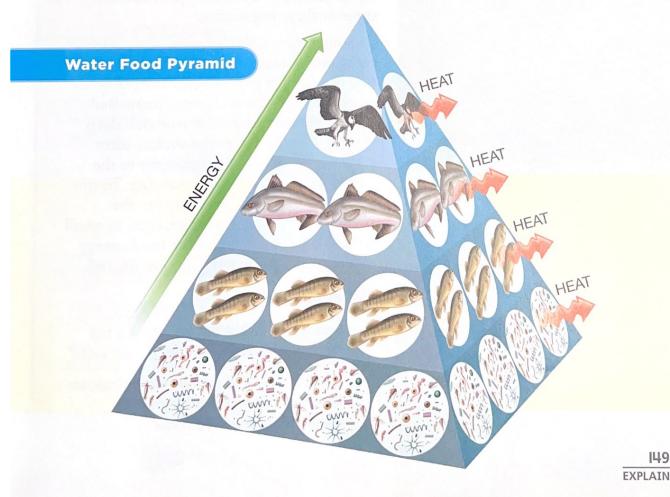


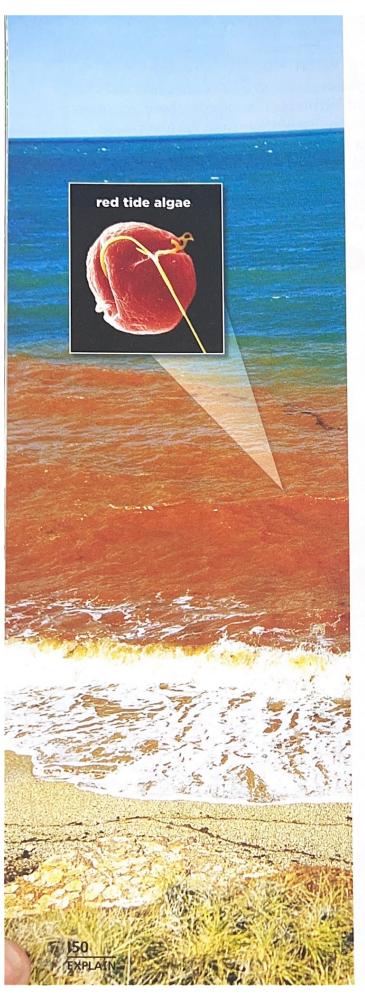
Quick Check

Sequence Explain how energy is utilized in an energy pyramid.

Critical Thinking In a prairie ecosystem, would you expect a rabbit or a hawk population to be larger? Explain.

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How does change affect a food web?

Most ecosystems stay in balance most of the time. What happens when a top carnivore is removed from a food web? What happens when a population in a food web increases in number? These changes set off a chain of events that affect all the organisms in a food web.

When top carnivores are removed from a food chain, prey populations are no longer controlled. Now prey organisms can reproduce without limits. When prey populations increase in number, more producers are required to supply them with energy. For example, if you removed the bobcat from the forest food web, the populations of birds, mice, and raccoons would increase. Soon there would be less grass, trees, and other producers to support these organisms.

Sometimes, a single population can grow out of control. For example, a *red tide* is a sudden explosive growth of single-celled algae in coastal areas. Red tides can occur when nutrient-rich deep water gets brought to the surface after a storm. With so many nutrients in the water, the algae keep reproducing. Toxins produced by the algae can cause the organisms that eat the algae, such as smal fish, to die. This reduces the food energy available for predators who eat the fish.

V

Quick Check

Sequence What occurs when a top carnivore is removed from a food web?

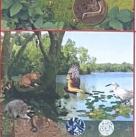
Critical Thinking What might happer if a population of producers was removed from a food web?

Lesson Review

Visual Summary



Producers, consumers, and decomposers all play important roles in food chains.



Food webs are networks of food chains that share common links.



Energy pyramids show the amount of energy available at each level of an ecosystem.

Make a FOLDABLES **Study Guide**

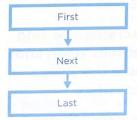
Make a Trifold Book. Use the titles shown. Tell about the topic

on the inside of each fold.



Think, Talk, and Write

- 1 Main Idea How do producers and consumers obtain energy?
- 2 Vocabulary A consumer that hunts for its food is called a(n) _____.
- **3 Sequence** Describe the events that take place as energy from the Sun travels through an energy pyramid.



- Critical Thinking Where would you place decomposers on an energy pyramid? Explain.
- 5 Test Prep A food web can be broken down into separate
 - A producers. C food chains.

 - **B** decomposers. **D** food pyramids.
- **(3) Test Prep** Which of the following is the largest group in an energy pyramid?
 - A consumers
- C carnivores
- **B** producers
- **D** herbivores



Writing Link

Your Food Chain

What food chains are you a part of? Describe what you ate for lunch today. Tell how the foods you ate link back to a food chain or food web.



Math Link

Food Pyramid

Suppose all the faces, or sides, of a food pyramid are triangles. How many sides, edges (where two sides meet), and vertices (where two or more edges meet) does it have?