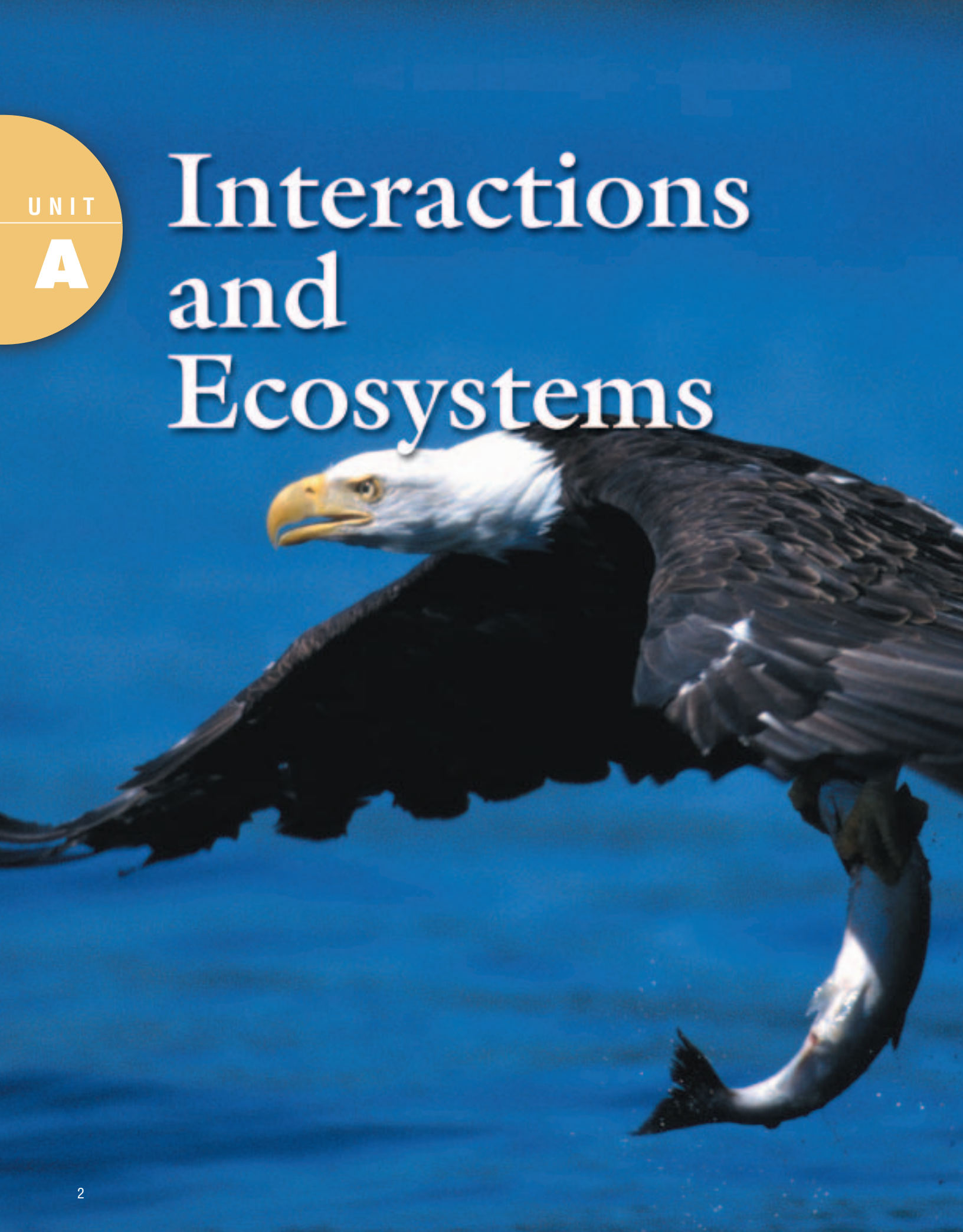
UNIT

A

Interactions and Ecosystems



In this unit, you will cover the following sections:

1.0 **Relationships exist between living things and their environments.**

- **1.1** Defining an Ecosystem and Learning about Basic Needs
- **1.2** Interactions among Living Things
- **1.3** Human Impacts on Ecosystems

2.0 **The flow of energy and the cycling of matter can be traced and interpreted in ecosystems.**

