

Energy Flow in Ecosystems

Reading Preview

Key Concepts

- What energy roles do organisms play in an ecosystem?
- How does energy move through an ecosystem?
- How much energy is available at each level of an energy pyramid?

Key Terms

- producer • consumer
- herbivore • carnivore
- omnivore • scavenger
- decomposer • food chain
- food web • energy pyramid

Target Reading Skill

Building Vocabulary A definition states the meaning of a word or phrase by telling about its most important feature or function. After you read the section, reread the paragraphs that contain definitions of Key Terms. Use all the information you have learned to write a definition of each Key Term in your own words.

Lab
zone

Discover Activity

Where Did Your Dinner Come From?

1. Across the top of a sheet of paper, list the different types of foods you ate for dinner last night.
2. Under each item, write the name of the plant, animal, or other organism that was the source of that food. Some foods have more than one source. For example, macaroni and cheese contains flour (which is made from a plant such as wheat) and cheese (which comes from an animal).

Think It Over

Classifying How many of your food sources were plants? How many were animals?

Do you play an instrument in your school band? If so, you know that each instrument has a role in a piece of music. For instance, the flute may provide the melody while the drum provides the beat.

Just like the instruments in a band, each organism has a role in the movement of energy through its ecosystem. A bluebird's role, for example, is different from that of the giant oak tree where it is perched. But all parts of the ecosystem, like all parts of a band, are necessary for the ecosystem to work.

Energy Roles

An organism's energy role is determined by how it obtains energy and how it interacts with other organisms. **Each of the organisms in an ecosystem fills the energy role of producer, consumer, or decomposer.**

Producers Energy enters most ecosystems as sunlight. Some organisms, such as plants, algae, and some bacteria, capture the energy of sunlight and store it as food energy. These organisms use the sun's energy to turn water and carbon dioxide into food molecules in a process called photosynthesis.

An organism that can make its own food is a **producer**. Producers are the source of all the food in an ecosystem. In a few ecosystems, producers obtain energy from a source other than sunlight. One such ecosystem is found in rocks deep beneath the ground. How is energy brought into this ecosystem? Certain bacteria in this ecosystem produce their own food using the energy in a gas, hydrogen sulfide, that is found in their environment.

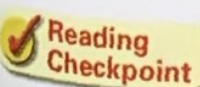
Consumers Some members of an ecosystem cannot make their own food. An organism that obtains energy by feeding on other organisms is a **consumer**.

Consumers are classified by what they eat. Consumers that eat only plants are **herbivores**. Familiar herbivores are caterpillars and deer. Consumers that eat only animals are **carnivores**. Lions and spiders are some examples of carnivores. Consumers that eat both plants and animals are **omnivores**. Crows, bears, and most humans are omnivores.

Some carnivores are scavengers. A **scavenger** is a carnivore that feeds on the bodies of dead organisms. Scavengers include catfish and vultures.

Decomposers If an ecosystem had only producers and consumers, the raw materials of life would stay locked up in wastes and the bodies of dead organisms. Luckily, there are organisms in ecosystems that prevent this problem. **Decomposers** break down wastes and dead organisms and return the raw materials to the ecosystem.

You can think of decomposers as nature's recyclers. While obtaining energy for their own needs, decomposers return simple molecules to the environment. These molecules can be used again by other organisms. Mushrooms and bacteria are common decomposers.



What do herbivores and carnivores have in common?



Consumer—Herbivore

Producer



Consumer—Omnivore



Decomposer

FIGURE 1

Energy Roles

Each organism in an ecosystem fills a specific energy role. Producers, such as oak trees, make their own food. Consumers, such as luna moth larvae and eastern bluebirds, obtain energy by feeding on other organisms. **Classifying** What role do decomposers play in ecosystems?

Food Chains and Food Webs

As you have read, energy enters most ecosystems as sunlight and is converted into food molecules by producers. This energy is transferred to each organism that eats a producer, and then to other organisms that feed on these consumers. **The movement of energy through an ecosystem can be shown in diagrams called food chains and food webs.**

Food Chains A **food chain** is a series of events in which one organism eats another and obtains energy. You can follow one food chain in Figure 2. The first organism in a food chain is always a producer, such as the tree. The second organism feeds on the producer and is called a first-level consumer. The termite is a first-level consumer. Next, a second-level consumer eats the first-level consumer. The second-level consumer in this example is the woodpecker.

