

Introducing Ecosystems

Imagine you are planning a backpacking trip to Algonquin Park in Ontario (Figure 1). You intend to spend four days hiking through the wilderness. To be fully prepared, you must bring proper food, clothing, and equipment (Figure 2). You must also consider the living things you may encounter. Mosquitoes will be abundant, so you pack insect repellent. You will also need a water filter to provide safe drinking water. You know that bears and raccoons are a possibility, so you bring a long rope so that you can hang your food pack in a tree at night. You also pack a stove and matches, and, most importantly, a map and maybe a global positioning system (GPS). 🌐 🗺️

To learn more about hiking in Ontario,



GO TO NELSON SCIENCE

To learn more about becoming a park warden,



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Figure 1 Backpacking is a common summer activity.



Figure 2 During a backpacking trip, you must have appropriate equipment and supplies to survive in the environment.

ecosystem all the living organisms and their physical and chemical environment

biotic factors living things, their remains, and features, such as nests, associated with their activities

abiotic factors the non-living physical and chemical components of an ecosystem

Planning for such a trip reminds us of the many factors we encounter in any ecosystem. Scientists define an **ecosystem** as all of the living organisms that share a region and interact with each other and their non-living environment. An ecosystem is composed of both living and non-living components. Some factors, such as the terrain and the weather, are non-living. Other factors, such as insects, bears, and micro-organisms, are alive. The living components, called **biotic factors**, include all organisms, their remains, and their products or wastes. The non-living components, or **abiotic factors**, include physical and chemical components such as temperature, wind, water, minerals, and air.

Some materials, such as a hard coral reef, are not easy to classify. They are built by coral animals and are therefore biotic in origin. Over time, parts of the reef may break down, forming white coral sand, which is usually considered an abiotic factor.

Individual organisms from many species share an ecosystem. Together, all of the individuals of a single species in a particular area make a population. Individuals from all of the populations form the community. An ecosystem is the term given to the community and its interactions with the abiotic environment.

Figure 3 shows how ecosystems are composed of individual organisms, populations, communities, and the physical surroundings in which communities of organisms live.

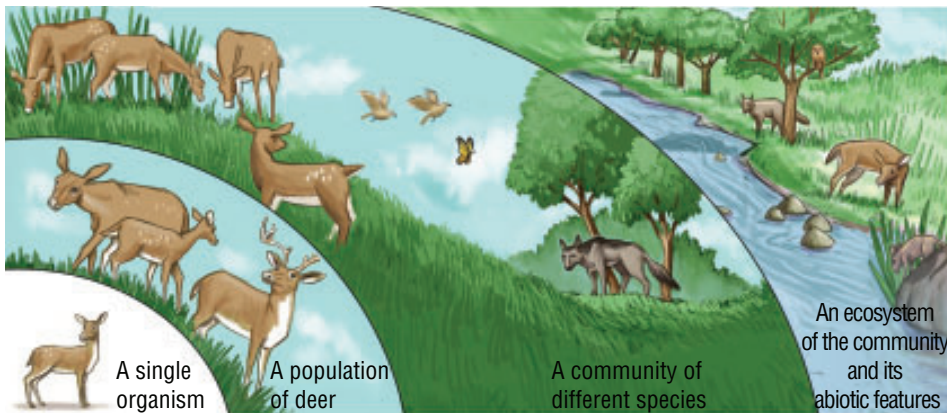


Figure 3 An ecosystem is composed of populations of plant and animal species and their biotic and abiotic environments.

TRY THIS ECOSYSTEM ABCs

SKILLS: Analyzing, Communicating

Everything we use and consume in our daily lives comes from the biotic and abiotic parts of our environment. In this activity, you will reflect on our dependence on the environment for the items we use every day.

1. Brainstorm a list of 20 diverse items you have used in the past week. Your list could include foods, fuel, consumer products, packaging materials, or even the sidewalk you walked on.
 2. Make a list of separate materials contained in each item. Do not worry if you cannot identify all the materials.
 3. Determine whether these materials are a biotic or an abiotic resource.
 4. Draw a Venn diagram of two overlapping circles with the headings “abiotic” and “biotic.” The overlapping region is for the combined (both abiotic and biotic) resources (Figure 4). Place each of your original items in your Venn diagram. For example, a CD case would be placed in the overlapping portion of the diagram. The paper liner is of biotic origin, while the plastic case is abiotic.
- A. Do you depend on both biotic and abiotic resources in your everyday life? Give examples to support your answer. **A**
- B. Do you think biotic or abiotic resources are more important for your survival? Explain. **T/I C**

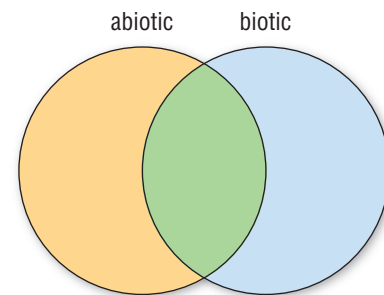


Figure 4 Sample Venn diagram

- C. The forestry and mining industries are major employers in Ontario. Identify which of your items were dependent on these two industries for their production. **T/I**
- D. Is it likely that either the forestry or mining industry will become obsolete? Explain. **T/I**
- E. All food items are biotic in nature. Describe how food items themselves are dependent on abiotic resources. **K/U**
- F. Based on this activity and the definition of an ecosystem, do you think the human species is part of Earth’s ecosystem? Explain your reasoning. **C A**

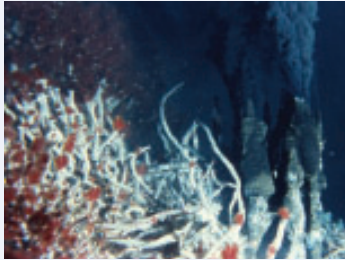
Describing Ecosystems

Ecosystems are highly variable. They can differ dramatically in size and in their biotic and abiotic features. We generally think of an ecosystem as a fairly large area, such as a forest or a lake. On a much smaller scale, the community of bacteria and fungi living in a rotting log is an ecosystem. In this way, large ecosystems may include many much smaller ecosystems.