- **2.1** Ecosystems Have Interactions among Producers, Consumers, and Decomposers
- **2.2** Food Chains Demonstrate the Flow of Energy in Ecosystems
- **2.3** Food Webs
- **2.4** Matter Cycles in Ecosystems

3.0 **Changes can be observed and monitored in ecosystems.**

- **3.1** Investigating the Distribution of Living Things in an Environment
- **3.2** Interactions and Changes Occur in Ecosystems
- **3.3** Succession: How Ecosystems Change over Time

4.0 **Maintaining sustainable environments requires knowledge, decisions, and actions.**

- **4.1** There Are Intended and Unintended Consequences of Human Activities within Ecosystems
- **4.2** Information from Scientific Investigations Can Assist Environmental Decision-Making
- **4.3** There Are Limitations to Scientific and Technological Knowledge
- **4.4** Using Evidence from Many Sources Can Help Analyze a Local Environmental Problem

Exploring

Imagine you are out on a winter camping trip in northern Alberta. You see a wolf chasing a rabbit among the snow-covered trees. At that moment, you all have something in common. You are all part of an ecosystem. An **ecosystem** is an area where living things interact with other living and non-living things.

In this unit, you will find out how all living things are related and depend on each other. You will learn how ecosystems work and are maintained and why that is important for the well-being of Earth. You will discover how human actions can impact Earth in both positive and negative ways. In Alberta, a new wetland was created thanks to many concerned organizations and individuals.

Saving Frank Lake

Just east of the town of High River, in south-central Alberta, a wetland has been created. It is called Frank Lake. Thanks to Ducks Unlimited, a national non-profit conservation organization, what was once a shallow lake that disappeared in dry summers, is now a wetland which will have water all year.

Ducks Unlimited works to restore, improve, and/or preserve habitats that are critical for ducks and other migrating waterfowl. Alberta is home to 20% of all the ducks surveyed each spring in North America. The Frank Lake project is an important one since its location is a stopover spot for birds like ducks, geese, and shorebirds as they make their way north in spring and south in fall. It is also a breeding ground for many of these birds.

Frank Lake before it became a wetland

What human actions were needed to make Frank Lake a wetland? Finding a source of water was the key factor. This happened through a unique partnership between Ducks Unlimited and a local meat-packing plant.

Waste water from the meat-packing plant is treated and cleaned. The water is then piped from the town of High River to Frank Lake. Water levels and water quality are continually monitored at Frank Lake. During dry, hot years, more water can be piped into the lake. If there is a wet period, less water is required.

Now the water flows all year in Frank Lake, providing a habitat for amphibians, fish, and plants as well as rare birds like the peregrine falcon and trumpeter swan. It also provides a grazing area for the cattle of local farmers, and a rich wildlife viewing area for local naturalists. According to Jerry Brunen, an area manager for Ducks Unlimited, "Frank Lake is once again the most important wetland in southwestern Alberta."

Frank Lake, the new wetland

Give it a **TRY** **Activity**

Creating a Plan

Think about a natural area in your community that you enjoy. Work with a partner or small group to brainstorm ways that people might have a negative impact on this area. For example, too much litter in a park or too many people in an area can damage plants. Once you have identified three to five negative impacts, suggest some possible ways to reduce these impacts. Your suggestions can be creative, but make sure they can be done in a reasonable amount of time at a reasonable cost.

Select your best idea and be prepared to share it with the class.

Focus On

Social and Environmental Context

As you work through this unit, you will be asked to organize your thoughts about how society and environmental changes influence ecosystems. Many decisions regarding ecosystems involve a variety of perspectives. You will be asked to consider some of these perspectives as you perform certain activities and answer certain questions throughout this unit. As you work through this unit, think about the following questions:

1. **How do human activities affect ecosystems?**
2. **What methods can we use to observe and monitor changes in ecosystems?**
3. **How can we assess the impact of our actions on ecosystems?**

The answers to these and other questions about ecosystems will help you understand the role that science and technology has in monitoring and maintaining ecosystems, as well as the intended and unintended consequences of human activity, and the need for responsible decision-making and action. The project at the end of the unit allows you to apply your knowledge of how to balance the needs for human growth and development with the needs of an ecosystem.

1.0

Relationships exist between living things and their environments.

