

# Living Things Need Energy

## Terms to Learn

- |            |                |
|------------|----------------|
| herbivore  | food web       |
| carnivore  | energy pyramid |
| omnivore   | habitat        |
| scavenger  | niche          |
| food chain |                |

## What You'll Do

- ◆ Describe the functions of producers, consumers, and decomposers in an ecosystem.
- ◆ Distinguish between a food chain and a food web.
- ◆ Explain how energy flows through a food web.
- ◆ Distinguish between an organism's habitat and its niche.

All living things need energy to survive. For example, black-tailed prairie dogs, which live in the grasslands of North America, eat grass and seeds to get the energy they need. They use this energy to grow, move, heal injuries, and reproduce. In fact, everything a prairie dog does requires energy. The same is true for the plants that grow in the grasslands where the prairie dogs live. Coyotes that stalk prairie dogs, as well as the bacteria and fungi that live in the soil, all need energy.

## The Energy Connection

Organisms in a prairie or any community can be divided into three groups based on how they obtain energy. These groups are producers, consumers, and decomposers. Examine **Figure 4** to see how energy passes through these groups in an ecosystem.

**Producers** Organisms that use sunlight directly to make food are called *producers*. They do this using a process called photosynthesis. Most producers are plants, but algae and some bacteria are also producers. Grasses are the main producers in a prairie ecosystem. Examples of producers in other ecosystems include cordgrass and algae in a salt marsh and trees in a forest. Algae are the main producers in the ocean.

**Figure 4** Follow the pathway of energy as it moves from the sun through the ecosystem.

**Energy**  
Sunlight is the source of energy for almost all living things.

**Producer**  
Plants use the energy in sunlight to make food.

### Consumer

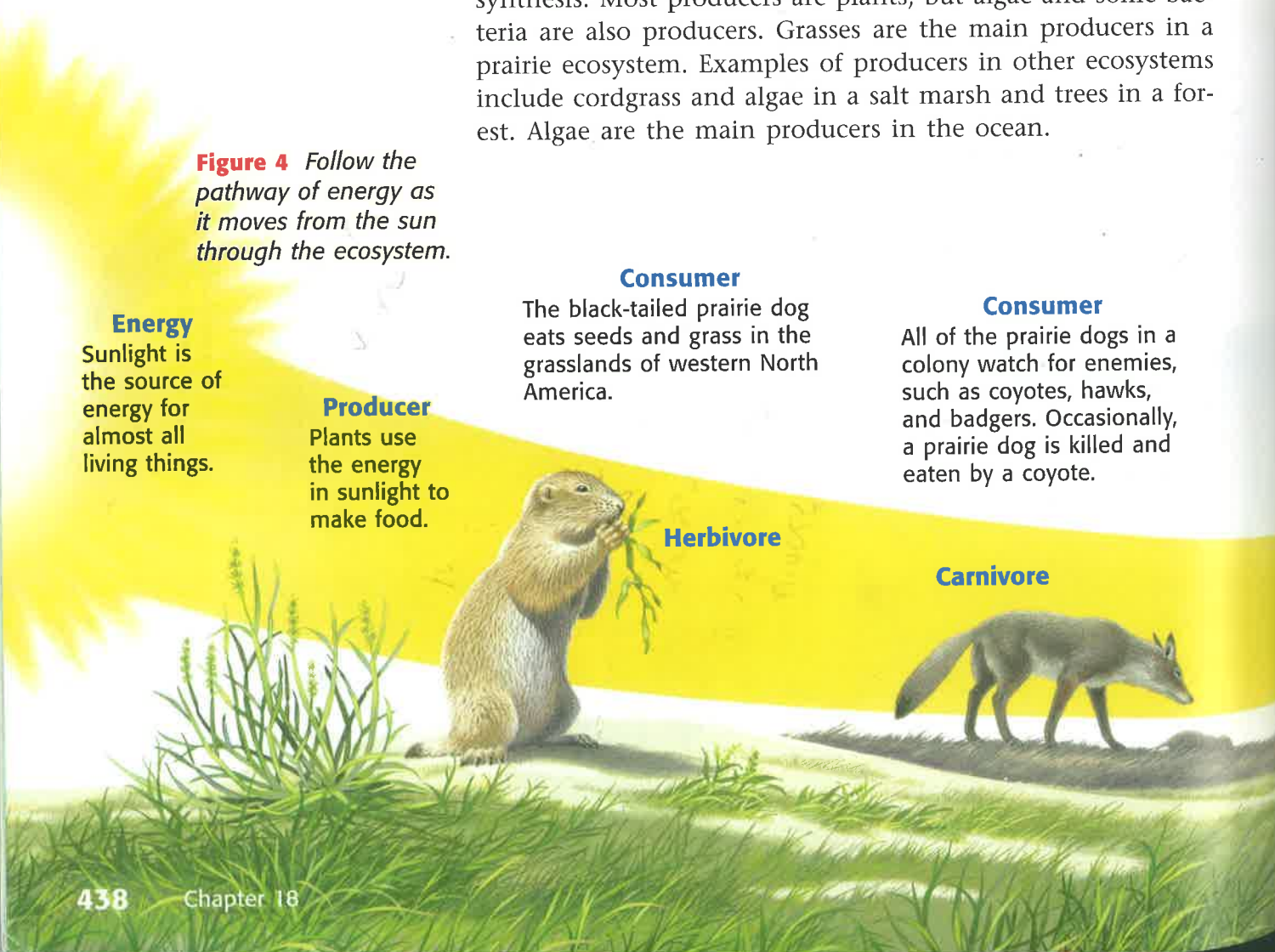
The black-tailed prairie dog eats seeds and grass in the grasslands of western North America.

