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CHAPTER 36 Ecosystems and Conservation Biology

Summary of Key Concepts

Concept 36.1 Feeding relationships determine the path of energy and chemicals in ecosystems. (pp. 788–791)

Energy flow through ecosystems begins with producers. *Producers* are generally photosynthetic organisms such as plants that convert light energy from sunlight to the chemical energy of organic compounds. Producers also include chemoautotrophs, prokaryotes that extract energy from inorganic compounds. Organisms called *consumers* obtain chemical energy by feeding on producers or on other consumers. Organisms called *decomposers* obtain energy by breaking down wastes and dead organisms. As organisms use chemical energy, they release thermal energy (heat). Thus, energy enters most ecosystems as sunlight and exits ecosystems as heat. In contrast, chemicals can be recycled between the living and nonliving parts of ecosystems and the biosphere.

Both energy and chemicals move from one organism to the next as organisms feed. Each of the feeding organisms represents a *trophic level* in the ecosystem. The pathway of food transfer from one trophic level to another is called a *food chain.* In all food chains, producers make up the trophic level that supports all other levels. A consumer that eats only producers is an *herbivore.* A consumer that eats only other consumers is a *carnivore.* A consumer that eats both producers and consumers is an *omnivore.* When a consumer feeds directly on producers it is called a *primary consumer. Secondary consumers* eat primary consumers. *Tertiary consumers* eat secondary consumers. Decomposers are consumers that feed on *detritus,* the wastes and remains of dead organisms. Consumers usually have many food sources. The pattern made by interconnected and branching food chains is a *food web*.

1. How is the flow of energy through ecosystems different from the flow of chemicals through ecosystems? _____

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2. How is a food web different from a food chain? _____

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Concept 36.2 Energy flows through ecosystems. (pp. 792–794)

Because there is a limited amount of energy in an ecosystem, energy is divided among the different trophic levels. This energy "budget" influences the types and numbers of organisms in an ecosystem. The producers store chemical energy in organic material, or *biomass.* The rate at which producers in an ecosystem build biomass is called *primary productivity.* Primary productivity determines the maximum amount of energy available to the higher trophic levels in an ecosystem. Energy is "spent" at each step in a food web.

Ecologists use three types of diagrams to depict information about energy, biomass, and number of organisms at different trophic levels. An *energy pyramid* depicts the energy loss from one trophic level to the next. In general, an average of only 10 percent of available energy at a trophic level is

converted to biomass at the next higher trophic level. A *biomass pyramid* depicts the actual biomass (dry mass of all organisms) in each trophic level. A *pyramid of numbers* depicts the number of individual in each trophic level.

3. How is primary productivity related to biomass? _____

_____

4. What does each type of ecological pyramid depict? _____

_____

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Concept 36.3 Chemicals cycle in ecosystems. (pp. 795–798)

Chemical cycles typically involve three general steps. First, producers use chemicals from the nonliving environment to make organic compounds. Second, as consumers feed on producers, they take chemicals into their bodies and release some back into the environment as waste. Third, decomposers break down dead organisms, returning inorganic chemicals to the soil, water, and air. Producers can then use these chemicals to make organic compounds, continuing the cycle.

In the carbon and oxygen cycle, producers use carbon dioxide in the air or water and release oxygen as they make organic compounds through photosynthesis. Consumers, which eat the organic compounds, use oxygen and release carbon dioxide during cellular respiration. In the nitrogen cycle, certain types of bacteria convert nitrogen gas in the air to ammonia through a process called *nitrogen fixation.* These bacteria live in the soil and on the roots of certain plants. In soil, the ammonia forms ammonium. Other soil bacteria then convert ammonium to nitrates in a process called *nitrification.* Ammonium and nitrates move through the food webs, and nitrogen gas is eventually released back into the air. In the water cycle, three major processes move water between the land, bodies of water, and the atmosphere: evaporation, condensation, and precipitation (rain, snow, hail, and sleet). A large amount of water exits plants during *transpiration,* evaporation from a plant's leaves.