Key Concepts

In this section, you will learn about the following key concepts:

- interactions and interdependencies
- environmental monitoring
- environmental impacts
- environmental management

Learning Outcomes

When you have completed this section, you will be able to:

- define an ecosystem
- identify abiotic and biotic factors
- explain how basic needs are met in an ecosystem
- describe interactions among living things
- identify human impacts on ecosystems
- recognize that in order to make an informed decision about an environmental issue, scientific knowledge and exploration are involved

Imagine sitting quietly in a natural setting such as a field or on the side of a mountain. What sensations would you have? There certainly would be a wide variety of plants to look at. Would there be rocks, sand piles, and soil, too? Would you see animals moving around? What would you smell: flowers, pine needles, wet grass? Would you hear bird calls, the buzz of insects, rustling in the grass or bushes? The environment in which we live is composed of a wide variety of living and non-living things. In fact, your life—all life—depends on and is connected with other living things.

For Web links relating to 1.0, visit **www.pearsoned.ca/scienceinaction**

1.1 Defining an Ecosystem and Learning about Basic Needs

Any place on Earth where living things interact with other living and non-living things is called an **ecosystem**. The living things are called the **biotic** factors, or parts, of the ecosystem; the non-living things are called the **abiotic** factors. The "bio" part of the word comes from a Greek word that means *life*, and the "a" part means *not*, so biotic means living, and abiotic means not living.

Figure 1.1 A rotting log ecosystem

Ecosystems may be large, such as an ocean or desert. They may also be small, such as a puddle or a rotting log.

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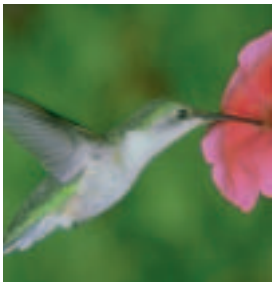
An Ecosystem?



Is this an example of an ecosystem?

Give it a **TRY** ACTIVITY

BIOTIC AND ABIOTIC FACTORS IN THE CLASSROOM

Look around your classroom. Try to find as many biotic (living) and abiotic (non-living) factors as possible. Work with a partner to make a table.

Compare your table with those of other pairs. Did you have similar tables? Add any missing factors to your table.

Your Schoolyard

Is your school located in the heart of a major city? Is it in the suburbs, or in a smaller city or town, or in the countryside? Regardless of where your school is located, it's probably surrounded by plants, soil, animals, rocks, and other living and non-living things including you and the people that go to your school. Some things may be big enough for you to notice easily. Others may be small enough for you to have missed. Until now.

Take a moment. Consider what living and non-living things make your schoolyard their home. Make a list of them. Now think about the relationships between the abiotic and biotic factors on your list. Describe the interactions among them.

Figure 1.2 Interactions between biotic and abiotic factors

Figure 1.3 What biotic and abiotic factors can you see in this photo?

The World within an Ecosystem

Earth contains many ecosystems. Each ecosystem contains a variety of different **species**. Living things of the same species are able to reproduce and have young that are also able to reproduce. The young usually look very similar to the parents. When a number of individuals from the same species live together in the same area, the group is called a **population**. All the populations of different species that live and interact in the same place form a **community**. An ecosystem could be considered the area where all the living and non-living things within a community interact.

Figure 1.4a) This ant is a member of one of many species of ants.

Figure 1.4b) All the ants of this species living together in one area form a population. Ants of the same species living in another area would form a separate population.

Figure 1.4c) This tree is a member of the species *Picea glauca.*

Figure 1.4d) All the trees of this species that grow in the same area form one population.

Figure 1.4e) All the populations of various living things that live together in an area—including trees and ants—form a community. How many different populations can you see in this community?

The Needs of Living Things

Some living things are able to live in your schoolyard while other living things just visit or pass through your schoolyard. You are an example of a living thing that just visits your schoolyard. This is because all of your **basic needs** cannot be met in the schoolyard ecosystem. An ecosystem must meet the needs of the living things that are present in it. What do living things need in order to survive?

Figure 1.5 A tiger meeting its basic need of water

Living Things Need Water

About three-quarters of our planet's surface is covered with water. Water not only makes up the majority of Earth's surface, but also makes up the majority of all living things. For example, about two-thirds of your body is made up of water. About nine-tenths (or more) of a head of lettuce is water! Life cannot exist without water.

Figure 1.6 Students getting the nutrients they need

Living Things Need Food

You need food for the **nutrients** it provides. Nutrients include substances such as carbohydrates, fats, proteins, vitamins, and minerals. All these substances supply your body with energy and materials that you need to move, grow, and to repair and maintain the health of the billions of cells in your body. Most other living things need nutrients for the same reason.