### Consumer

All of the prairie dogs in a colony watch for enemies, such as coyotes, hawks, and badgers. Occasionally, a prairie dog is killed and eaten by a coyote.

### Herbivore

### Carnivore



**Consumers** Organisms that eat producers or other organisms for energy are called *consumers*. They cannot use the sun's energy directly like producers can. Instead, consumers must eat producers or other animals to obtain energy. There are several kinds of consumers. A **herbivore** is a consumer that eats plants. Herbivores in the prairie ecosystem include grasshoppers, gophers, prairie dogs, bison, and pronghorn antelope. A **carnivore** is a consumer that eats animals. Carnivores in the prairie ecosystem include coyotes, hawks, badgers, and owls. Consumers known as **omnivores** eat a variety of organisms, both plants and animals. The grasshopper mouse is an example of an omnivore in the prairie ecosystem. It eats insects, scorpions, lizards, and grass seeds. **Scavengers** are animals that feed on the bodies of dead animals. The turkey vulture is a scavenger in the prairie ecosystem. Examples of scavengers in aquatic ecosystems include crayfish, snails, clams, worms, and crabs.

**Decomposers** Organisms that get energy by breaking down the remains of dead organisms are called *decomposers*. Bacteria and fungi are examples of decomposers. These organisms extract the last bit of energy from dead organisms and produce simpler materials, such as water and carbon dioxide. These materials can then be reused by plants and other living things. Decomposers are an essential part of any ecosystem because they are nature's recyclers.



**BRAIN FOOD**

Prairie dogs are not really dogs. They are rodents. They are called dogs because their warning calls sound like the barking of dogs.

### ✓ Self-Check

Are you a herbivore, a carnivore, or an omnivore? Explain. (See page 782 to check your answer.)

#### Consumer

A turkey vulture may eat some of the coyote's leftovers. A scavenger can pick bones completely clean.

#### Decomposer

Any prairie dog remains not eaten by the coyote or the turkey vulture are broken down by bacteria and fungi that live in the soil.

