

13.3 Energy in Ecosystems

VOCABULARY

producer
autotroph
consumer
heterotroph
chemosynthesis

KEY CONCEPT Life in an ecosystem requires a source of energy.

MAIN IDEAS

- Producers provide energy for other organisms in an ecosystem.
- Almost all producers obtain energy from sunlight.

Connect to Your World

You play an important role in the cycling of energy on Earth, as do the plants and animals you eat. This energy that cycles through Earth's ecosystems is needed to fuel your life processes, such as breathing and growing. Where does this energy come from, and what role does it play in an ecosystem?

MAIN IDEA

Producers provide energy for other organisms in an ecosystem.

All organisms must have a source of energy in order to survive. However, not all organisms obtain their energy by eating other organisms.

- Producers** are organisms that get their energy from nonliving resources, meaning they make their own food. Their distribution is shown in **FIGURE 3.1**. Producers are also called **autotrophs** (AW-tuh-TRAHFS). In the word *autotroph*, the suffix *-troph* comes from a Greek word meaning “nourishment.” The prefix *auto-* means “self.”
- Consumers** are organisms that get their energy by eating other living or once-living resources, such as plants and animals. Consumers are also called **heterotrophs** (HEHT-uh-uh-TRAHFS). In the word *heterotroph*, the prefix *hetero-* means “different.”

All ecosystems depend on producers, because they provide the basis for the ecosystem's energy. Even animals that eat only meat rely on producers. One such species is the gray wolf. Gray wolves are consumers that eat elk and moose. Elk and moose are consumers that eat plants, such as grasses and shrubs. Plants are producers that make their own food. If the grasses and shrubs disappeared, the elk and moose would either have to find some other producer to eat or they would starve. The wolves would also be affected because they eat elk and moose. Although the wolves do not eat plants, their lives are tied to the grasses and shrubs that feed their prey. Likewise, all consumers are connected in some way to producers.

Most producers need sunlight to make food. These producers depend directly on the sun as their source of energy. For this reason, all the consumers connected to these producers depend indirectly on the sun for their energy.

Predict How would a long-term drought affect producers and consumers?

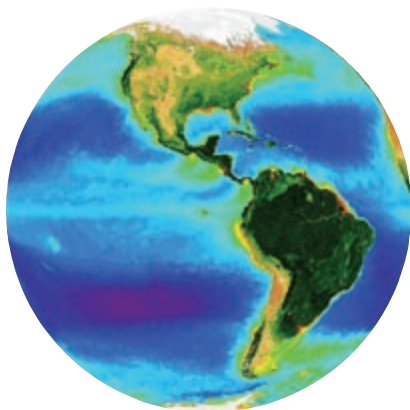


FIGURE 3.1 This satellite image uses chlorophyll abundance to show the distribution of producers in the Western Hemisphere. Dark green areas are heavily forested, while yellow areas have limited vegetation.

▶ MAIN IDEA

Almost all producers obtain energy from sunlight.

Most producers on Earth use sunlight as their energy source. Photosynthesis is the two-stage process that green plants, cyanobacteria, and some protists use to produce energy. Chemical reactions form carbohydrates from carbon dioxide and water. Oxygen is released as a waste product.

Photosynthesis in plants begins when energy from the Sun hits chloroplasts and is absorbed by chlorophyll. In the first stage of photosynthesis, energy from sunlight is converted to chemical energy. In the second stage, this chemical energy is used to change carbon dioxide into carbohydrates, such as glucose. Plants use these carbohydrates as an energy source to fuel cellular respiration.

Not all producers depend on sunlight for their energy. Scientists were stunned in 1977 when they first visited deep-sea vents on the bottom of the ocean. There they found thriving ecosystems in places where super-heated water shoots up from the ocean floor. Studies showed that tiny prokaryotes were making their own food from minerals in the water. They had no need for sunlight.

Chemosynthesis (KEE-moh-SIHN-thih-sihs) is the process by which an organism forms carbohydrates using chemicals, rather than light, as an energy source. A series of reactions changes the chemicals into a usable energy form. Different reactions occur depending on which chemicals are present.

In addition to deep-sea vents, chemosynthetic organisms are also found in sulfur-rich salt marsh flats and in hydrothermal pools, such as those in Yellowstone National Park, shown in **FIGURE 3.2**. In this case, chemical energy is used to change carbon dioxide (CO_2), water (H_2O), hydrogen sulfide (H_2S), and oxygen (O_2) into an energy-rich sugar molecule. Sulfuric acid (H_2SO_4) is released as a waste product.

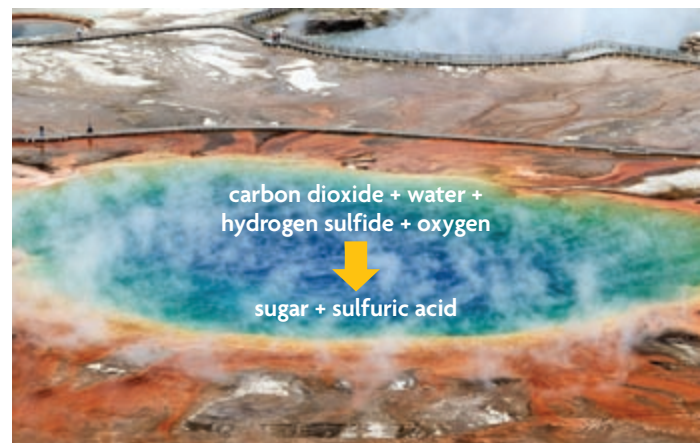


FIGURE 3.2 Chemosynthetic bacteria thrive in many of Yellowstone National Park's hydrothermal pools.

Contrast How do photosynthesis and chemosynthesis differ?

©Dennis Frates/Alamy

13.3 Formative Assessment

REVIEWING ▶ MAIN IDEAS

1. How does the stability of an ecosystem depend on its **producers**?
2. What are the two processes used by producers to obtain energy?

CRITICAL THINKING

3. **Hypothesize** Few producers live deep below a lake's surface. Suggest an explanation for this pattern.
4. **Infer** Could producers survive without **consumers**? Explain why or why not.



SELF-CHECK Online
HMDSscience.com

PREMIUM CONTENT

CONNECT TO

HISTORY OF LIFE

5. How might chemosynthetic organisms help scientists to understand how life developed on Earth?