Figure 1.7 An athlete using energy to win a race

Living Things Need Energy

You need energy to walk, run, breathe, eat, digest what you eat, and grow. You need energy even when you're sitting still and relaxing. Energy keeps your heart beating, air moving in and out of your lungs, and the rest of your organs working properly. So you need energy even when you're asleep!

- Where do you get the energy you need to survive?
- Where does this energy source come from?

Living Things Need Oxygen

When you eat, chemical reactions take place inside your body. These reactions use oxygen to break down the food to provide you with energy. With only a few exceptions, all living things need oxygen to provide the energy they need to survive. This includes animals, plants, fungi such as mushrooms, and microscopic life forms such as bacteria.

- Where do you get the oxygen you need to survive?
- Where do living things in water get their oxygen?

Figure 1.8 This backpacker uses oxygen when hiking.

Living Things Need Suitable Living Conditions

Life can exist in harsh conditions. For example, certain kinds of microscopic bacteria and algae thrive in hot springs that can reach temperatures of up to 85°C. Other kinds of life exist in the Antarctic, where temperatures can reach as low as –90°C. However, most living things live best in a more moderate range of temperatures. They often build shelters to provide safety and comfort.

- What kinds of shelters do people build?
- What kinds of shelters do other animals build?

Figure 1.9 Two shelters in very different climates

Decision Making Activity

Buried Alive

The Issue

For publicity, magician David Blaine wanted to convince people of his skills as a magician and illusionist. He was buried in a coffin for seven days with only a few tablespoons of water every day. How long can humans survive without being able to meet their needs?

Background Information

On April 5, 1999, at 10:00 a.m., magician David Blaine was lowered into a 1.83-m-deep hole in a clear Plexiglas coffin at a New York City construction site. A water-filled tank was placed atop his coffin, and gravel was poured around him. To prepare for this event, Blaine fasted for six days prior to it to clean out his body. He also spent four days a week living in a coffin in his living room to help him get used to living in a small space. A plastic container, funnel, and tube was used to eliminate the urine from the three to four tablespoons of water he consumed each day.

Figure 1.10 David Blaine, seconds before emerging from his coffin

Fresh air was pumped into the coffin, a tent was raised over the water tank if the sun got too hot, around-the-clock medical personnel were on hand, as was a crane to remove the water tank, and a panic button. When Blaine came out of the coffin seven days later, he was quite weak, but otherwise healthy.

Support Your Opinion

Could David Blaine have survived for a longer period of time? If so, would some needs become more important than others in the next few days? Why do you think that? How did Blaine meet his basic needs of

- water?
- food?
- energy?
- oxygen?
- suitable living conditions?

Meeting Your Basic Needs

An ecosystem must meet the needs of the organisms living in it. Think about your basic needs for survival. Illustrate with a labelled picture how basic needs for survival are met in your own life. Identify three things in your life that you could do without and still meet your basic needs.

Check and Reflect

1. Which living things probably live full time in your schoolyard? What is it about your schoolyard that makes it a good place for these living things to live?
2. What other living things just visit or pass through your schoolyard? Where do you think they live? Why would they live there and not in your schoolyard?
3. Select an area near your school that has both abiotic and biotic factors. List at least three of each. Illustrate possible interactions between the different factors that you listed.
4. In your notebook, classify the items in the list below into one of the following three categories: species, population, community.

   flock of birds
   grizzly bear
   school of fish
   pond
   ant
   pack of wolves
   dragonfly
   herd of elk
   moose
   prairies
   grasshopper

5. In your own words define an ecosystem. Use your definition to explain whether you think the following statement is true or false: A schoolyard is an ecosystem.
6. Identify which of the following statements are false. Reword these false statements to make them true.
   a) Ecosystems can only be large.
   b) Ecosystems contain both biotic and abiotic factors.
   c) Only the stones and sand in a puddle are needed to make up an ecosystem.
   d) Your schoolyard is an ecosystem.
   e) Ecosystems do not need water.

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Learning about Dinosaurs

Scientists often have to learn about living things, or **organisms**, from evidence rather than from observing the real thing. Dinosaurs are an example of this. Research what scientists have learned about dinosaurs.