Scavenger



Recycler



## Self-Check

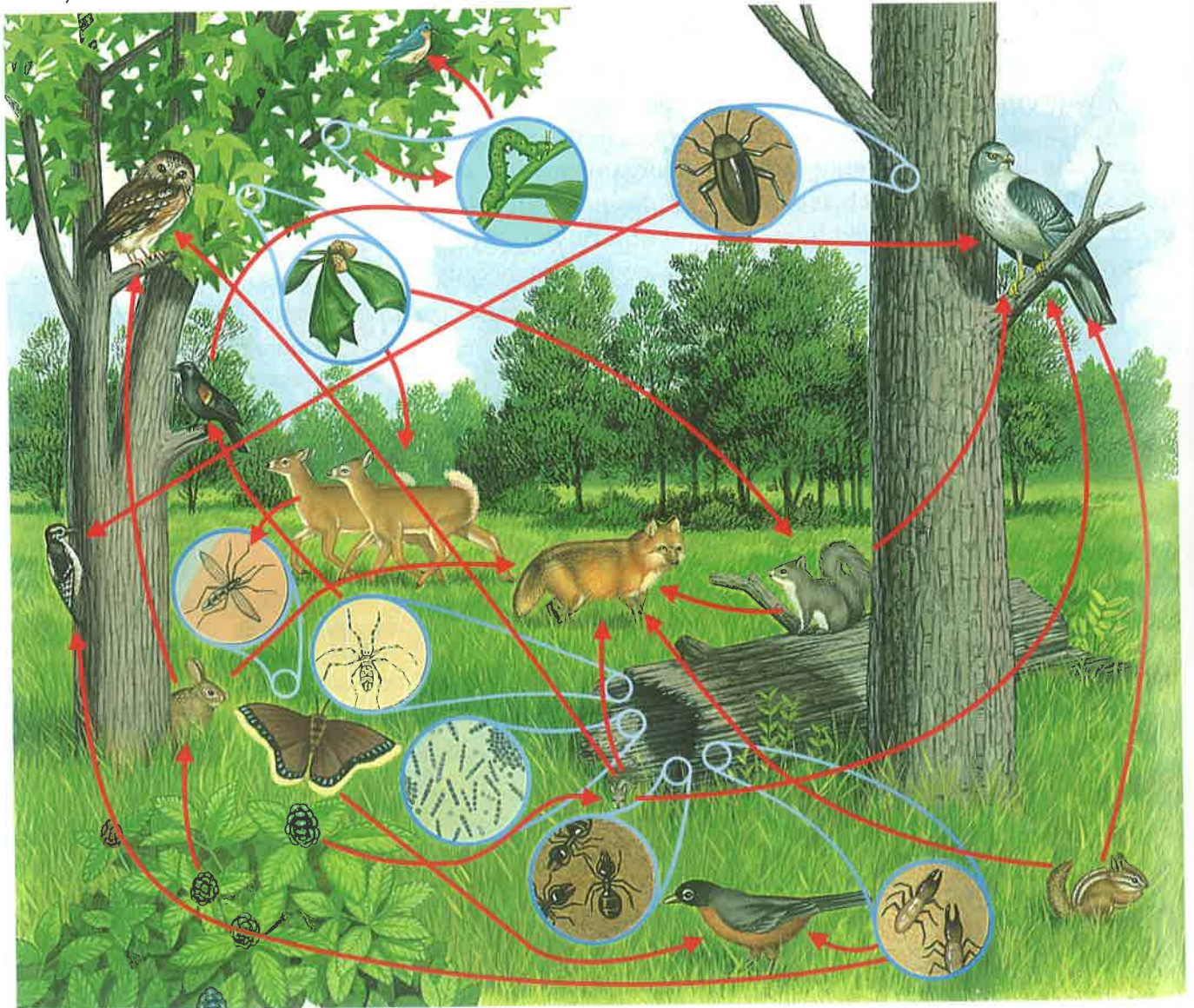
How is a food web different from a food chain? (See page 782 to check your answer.)

## Food Chains and Food Webs

Figure 4, on pages 438–439, shows a **food chain**, which represents how the energy in food molecules flows from one organism to the next. But because few organisms eat just one kind of organism, simple food chains rarely occur in nature. The many energy pathways possible are more accurately shown by a **food web**. **Figure 5** shows a simple food web for a woodland ecosystem.

Find the fox and the rabbit in the figure below. Notice that the arrow goes from the rabbit to the fox, showing that the rabbit is food for the fox. The rabbit is also food for the owl. Neither the fox nor the owl is ever food for the rabbit. Energy moves from one organism to the next in a one-way direction, even in a food web. Any energy not immediately used by an organism is stored in its tissues. Only the energy stored in an organism's tissues can be used by the next consumer.

**Figure 5** Energy moves through an ecosystem in complex ways. Most consumers eat a variety of foods and can be eaten by a variety of other consumers.





