The Organization of Life

CHAPTER 4

READING WARM-UP

Before you read this chapter, take a few minutes to answer the following questions in your ***EcoLog.***

1. What is an ecosystem? Give two examples of ecosystems.
2. How is antibiotic resistance related to evolution?

A coral reef is an ecosystem that contains a wide variety of species. How many different species can you find in this photograph?

SECTION 1

Ecosystems: Everything Is Connected

You may have heard the concept that in nature everything is connected. What does this mean? Consider the following example. In 1995, scientists interested in controlling gypsy moths, which kill oak trees, performed an experiment. The scientists removed most mice, which eat young gypsy moths, from selected plots of oak forest. The number of young gypsy moth eggs and young increased dramatically. The scientists then added acorns to the plots. Mice eat acorns. The number of mice soon increased, and the number of gypsy moths declined as the mice ate them as well.

This result showed that large acorn crops can suppress gypsy moth outbreaks. Interestingly, the acorns also attracted deer, which carried ticks. Young ticks soon infested the mice. Wild mice carry the organism that causes Lyme disease. Ticks can pick up the organism when they bite mice. Then the ticks can bite and infect humans. This example shows that in nature, things that we would never think were connected—mice, acorns, ticks, and humans—can be linked to each other in a complex web.

Objectives

- Distinguish between the biotic and abiotic factors in an ecosystem.
- Describe how a population differs from a species.
- Explain how habitats are important for organisms.

Key Terms

ecosystem
biotic factor
abiotic factor
organism
species
population
community
habitat

Defining an Ecosystem

The mice, deer, moths, oak trees, and ticks in the previous example are all part of the same ecosystem. An **ecosystem** (EE koh SIS tuhm) is all of the organisms living in an area together with their physical environment. An oak forest is an ecosystem. The coral reef on the opposite page is an ecosystem. Even a vacant lot, as shown in **Figure 1,** is an ecosystem.

Figure 1 ▶ This vacant lot is actually a small ecosystem. It includes various organisms, including plants and insects, as well as soil, air, and sunlight.

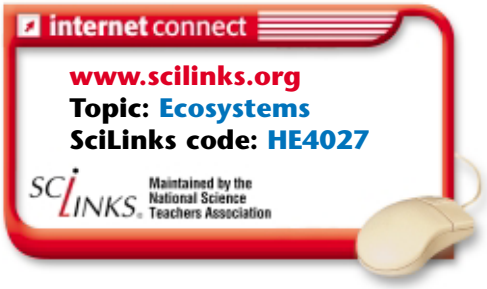


Figure 2 ▶ Like all ecosystems, this desert in France contains certain basic components. What components can you identify?

Geofact

The Living Soil Soil, which is part of nearly all ecosystems on land, is formed in part by living organisms, which break down dead leaves and organisms. Small, plantlike organisms even help break down rocks!

Figure 3 ▶ This caribou is a biotic factor in a cold, northern ecosystem in Denali National Park, Alaska.

Ecosystems Are Connected People often think of ecosystems as isolated from each other, but ecosystems do not have clear boundaries. Things move from one ecosystem into another. Soil washes from a mountain into a lake, birds migrate from Michigan to Mexico, and pollen blows from a forest into a field.

The Components of an Ecosystem

In order to survive, ecosystems need at least five basic components. These include energy, mineral nutrients, water, oxygen, and living organisms. As shown in **Figure 2**, plants and rock are two of the most obvious components of most land ecosystems. The energy in most ecosystems comes from the sun.

To appreciate how all of the things in an ecosystem are connected, think about how a car works. The engine alone is made up of hundreds of parts that all work together. If even one part breaks, the car might not run. Likewise, if one part of an ecosystem is destroyed or changes, the entire system may be affected.

Biotic and Abiotic Factors An ecosystem is made up of both living and nonliving things. **Biotic factors** are the living and once living parts of an ecosystem, including all of the plants and animals. Biotic factors include dead organisms, dead parts of organisms, such as leaves, and the organisms' waste products. The biotic parts of an ecosystem interact with each other in various ways. They also interact with the **abiotic** (ay bie AHT ik) **factors,** the nonliving parts of the ecosystem. Abiotic factors include air, water, rocks, sand, light, and temperature. **Figure 3** shows several biotic and abiotic factors in an Alaskan ecosystem.