1.2 Interactions among Living Things

Interactions exist between living things. You probably can list many ways that living things interact with each other. Clown fish live unharmed among the stinging tentacles of sea anemones, where the fish are protected from predators. You eating a green salad is another example! Interactions are important for the survival of most organisms.

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Microscopic Interactions

Interactions occur everywhere. These dust mites live in your bedroom! They eat the dust that comes from your hair, flakes of skin, and clothes.

Symbiotic Relationships

Living things sometimes interact with other living things in very surprising ways. For example, some plants grow best in soil that has a particular type of fungus present there. And certain species of birds are often found on the backs of cattle and other large grazing animals. The birds eat the insects off the backs of the cattle. As the cattle walk and stir up more insects, the birds have an easy food source. Whenever different living things live closely together where the relationship may benefit one or both living things, this relationship is called **symbiosis**. There are three major types of symbiotic relationships: **commensalism**, **mutualism**, and **parasitism**.

Commensalism

This is a relationship in which one species in the relationship benefits while the other neither benefits nor is harmed. An example of this relationship is that between trees and a species of flower called an orchid. Orchids live by attaching themselves to the branches of a tree. The tree neither benefits nor is harmed, while the orchid benefits because it receives access to sunlight.

Figure 1.11 An orchid attached to a tree

Mutualism

This is a relationship in which both species in the relationship benefit. An example of this is the relationship between the goby fish and snapping shrimp. The shrimp builds a sand burrow and allows the goby fish to share the burrow. The shrimp is almost blind, so it always has a feeler on the goby. The goby warns the shrimp when danger is approaching by a flick of its fins, and both retreat into their burrow.

Figure 1.12 A goby fish and a snapping shrimp helping each other

Parasitism

This is a relationship in which one species in the relationship benefits while the other species is harmed. If you have ever been bitten by a mosquito, then you have experienced parasitism! The mosquito sucks blood from you so it can make its eggs. It leaves you with an itchy lump.

Figure 1.13 A mosquito biting a human

Inquiry Activity

Ecosystem in a Jar

The Question

What types of living and non-living things can you put in a sealed jar to make a self-sustaining mini-ecosystem?

Materials & Equipment

- glass jar with lid
- gravel or rocks
- pond water
- tap water
- pond snails
- aquatic plants such as duckweed or elodea
- duct tape

Procedure

1. Make sure your jar is clean and the label is removed. Put your name and today's date on the lid.
2. Look at the materials your teacher has made available for this activity. Make a list of the ones you will use in your mini-ecosystem jar. Remember: You want to make sure that whatever you put in allows the snails and plants to stay alive in the sealed jar.
3. Show your list to your teacher for approval. After your teacher checks it, assemble your mini-ecosystem in your jar.
4. Predict what you think the jar will look like in three weeks. Draw a picture to record your prediction. After three weeks, examine how your mini-ecosystem jar is working.

Figure 1.14 An ecosystem in a jar

Collecting Data

5. Record the final number of each type of living and non-living thing that you put into the jar.
6. Create a table that will allow you to monitor and record any changes to the living and non-living things in your jar over the next three weeks.

Analyzing and Interpreting

7. Is your mini-ecosystem jar a totally closed system? Explain your answer.
8. Identify all the living and non-living things in your mini-ecosystem jar.
9. Suggest some possible interactions between the things in your mini-ecosystem jar.

Forming Conclusions

10. Describe what your mini-ecosystem looked like after three weeks. Explain any changes that happened since you first put it together.

Adapting to the Environment

Living things meet their needs in many different ways. Each organism in an ecosystem has certain unique characteristics. **Adaptation** is how organisms respond to their environment. Only those species that are best suited to their environment will survive and produce offspring. Over many generations, the offspring that inherit their parents' successful characteristics continue to reproduce, whereas the species that are not well suited to their environment are less likely to survive and produce offspring. So, over time, the successful characteristics will be more common in the population. These changes in the behaviour and physical characteristics of species make them better adapted to their environment.

It is important to understand that living things cannot choose how they will change. They do not decide to develop characteristics that will allow them to live successfully in their environment. However, living things have changed in many ways to meet the challenges of their environment.

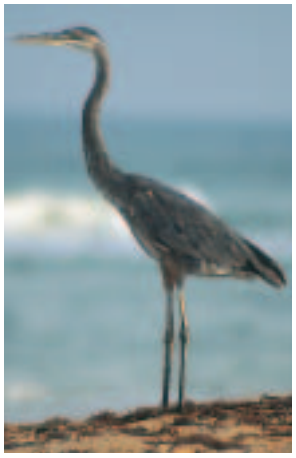

Figure 1.15 The great blue heron's sharp beak, long neck, and long legs are its adaptations for catching fish.