## Energy Pyramids

A grass plant uses most of the energy it obtains from the sun for its own life processes. But some of the energy is stored in its tissues and is left over for prairie dogs and other animals that eat the grass. Prairie dogs need a lot of energy and have to eat a lot of grass. Each prairie dog uses most of the energy it obtains from eating grass and stores only a little of it in its tissues. Coyotes need even more energy than prairie dogs, so they must eat many prairie dogs to survive. There must be many more prairie dogs in the community than there are coyotes that eat prairie dogs.

The loss of energy at each level of the food chain can be represented by an **energy pyramid**, as shown in **Figure 6**. You can see that the energy pyramid has a large base and becomes smaller at the top. The amount of available energy is reduced at higher levels because most of the energy is either used by the organism or given off as heat. Only energy stored in the tissues of an organism can be transferred to the next level.

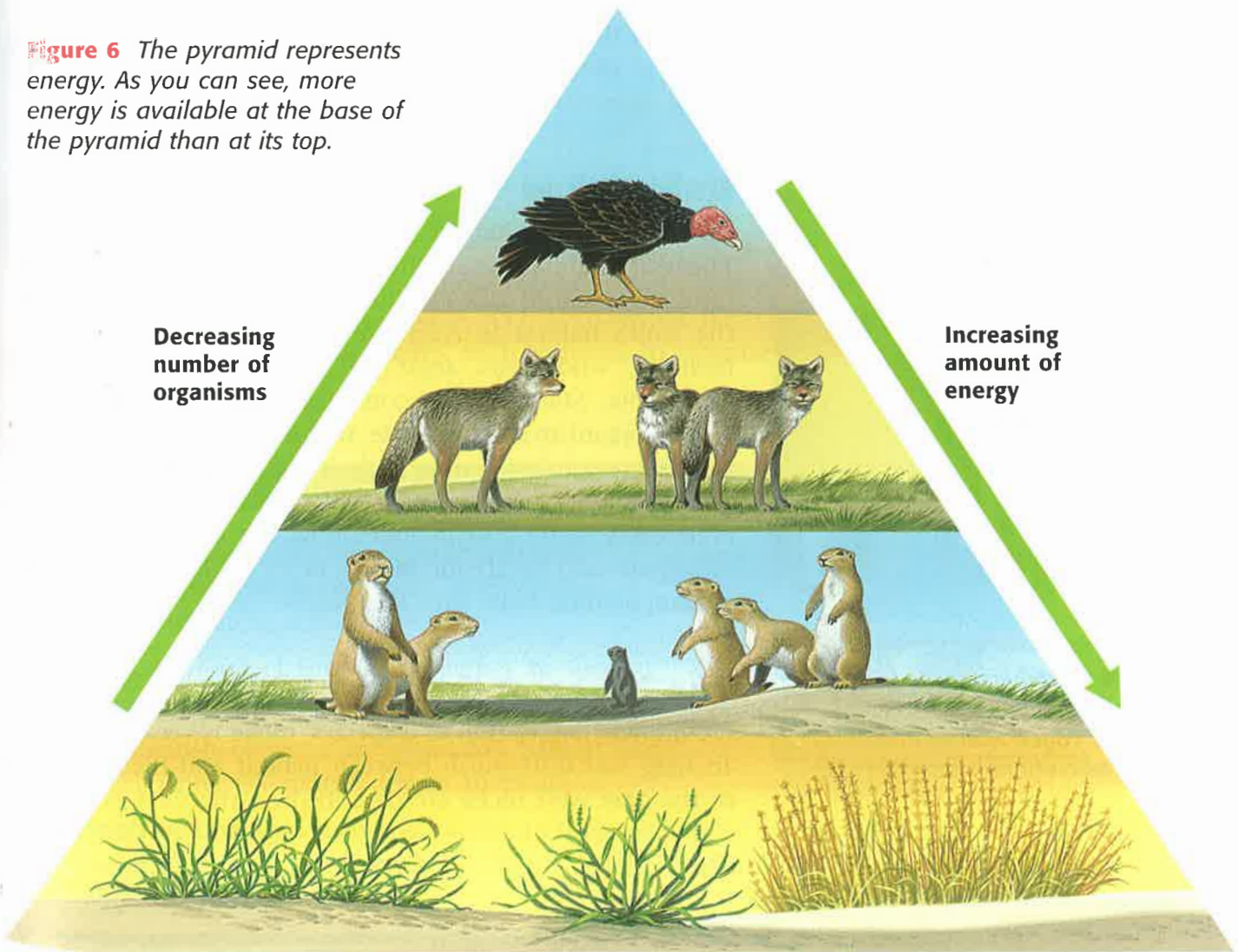
$\div$   $\delta$   $\div$   $\Omega$   $\leq$   $\infty$   $+$   $\Omega$   $\sqrt{\quad}$   $\infty$   $\leq$   $\Sigma$  2

