

2.1

Biotic and Abiotic Factors in Ecosystems

Ecology is the study of how organisms interact with each other and with their physical environment. Ecologists collect information about living things, and then look for patterns to explain the observations. This is an enormous challenge because there is a tremendous variety of organisms and so many different relationships among them. It is for this reason that ecologists organize their study into several levels (Figure 1).

The first and simplest level of organization that ecologists study is a single living thing or **organism**. They study the behaviours, the functions, and the body structures that an organism has in order to survive in its **habitat**, or region in which it lives. For example, they might study how a sea otter captures food or how its body is specialized for the marine habitat. But most organisms do not live as isolated individuals. Usually organisms live as a **population** (the second level of organization), which is all of the organisms of the same species that share a habitat. Ecologists might study how the number of sea otters in the waters of coastal British Columbia changes over time. But populations interact with other populations of organisms.



Sounds like Greek to Me!

The word "ecology" comes from two Greek words: *oikos*, which means "house," and *logos* or "word," referring to study. So, ecology is literally the science of studying the place where something lives.

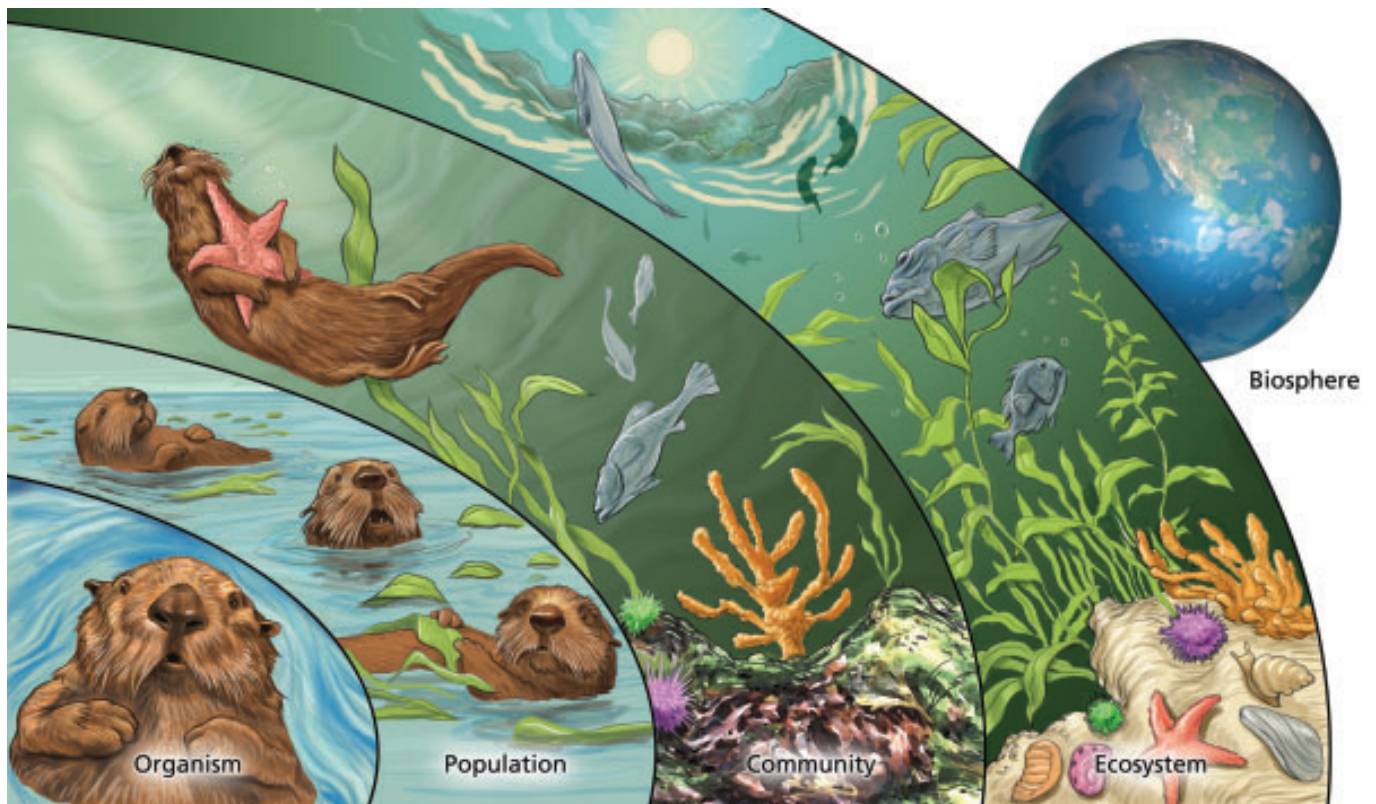


Figure 1 The study of ecology involves organisms, populations, communities, and ecosystems. The biosphere includes all of the ecosystems on Earth.

STUDY TIP •


Check your understanding. Are you able to recall the levels within the biosphere? If not, reread the main ideas and words in bold, and re-examine Figure 1, on page 21.

To learn more about the ecosystems found in British Columbia, go to

www.science.nelson.com



All of the different populations in a particular area interact, forming a **community**, which is the third level of organization. The community that lives within the kelp beds off the coast of British Columbia includes many populations of plants, fish, and invertebrates like sea urchins, sea stars, and sponges. At the community level, an ecologist might study how the number of sea urchins affects the number of sea otters in the kelp bed community. They are interested in ways that internal and external factors affect the size of the populations in a community.

An **ecosystem**, which is the fourth and most complex level of organization, includes the living community as well as the physical environment in which the organisms live. 

Factors such as the introduction of a new species or a temperature change would have a huge impact on the kelp bed community. An ecosystem is simply a convenient way to look at interactions between the living and the non-living things in an area. It is not defined by size or complexity. It could be as small as the spaces in a rotting log, or as big as the ocean. You could even think of Earth as one big ecosystem, but because of its complexity it is usually considered on a different level called the **biosphere**. The biosphere is the total area of Earth where living things are found, including the soil, atmosphere, and ocean.