Check and Reflect

1. Draw a labelled diagram to demonstrate your understanding of how humans interact with other living and non-living things in their environment.
2. Describe an example of a symbiotic relationship between two living things, and the adaptations involved.
3. Look at the examples below and decide whether the relationship is commensalism, mutualism, or parasitism.

Figure 1.16 The sea lamprey attaches itself to other fishes by suction. Some of the lamprey's victims may die, while others live but have a scar where the lamprey had attached itself.

Figure 1.17 Barnacles, unable to move on their own, attach themselves to whales to increase their chance of finding food. Whales are not affected by the barnacles.

Figure 1.18 As the butterfly feeds, pollen sticks to its body. The butterfly carries the pollen to the next flower it feeds from. Most flowers need this pollen to produce seeds.

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Plant Uses

Many Aboriginal peoples have a close relationship with the animals and plants in their ecosystem. They have used plants like bearberry for soap, and willow as a painkiller. Research some other uses of plants in the Aboriginal culture.

1.3 Human Impacts on Ecosystems

Ecosystems are impacted by human actions. Even if our intentions are good, the impact may have unintended consequences as in the case of the beaver population in Yoho National Park.

Declining Beaver Population

Many times, humans think that they are trying to help the ecosystem, but their help has unintended consequences. For example, biologists have recently been studying the dramatic decline in the beaver population in Yoho National Park after noting that the population is significantly lower than it was 100 years ago.

Fire management practices have changed since Yoho became a national park. While forest fires were a relatively frequent occurrence in Yoho before it became a park, they are almost non-existent now since the development of efficient fire-monitoring and fire-fighting teams. The decision to put out all fires appeared to be in the best interests of wildlife, people, and the park. However, since there are no longer any fires, the trees in the park have grown larger. As a result, there is not enough light for the young aspen trees to grow. Since this tree is the preferred food and shelter for the beaver, beavers are no longer able to live in this area. So what was meant to be a deliberate attempt to manage the forest fires in this area has had an unintended impact on the beaver population.

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Toad Tunnels

In England, cars travelling on the highways have killed more than 100 000 toads each year. So, special toad tunnels have been built under the roads. The tunnels can fit about 200 toads per hour.

Give it a **TRY** **Activity**

Impacts on Ecosystems

Work with a group. Think about the following situations. Explain how the individual in each situation has an impact on his or her environment.

- a student throwing a candy wrapper on the ground
- a student riding a mountain bike on a thin trail through the forest
- a farmer plowing a field
- a person involved in a strip-mining operation
- a fisheries biologist adding trout to a lake
- a biologist cleaning oil off the wings of a duck

Can you think of one more impact an individual could make?

Figure 1.19 A garbage dump containing consumer waste

Dealing with Our Garbage

Humans have a bigger impact on ecosystems than any other living things. No other species inhabits as many different ecosystems. We also invent and use technology to alter the ecosystems in which we live. And technology has affected the amount and type of waste we produce.

As long as there have been people on the planet, they have produced waste material. Long ago, all waste material could be broken down to be returned to the environment. However, we now use a lot of materials, like plastic, that cannot be broken down, or produce so much of it that the natural cycles cannot keep up.

In the past, it was common for garbage to be poured into large pits. These pits were called "dumps" because people just dumped their garbage there. Dumps were smelly and looked unattractive. Sometimes they caught fire, polluting the air with sooty, foul smoke. Rainwater often washed dangerous chemicals and disease-causing bacteria from the dumps into local water systems. Think about the potential impact of waste products on the environment. How have our needs and wants affected the types of garbage we produce? What has been done to clean up our act?

Decision Making Activity

What Kind of Drink Container Would Lessen Our Impact on the Environment?

The Issue

Think about the impact that drink containers can have on the environment. What kind of drink container would lessen the impact on it?

Background Information

1 Brainstorm a list of all the different kinds of drink containers.

Figure 1.20 Students assessing drink containers

Drink Container Features		
Drink Container	**+**	**–**
can		

2 Compare the different kinds by making a plus/minus chart like the one shown above. In the "plus" column, list the positive features of each container. In the "minus" column, list the negative features of each one. When making your chart, think about safety, cost, waste, energy, and recycling.