Food Webs A food chain shows only one possible path along which energy can move through an ecosystem. But just as you do not eat the same thing every day, neither do most other organisms. Most producers and consumers are part of many food chains. A more realistic way to show the flow of energy through an ecosystem is a food web. As shown in Figure 2, a **food web** consists of the many overlapping food chains in an ecosystem.

In Figure 2, you can trace the many food chains in a woodland ecosystem. Note that an organism may play more than one role in an ecosystem. For example, an omnivore such as the mouse is a first-level consumer when it eats grass. But when the mouse eats a grasshopper, it is a second-level consumer.

Just as food chains overlap and connect, food webs interconnect as well. While a gull might eat a fish at the ocean, it might also eat a mouse at a landfill. The gull, then, is part of two food webs—an ocean food web and a land food web. All the world's food webs interconnect in what can be thought of as a global food web.

Food Chain

Woodpecker



Carpenter ant



Tree

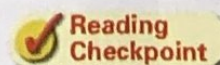
Lab zone Try This Activity

Weaving a Food Web

This activity shows how the organisms in a food web are interconnected.

1. Your teacher will assign you a role in the food web.
2. Hold one end of each of several pieces of yarn in your hand. Give the other ends of your yarn to the other organisms to which your organism is linked.
3. Your teacher will now eliminate an organism. All the organisms connected to the missing organism should drop the yarn that connects them.

Making Models How many organisms were affected by the removal of just one organism? What does this activity show about the importance of each organism in a food web?