Scientists organize living things into various levels. **Figure 4** shows how an ecosystem fits into the organization of living things. The illustration shows the different levels of ecological organization, from the individual organism to the biosphere.

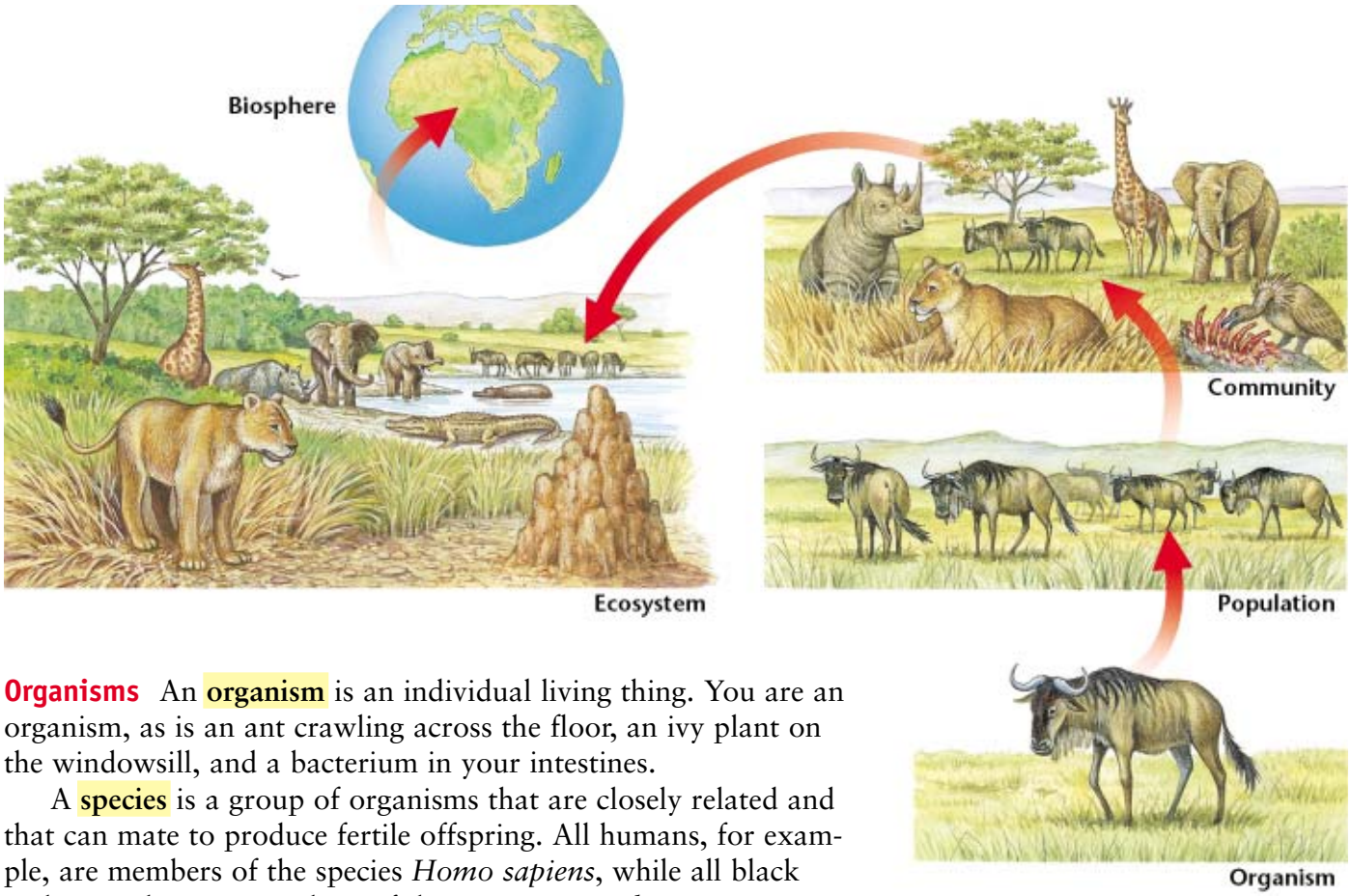


Figure 4 ▶ An individual organism is part of a population, a community, an ecosystem, and the biosphere.