5. How are bacteria involved in the nitrogen cycle? _____

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_____

6. What are the three major processes that move water through the water cycle? _____

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Concept 36.4 Human activities can alter ecosystems. (pp. 799–804)

Human activities can greatly affect chemical cycles. For example, the burning of fossil fuels adds carbon dioxide to the atmosphere. The carbon cycle is also affected by *deforestation,* the clearing of forests for agriculture, lumber, and other uses. Deforestation clears away plants that absorb carbon dioxide during photosynthesis. The burning of trees during deforestation releases carbon dioxide into the atmosphere. Gases such as carbon dioxide trap the sun's heat in the atmosphere through a process called the *greenhouse effect.* As levels of carbon dioxide in the atmosphere rise, more heat is trapped, and the average temperature rises. Such an overall rise in Earth's average temperature is called *global warming.*

Human activities impact the nitrogen cycle mostly by moving large amounts of nitrogen compounds into the water or air. For example, fertilizers applied to crops are one source of nitrogen compounds in water. High levels of nitrogen in water can cause the rapid growth of algae, a condition called *eutrophication.* Bacteria that decompose the algae use so much oxygen that there is not enough oxygen left for other organisms to live. Other human activities, such as driving cars, release nitrogen and sulfur compounds into the atmosphere. These compounds form acids with the water vapor in the atmosphere. The precipitation that carries these acids back to Earth's surface is called *acid rain.* Acid rain causes damage to the environment.

Human activities can also impact the water cycle. For example, humans can use water faster than the water cycle can replace it, causing rivers and underground water sources to run dry.

The addition of substances to the environment that result in a negative effect is called *pollution.* Pollution can affect food chains. For example, pollutants become more concentrated from one trophic level to the next in a food web in a process called *biological magnification.* Pollutants can also affect the atmosphere. For example, some pollution affects a gas called *ozone* (O_3), which absorbs ultraviolet light. The result is damage to the ozone layer, a region high above Earth's surface that shields organisms from the sun's damaging effects.

7. How does deforestation affect the carbon cycle? _____

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8. How does pollution cause acid rain? _____

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Concept 36.5 Conservation biology can slow the loss of biodiversity. (pp. 805–809)

Biodiversity is the variety of life on Earth. Biodiversity includes the genetic variety among individuals in a species, the number of species in an ecosystem, and the variety of ecosystems in the biosphere. One reason that biodiversity matters is that many of the species in an ecosystem are interconnected. If a key species disappears, the health of the whole ecosystem may be affected. There is currently a period of mass extinction taking place on Earth. The main factors causing this threat to biodiversity are pollution, habitat destruction, introduced species, and overexploitation. *Overexploitation* is the practice of harvesting or hunting to such a degree that few remaining individuals may not be able to reproduce the population. The field of *conservation biology* uses knowledge of biology to counter the loss of biodiversity.

Conservation biologists often focus on "hot spots," small geographic areas with large numbers of species. They also try to understand an organism's habitat and try to find a balance in the demands for resources. One way for nations to protect ecosystems is to establish *zoned reserves,* undisturbed areas of land that are surrounded by *buffer zones,* areas with little human impact. Many nations and private foundations are working toward a goal of *sustainable development*—developing natural resources so that they can renew themselves and be available for the future.

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9. What is one reason biodiversity is important? _____

_____

10. How does overexploitation threaten biodiversity? _____

_____

11. What are four approaches conservation biologists use in conserving biodiversity? _____

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Reading Skills Practice

Interpreting illustrations By looking carefully at illustrations in textbooks, you can help yourself better understand what you have read. Look carefully at Figure 36-3 on page 790. On a separate sheet of paper, write a paragraph that explains the main ideas that the illustration communicates.

Vocabulary Review and Reinforcement

In 1–5, write the letter of the correct definition on the line next to each term.

_____ **1.** trophic level

_____ **2.** zoned reserve

_____ **3.** greenhouse effect

_____ **4.** biological magnification

_____ **5.** global warming

a. process by which atmospheric gases trap heat

b. overall rise in Earth's average temperature

c. feeding level in an ecosystem

d. area of land that is relatively undisturbed

e. process by which pollutants become more concentrated in successive trophic levels

WordWise

Complete the sentences by using one of the scrambled Key Terms below.

noasariptnirt dttrsiue tituonpicaorhe rvnmoioe
posmeocred deritisyvoib zenoo

1. Wastes and remains of dead organisms are called _____.

2. A(n) _____ is a consumer that eats both producers and consumers.

3. A layer of gas called the _____ layer shields organisms from the damaging effects of ultraviolet radiation.

4. The rapid growth of algae in bodies of water produces a condition called _____.

5. Evaporation from a plant's leaves is called _____.

6. The number of ecosystems in the biosphere is one way to measure _____.

7. A(n) _____ breaks down wastes and dead organisms.