3 Review your chart. Suggest any additional scientific information about environmental impacts that you might need to complete the chart.

4 Develop a fair test that you could perform to help you gather more information.

5 As a group, determine which container would be best. Explain your reasons for your choice.

Support Your Opinion

6 Present your findings to your classmates.

7 Did your findings agree with those of other groups in the class?

8 What other aspects would you want to consider when making this decision?

The Garbage Solutions

Some of the ways we have cleaned up our act include: recycling, composting, incinerating, household hazardous waste operations, and sanitary landfills.

Here are examples of how some of these methods work.

Recycling handles paper products as well as clear glass bottles, metal cans, aluminum foil containers, and some plastics. These materials are separated, sorted, crushed, compacted, and then bundled for transport to various industries for reprocessing.

Sanitary landfills are similar to landfills. The wastes from both types of landfills are spread across the ground and then compacted by bulldozers into layers 0.5 m thick. A layer of soil is spread over the compacted wastes to reduce odours and litter, and to discourage animal activity.

However, landfills will leak. Sanitary landfills are designed not to leak. Once the hole for the sanitary landfill is dug, a clay liner and system of pipes is put in place to prevent leakage.

Although both the landfill and sanitary landfill handle solid wastes from municipal, residential, and industrial sources, sanitary landfills are a more environmentally friendly way of dealing with our garbage problem.

Figure 1.21 A recycling depot

Figure 1.22 A sanitary landfill

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Dealing with Waste

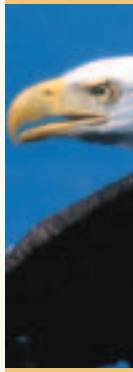
Find out how your community deals with household waste. What happens to it? Where does it go?

Check and Reflect

1. Draw a mind map or flowchart to show how discarding the pop can holder in Figure 1.23 could have an impact on the ecosystem.

Figure 1.23 Question 1

2. How does an answer to a question as simple as "What kind of drink container will I take to school?" have both intended and unintended consequences for the ecosystem?
3. How have humans had an impact on the Yoho National Park ecosystem? Was the impact positive or negative? Explain your answer.
4. What do you think can be done to lessen the "unintended consequences" that humans create for the ecosystem? Provide a specific example to illustrate your thoughts.
5. Create a web to demonstrate your understanding of all the things that must be considered when making an informed decision about an environmental issue.
6. Your school wants to start a recycling program. What kind of information would you need to know in order to determine if this is a good idea? Design a survey as a first step in investigating the issue.



Assess Your Learning

1. List three basic needs of living things and explain their importance.
2. a) Name four abiotic factors on our planet.
   b) Name four biotic factors on our planet.
   c) Choose one abiotic factor and one biotic factor that interact.
   d) Choose two biotic factors that interact.
   e) For parts c) and d), use words, pictures, or both to explain how they are connected to each other. Identify the type of interaction present.
3. Draw a picture to illustrate how the following biotic and abiotic factors together could make up one ecosystem.
   a) trees
   b) lake
   c) birds
   d) mosquitoes
   e) mushrooms
   f) soil
   g) campground
4. Imagine you were out for a walk along a river bank. You notice a large pile of household garbage on the other side of the river. What impact could this garbage have on the local ecosystem?
5. Identify an example of human impact on an ecosystem not mentioned in this section. Was the impact positive or negative? Were the consequences of the impact intended or unintended? Explain your answers.

Focus On — Social and Environmental Context

Science and technology are designed to meet human needs and expand human capability. Think about what you learned in this section.

1. What are the needs of all living things?
2. How can science and technology help humans balance their needs with the needs of the other organisms present in the ecosystem?
3. How can science and technology be used to lessen the unintended impacts that humans have on ecosystems? How would this expand human capabilities?

2.0

The flow of energy and the cycling of matter can be traced and interpreted in ecosystems.

Key Concepts

In this section, you will learn about the following key concepts:

- interactions and interdependencies
- producers, consumers, and decomposers
- nutrient cycles and energy flow
- environmental impacts

Learning Outcomes

When you have completed this section, you will be able to:

- identify the relationship between producers, consumers, and decomposers in ecosystems
- describe how energy and nutrients are stored in plants and animals
- describe how food chains and food webs demonstrate the flow of energy in ecosystems
- describe how matter is recycled in ecosystems
- predict changes to any part of a food web
- describe the cycles of matter of water and carbon in ecosystems

What would you say to getting rid of the biting insects that attack you each spring and summer? You would probably say "yes." But studies of ecosystems suggest that there is no easy way of eliminating certain species without harming the environment.