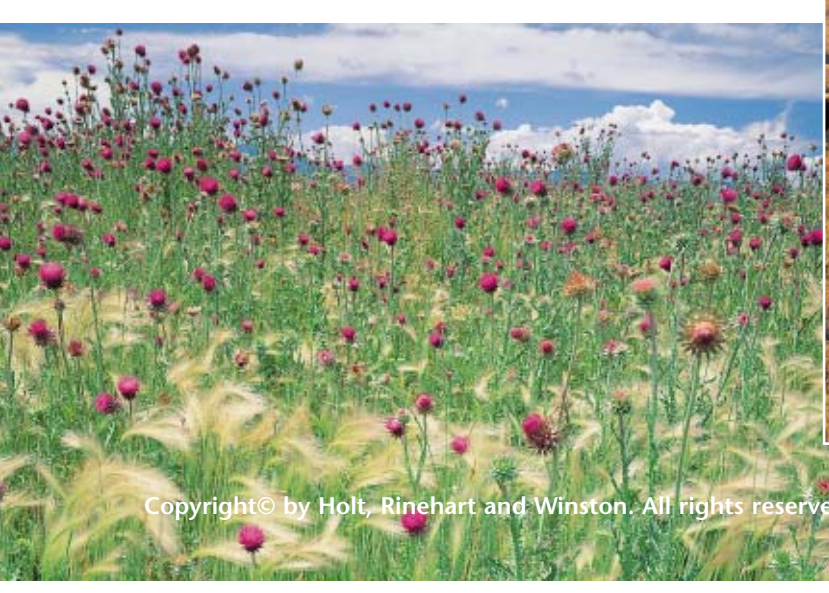
Organisms An **organism** is an individual living thing. You are an organism, as is an ant crawling across the floor, an ivy plant on the windowsill, and a bacterium in your intestines.

A **species** is a group of organisms that are closely related and that can mate to produce fertile offspring. All humans, for example, are members of the species *Homo sapiens*, while all black widow spiders are members of the species *Latrodectus mactans*. Every organism is a member of a species.

Populations Members of a species may not all live in the same place. Field mice in Maine and field mice in Florida will never interact even though they are members of the same species. An organism lives as part of a population. A **population** is all the members of the same species that live in the same place at the same time. For example, all the field mice in a corn field make up one population of field mice.

An important characteristic of a population is that its members usually breed with one another rather than with members of other populations. The bison in **Figure 5** (right) will usually mate with another member of the same herd, just as the wildflowers (left) will usually be pollinated by other flowers in the same field.

Figure 5 ▶ The two populations shown here are a population of purple-flowered musk thistle (left) and a herd of bison (right).



Communities An organism does not live alone and neither does a population. Every population is part of a **community,** a group of various species that live in the same place and interact with each other. A pond community, for example, includes all of the populations of plants, fish, and insects that live in and around the pond. All of the living things in an ecosystem are members of the same community.

The most obvious difference between communities is the types of species they have. Land communities are often dominated by a few species of plants. In turn, these plants determine what other organisms live in that community. For example, the most obvious feature of a Colorado forest might be its ponderosa pine trees. This pine community will have animals, such as squirrels, that live in and feed on these trees.

Figure 6 ▶ Salamanders, such as this red backed salamander, live in habitats that are moist and shaded.

Habitat

The squirrel discussed above lives in a pine forest. All organisms live in particular places. The place an organism lives is called its **habitat.** A howler monkey's habitat is the rain forest, a cactus's habitat is a desert, and a waterlily's habitat is a pond. The salamander shown in **Figure 6** is in its natural habitat, the damp forest floor. An organism's habitat may be thought of as its "address."

Every habitat has specific characteristics that the organisms that live there need to survive. A coral reef contains sea water, coral, sunlight, and a wide variety of other organisms. If any of these factors change, then the habitat changes.

Organisms tend to be very well suited to their natural habitats. Indeed, animals and plants usually cannot survive for long periods of time away from their natural habitat. For example, a fish that lives in the crevices of a coral reef will die if the coral reef is destroyed.

SECTION 1 Review

1. **List** the abiotic and biotic components you see in the northern ecosystem in Figure 3.
2. **Describe** a population not mentioned in this section.
3. **Describe** which factors of an ecosystem are not part of a community.
4. **Explain** the difference between a population and a species.

CRITICAL THINKING

5. **Analyzing Relationships** Write your own definition of the term *community,* using the terms *biotic factors* and *abiotic factors.* WRITING SKILLS
6. **Understanding Concepts** Why might a scientist say that an animal is becoming rare because of habitat destruction?