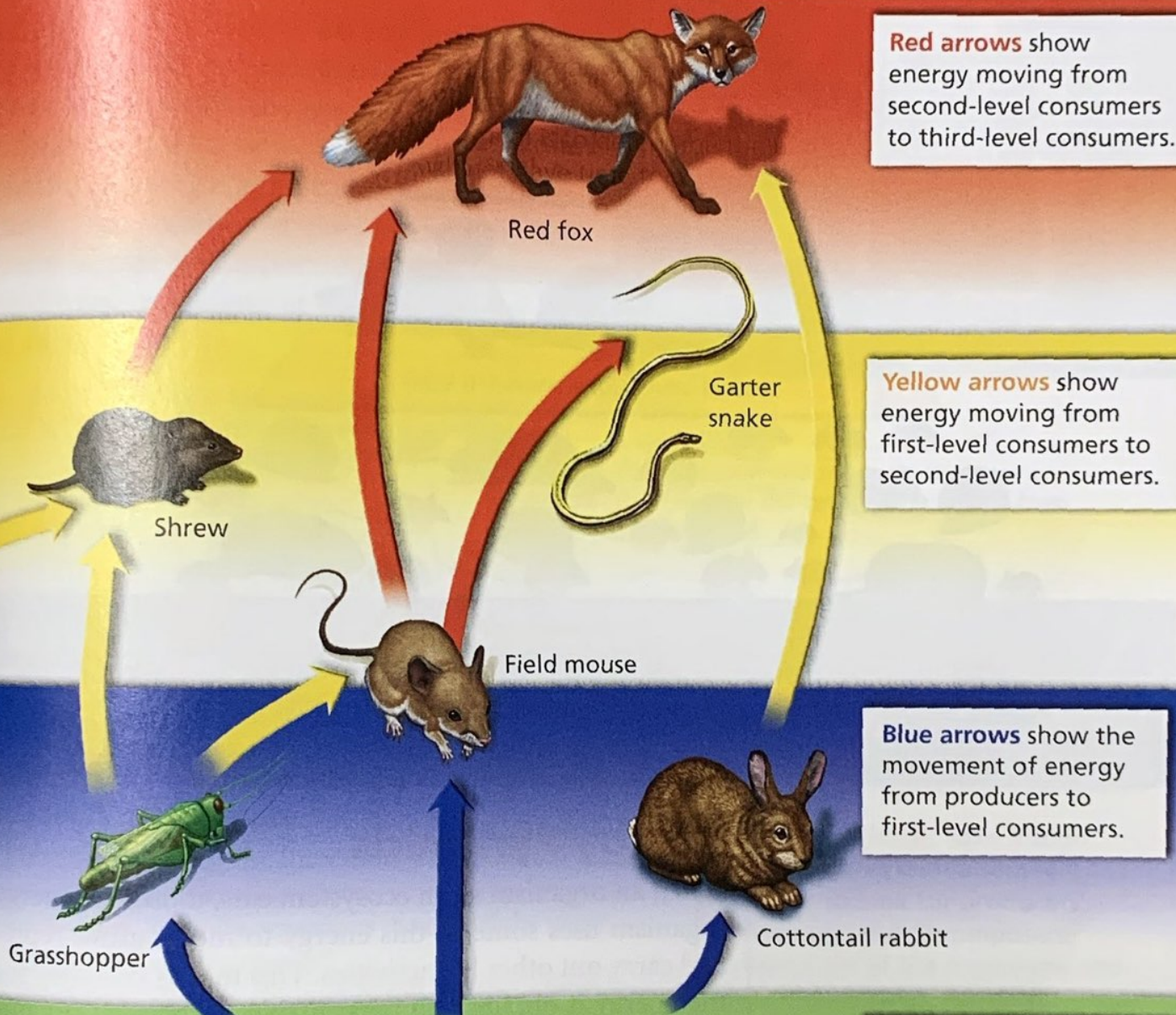


Reading Checkpoint

What energy role is filled by the first organism in a food chain?

FIGURE 2
A Food Web

A food web consists of many interconnected food chains. Trace the path of energy through the producers, consumers, and decomposers. **Interpreting Diagrams** Which organisms in the food web are acting as herbivores? Which are carnivores?



Red arrows show energy moving from second-level consumers to third-level consumers.

Yellow arrows show energy moving from first-level consumers to second-level consumers.

Blue arrows show the movement of energy from producers to first-level consumers.

Producers form the base of the food web.



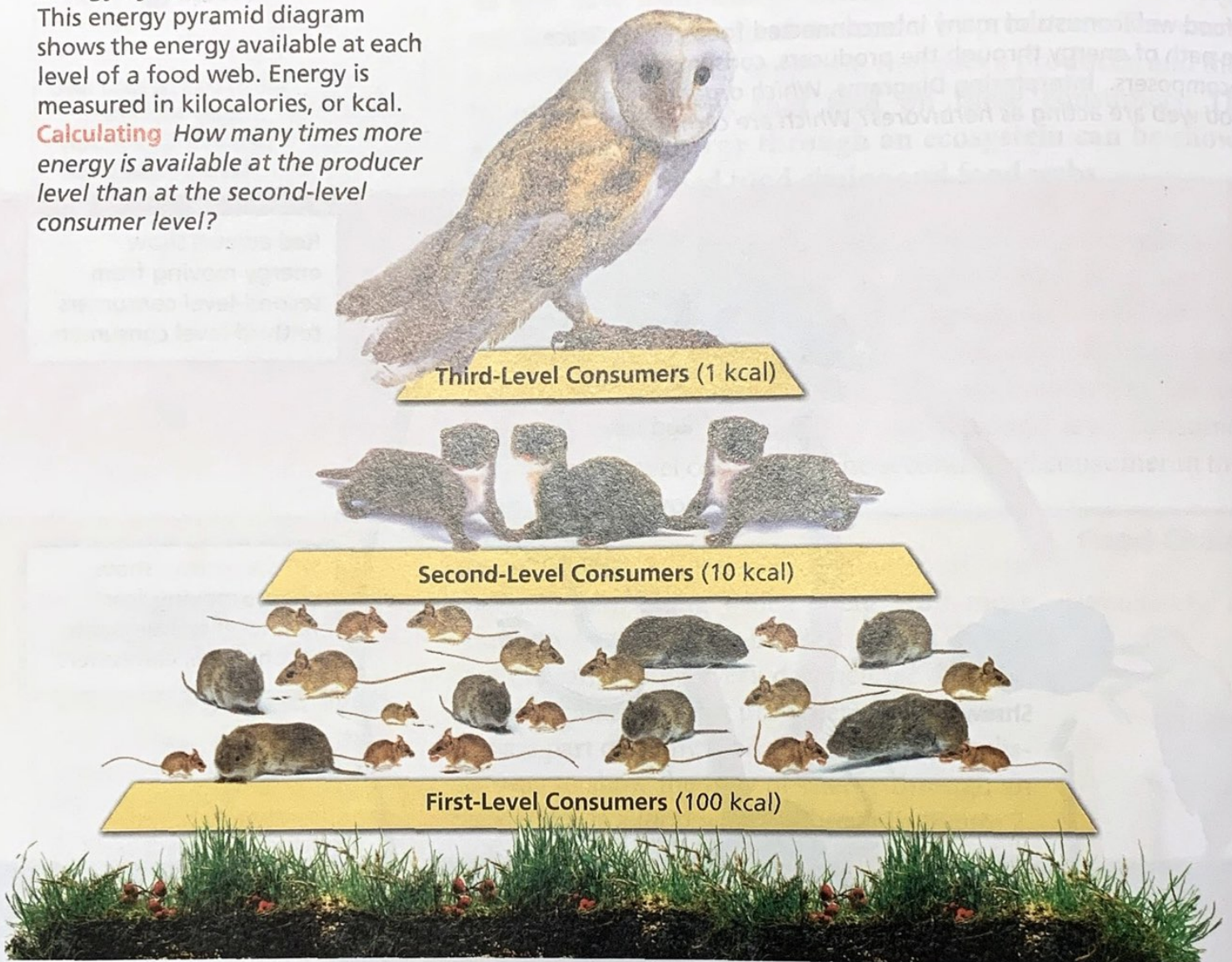
Decomposers consume the wastes and remains of other organisms.