### MATH BREAK

#### Energy Pyramids

Draw an energy pyramid for a river ecosystem that contains four levels—aquatic plants, insect larvae, bluegill fish, and a largemouth bass. The plants obtain 10,000 units of energy from the sun. If each level uses 90 percent of the energy it receives from the previous level, how many units of energy are available to the bass?

**Figure 6** The pyramid represents energy. As you can see, more energy is available at the base of the pyramid than at its top.





**Figure 7** As the wilderness was settled, the gray wolf population in the United States declined.

## Wolves and the Energy Pyramid

A single species can be very important to the flow of energy in an environment. Gray wolves, for example, are a consumer species that can control the populations of many other species. The diet of gray wolves can include anything from a lizard to an elk.

Once common throughout much of the United States, gray wolves were almost wiped out as the wilderness was settled. You can see a pair of gray wolves in **Figure 7**. Without wolves, certain other species, such as elk, were no longer controlled. The overpopulation of elk in some areas led to overgrazing and starvation.

Gray wolves were recently restored to the United States at Yellowstone National Park, as shown in **Figure 8**. The U.S. Fish and Wildlife Service hopes this action will restore the natural energy flow in this wilderness area. Not everyone approves, however. Ranchers near Yellowstone are concerned about the safety of their livestock.



**Figure 8** Members of the U.S. Fish and Wildlife Service are moving a caged wolf to a location in Yellowstone National Park.

## Habitat and Niche

An organism's **habitat** is the environment in which it lives. The wolf's habitat was originally very extensive. It included forests, grasslands, deserts, and the northern tundra. Today the wolf's habitat in North America is much smaller. It includes wilderness areas in Montana, Washington, Minnesota, Michigan, Wisconsin, and Canada.

An organism's way of life within an ecosystem is its **niche**. An organism's niche includes its habitat, its food, its predators, and the organisms with which it competes. An organism's niche also includes how the organism affects and is affected by abiotic factors in its environment, such as temperature, light, and moisture.

## The Niche of the Gray Wolf

A complete description of a species' niche is very complex. To help you distinguish between habitat and niche, parts of the gray wolf niche are described on the next page.



**Gray Wolves Are Consumers** Wolves are carnivores. Their diet includes large animals, such as deer, moose, reindeer, sheep, and elk, as well as small animals, such as birds, lizards, snakes, and fish.

### Gray Wolves Have a Social Structure

Wolves live and hunt in packs, which are groups of about six animals that are usually members of the same family. Each member of the pack has a particular rank within the pack. The pack has two leaders that help defend the pack against enemies, such as other wolf packs or bears.

### Gray Wolves Nurture and Teach Their Young

A female wolf, shown in **Figure 9**, has five to seven pups and nurses her babies for about 2 months. The entire pack help bring the pups food and baby-sit when the parents are away from the den. It takes about 2 years for the young wolves to learn to hunt. At that time, some young wolves leave the pack to find mates and start their own pack.



**Figure 9** In small wolf packs, only one female has pups. They are well cared for, however, by all of the males and females in the pack.

**Gray Wolves Are Needed in the Food Web** If wolves become reestablished at Yellowstone National Park, they will reduce the elk population by killing the old, injured, and diseased elk. This in turn will allow more plants to grow, which will allow animals that eat the plants, such as snowshoe hares, and the animals that eat the hares, such as foxes, to increase in number.

## REVIEW

1. How are producers, consumers (herbivores, carnivores, and scavengers), and decomposers linked in a food chain?
2. How do food chains link together to form a food web?
3. Distinguish between an organism's habitat and its niche using the prairie dog as an example.
4. **Applying Concepts** Is it possible for an inverted energy pyramid to exist, as shown in the figure at right? Explain why or why not.