DID YOU KNOW?





The Heat Is On!

Thermophiles live in extremely hot environments near undersea thermal vents. Water is ejected at extremely high pressure, and the temperature can exceed 100 °C. Thermal vents have their own unique ecosystem of bacteria, clams, mussels, and tube worms.



Whatever the size, every ecosystem is characterized by a distinctive set of features. For example, you could describe an ecosystem by its particular organisms, temperature range, or water depth (Table 1).

Table 1 Examples of Large and Small Ecosystems

Ecosystem	Characteristic abiotic features	Characteristic biotic features
coniferous forest 	<ul style="list-style-type: none"> • long, cold winter season • warm summers • moderate rainfall • much of the precipitation falls as snow • snow insulates and protects ground species 	<ul style="list-style-type: none"> • few species • dominated by black spruce forest and bogs • black bear, red squirrels, and moose • many biting flies • short growing season reduces ecosystem productivity
coral reef 	<ul style="list-style-type: none"> • water temperatures from 25–31 °C • water depth from 0–30 m • usually in tropical latitudes • sometimes used as a source of limestone 	<ul style="list-style-type: none"> • wide variety of marine life, including corals, sponges, and fishes • source of many valuable fish species • sensitive to changes in water temperature and chemistry
beaver pond 	<ul style="list-style-type: none"> • shallow water • water warm in summer and ice covered in winter • usually temporary, lasting years to decades • dams may break causing downstream flooding 	<ul style="list-style-type: none"> • variety of aquatic plants, fishes, frogs, turtles, insects, and beavers • surrounding forest used as food supply for beavers • flooding often kills trees that are then used by other species for food or shelter
rotting log 	<ul style="list-style-type: none"> • moist environment • low light • small, temporary ecosystem, lasting years to decades 	<ul style="list-style-type: none"> • variety of decomposing bacteria and fungi • beetles, larvae of various insects • provides cover for small vertebrates such as salamanders

Sustainability of Ecosystems

When we hear the word ecosystem, we tend to think about a natural, pristine environment where it is pleasant to hike, swim, or hang out. Most natural ecosystems are **sustainable**. This means that they maintain a relatively constant set of characteristics over a long period of time.

sustainable ecosystem an ecosystem that is maintained through natural processes

Human activities often change the biotic and abiotic features of an ecosystem. This can render a previously sustainable ecosystem unsustainable. **Sustainability** is the ability to maintain natural ecological conditions or processes without interruption, weakening, or loss of value. We will look at this in detail in Chapter 3.

sustainability the ability to maintain an ecological balance

Other ecosystems are artificially created and maintained by human actions. To create an artificial ecosystem, like an urban park or farm, desired plants and animals are introduced and maintained. Artificial ecosystems are not usually sustainable. They require management to maintain the biotic and abiotic features deemed desirable. We will consider artificial ecosystems in Chapter 4.

Like all species, humans are dramatically influenced by the biotic and abiotic features of the ecosystems that surround them. In northern Ontario, the economy is based on forestry, mining, and tourism. The economy in southern Ontario is based on agriculture and manufacturing. People living in northern environments are more likely to suffer from *seasonal affective disorder* (SAD) associated with low winter light levels. People living in large urban centres, however, are more likely to suffer from breathing problems linked to smog.

READING TIP

Text-to-Self Connections

Brainstorm text-to-self connections by jotting down everything that comes to mind when you think about the selection and your own experiences or those of relatives or friends. You can create a mind map to show the connections.

IN SUMMARY

- Ecosystems are characterized by their biotic and abiotic factors.
- Biotic factors are living components of an ecosystem. Abiotic factors are the non-living physical and chemical components.
- A population is all individuals of the same species living in an ecosystem.
- A community is all organisms living in the same ecosystem.
- Natural ecosystems are generally sustainable, whereas artificially created ecosystems must usually be managed.
- Surrounding ecosystems influence many aspects of our daily lives.

CHECK YOUR LEARNING

1. Classify each of the following as either biotic or abiotic features: temperature, bacteria, wind, sunlight, dead leaves, mosquitoes, sand, milk, hair, ice, plastic, an empty snail shell. **K/U**
2. Does a community include abiotic features? Explain. **K/U**
3. Which of the following are considered to be an ecosystem? Explain your reasoning. **K/U**
 - backyard pond
 - schoolyard
 - all the cats in your neighbourhood
 - vase of cut flowers
 - tree
 - potted plant
 - your digestive system
4. “Human activities change only the biotic features of an ecosystem.” Is this statement true or false? Explain why or why not. **K/U**
5. Would you consider a large city to be a population or a community? Explain your choice. **K/U**
6. This section describes categorizing all features of the world around us as either biotic or abiotic. Would you find these categories useful personally? Why do you think scientists use these terms? **A C**
7. In your day-to-day life, do you wonder about whether or not your actions are sustainable? Why is sustainability important in nature? Explain. **A C**