FIGURE 3

Energy Pyramid

This energy pyramid diagram shows the energy available at each level of a food web. Energy is measured in kilocalories, or kcal.

Calculating How many times more energy is available at the producer level than at the second-level consumer level?



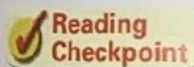
Energy Pyramids

When an organism in an ecosystem eats, it obtains energy. The organism uses some of this energy to move, grow, reproduce, and carry out other life activities. This means that only some of the energy it obtains will be available to the next organism in the food web.

A diagram called an **energy pyramid** shows the amount of energy that moves from one feeding level to another in a food web. You can see an energy pyramid in Figure 3. **The most energy is available at the producer level of the pyramid. As you move up the pyramid, each level has less energy available than the level below.** An energy pyramid gets its name from the shape of the diagram—wider at the base and narrower at the top.

In general, only about 10 percent of the energy at one level of a food web is transferred to the next higher level. The other 90 percent of the energy is used for the organism's life processes or is lost to the environment as heat. Since about 90 percent of the energy is lost at each step, there is not enough energy to support many feeding levels in an ecosystem.

The organisms at higher feeding levels of an energy pyramid do not necessarily require less energy to live than do the organisms at lower levels. Since so much energy is lost at each level, the amount of energy available at the producer level limits the number of consumers that the ecosystem is able to support. As a result, there are usually few organisms at the highest level in a food web.



Why is the pyramid shape useful for showing the energy available at each of the levels of a food web?



FIGURE 4
Energy Flow
This barn owl will soon use the energy contained in the rat to carry out its own life processes.

Section 1 Assessment

Target Reading Skill Building Vocabulary Use your definitions to help answer the questions below.

Reviewing Key Concepts

- a. **Identifying** Name the three energy roles that organisms fill in an ecosystem.

b. **Explaining** How do organisms in each of the three energy roles obtain energy?

c. **Classifying** Identify the energy roles of the following organisms in a pond ecosystem: tadpole, algae, heron.
- a. **Defining** What is a food chain? What is a food web?

b. **Comparing and Contrasting** Why is a food web a more realistic way of portraying an ecosystem than is a food chain?
- a. **Reviewing** What does an energy pyramid show?

b. **Describing** How does the amount of energy available at one level of an energy pyramid compare to the amount of energy available at the next level up?

c. **Relating Cause and Effect** Why are there usually few organisms at the top of an energy pyramid?

Lab zone

At-Home Activity

Energy-Role Walk Take a short walk outdoors with a family member to look for producers, consumers, and decomposers. Create a list of the organisms and their energy roles. For each consumer, try to classify it further according to what it eats and its level. Then explain to your family member how energy flows in ecosystems.