TRY THIS: Make a Model Ecosystem

Skills Focus: conducting, recording, communicating, questioning, evaluating

In this activity, you will combine living and non-living factors to create your own ecosystem.

Materials: 3–4 L jar with lid, 250 g of sand or gravel, 4–5 aquatic snails, 2 small guppies, 4–5 aquatic plants



Handle glass products with care. Assemble the equipment where it will stand so that it does not need to be moved after being filled.

1. Place 2–3 cm of sand or gravel into a large jar.
 2. Fill the jar with tap water to within 5 cm of the top. Let it stand without the lid on for 48 h.
 3. Add the aquatic plants, snails, and guppies.
 4. Place the lid on the jar and seal tightly.
 5. Place the jar in an area where it can receive indirect sunlight for 1 week.
- A. What was the purpose of sealing your model ecosystem?
 - B. What is the source of carbon dioxide that the algae and plants require?
 - C. What is the source of oxygen that the fish and snails require?
 - D. How do the plants and animals get the necessary nutrients?
 - E. What would happen to the ecosystem if one of the fish died?

There are two types of environmental factors in an ecosystem, the living community and the physical environment. The living components of the ecosystem are called **biotic factors**. For example, in the kelp beds off the coast of British Columbia the biotic factors include the plants, fish, and invertebrates, as well as the complex interactions occurring between them. The non-living components, or **abiotic factors**, include the physical and chemical components in the environment. Some of the more significant

abiotic factors are temperature, wind, water, sunlight, and oxygen. The abiotic factors in the kelp beds would include (among others) the water temperature, the currents, and factors such as an oil spill.

Abiotic and biotic factors are connected to each other (Figure 2). As organisms live, they alter the environment around them, which in turn affects the organisms. This type of balance, where there is continuous change but the overall system remains stable, is called **dynamic equilibrium**. Ecosystems are normally able to adjust to small changes from within. The importance of abiotic factors cannot be emphasized enough. The difference in abiotic factors like climatic conditions and soil quality determines the distribution of life and contributes to diversity within the biosphere. **2A • Investigation**

Sometimes one factor, known as a **limiting factor**, is the most critical factor in determining the types of organisms that can exist in an ecosystem. For example, the large Douglas fir trees in our Pacific coastal forests grow only in regions with high annual rainfall. In aquatic environments, important limiting factors are sunlight, temperature, and the amount of dissolved oxygen in the water.

Did You KNOW?

Abiotic Technology

Many of the technologies you use everyday were invented in response to an existing abiotic factor. Furnaces, air conditioners, solar panels, and many other technologies are just a few of the adaptations humans have made in response to abiotic factors.

2A • Investigation •

The Effect of Abiotic Factors on a Yeast Population

To perform this investigation, turn to page 42.

In this investigation, you will investigate the effects of abiotic factors on populations.



(a)



(b)



(c)

Figure 2 Abiotic factors such as (a) frost and biotic factors such as (b) pests and (c) other organisms affect the growth of the biotic factors like crops.

TRY THIS: A Day at the Beach

Skills Focus: recording, communicating

Abiotic factors have a large impact on living things. In this activity, you will explore the biotic and abiotic factors that can influence a day of outdoor fun.

Materials: notebook or graphic organizer

1. Plan a great day at the beach. Make a list of all of the things you should consider in your planning.

- A. What abiotic factors should you consider?
- B. Identify biotic factors that might be a part of your day at the beach.
- C. How would these abiotic and biotic factors differ if you were planning a great day of skiing or snowboarding?

- Compare the following terms. Give both similarities and differences.
 - ecosystem and habitat
 - organism and population
 - biosphere and community
 - ecosystem and community
- What level of organization within the biosphere is represented by each of the following?
 - a herd of water buffalo
 - the plants and animals on the Serengeti plain of Africa
 - a lake and all of the organisms that live within it
 - a grizzly bear
 - sunflowers growing in a garden
- Which level of organization is being considered in each of the following ecological studies?
 - observing how the talons of a bald eagle are used to capture food
 - observing the migratory pattern of a flock of snow geese
 - observing the impact of a hazardous chemical spill on living things in a nearby stream
 - observing the nest-building behaviour of hummingbirds
 - observing the effect of fleas on the health of house pets
 - measuring the changes in oxygen levels of a small lake during periods of rapid plant growth
- Why is the science of ecology important?
- List at least three characteristics of ecosystems that make them challenging to understand in detail.

- Provide two other situations besides ecology in which it is helpful to use a classification system like the one developed by ecologists.
- The mouth of a dog or Earth itself could each be defined as entire ecosystems. What characteristics do they have in common that makes this similar classification appropriate?
- Use Figure 3 to answer the following questions:

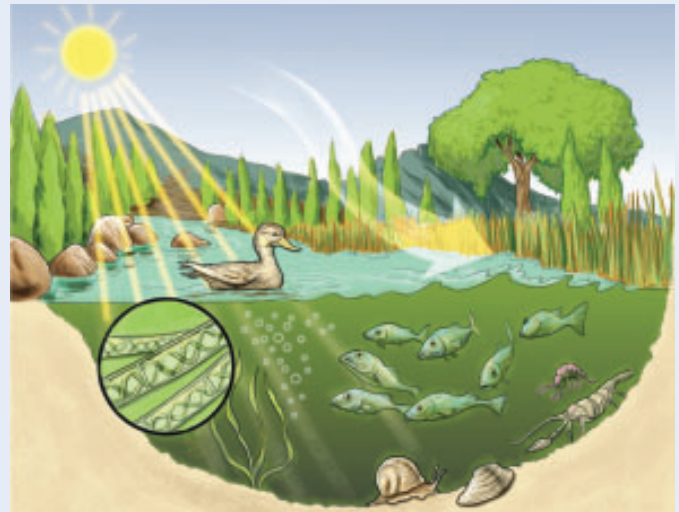


Figure 3

- Identify each of the following from the illustration. Explain your reasoning.
 - two biotic factors
 - two abiotic factors
 - a limiting factor
- Describe the relationship between the abiotic and biotic factors that you selected.
- Which abiotic factor could be altered to have the greatest effect on the ecosystem? Explain your reasoning.