At first, it would be great to have no mosquitoes, horseflies, or blackflies. In a couple of years, however, you would notice some important changes. Insects are a main food source for some birds and fish. Without a steady food source, what would happen to those animals? How about the animals that feed on those fish and birds—what would happen to them? Insects also pollinate many flowers, and without them, many plants would not produce fruits and seeds. The animals that eat these fruits and seeds would suffer. Some insects also have an important role in the breaking down of dead and decaying organisms.

As you can see, the elements in an ecosystem are interdependent. It's important to understand these relationships to see how an ecosystem works.

For Web links relating to 2.0, visit **www.pearsoned.ca/scienceinaction**

2.1 Ecosystems Have Interactions among Producers, Consumers, and Decomposers

By the time you have reached grade 7, your body mass has probably increased 10 times since you were a baby. Your body has gone through many changes. It needed energy to "fuel" all these changes. And it needed matter to supply what your body needed to increase in size and mass. The energy and matter that your body needed came from food. Your body broke down the food into a form that it could use. Choosing the right foods, then, is important, because no one food can supply your body with everything it needs.

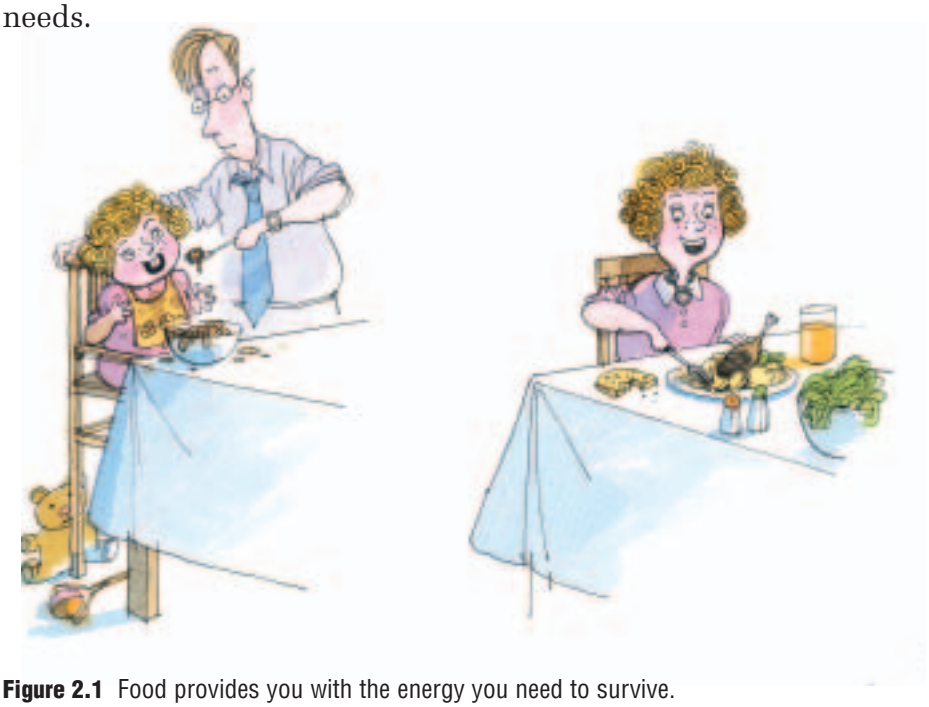


Figure 2.1 Food provides you with the energy you need to survive.

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Hyenas

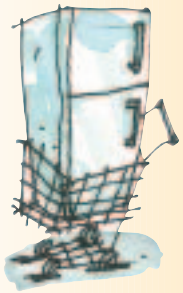
For a long time, scientists believed that hyenas were exclusively scavengers. That's because people saw hyenas scavenging during the day. Now, scientists have a different view. Researchers discovered that hyenas do hunt for their food, but only at night. In fact, hyenas are skilful, cunning hunters. But they're always ready and willing to scavenge if they have the opportunity.

Give it a **TRY** ACTIVITY

Creating a Food List

Take a moment. Think back to the foods you've eaten over the past two days. Design a chart to list them. Include the foods you ate for breakfast, lunch, and dinner, as well as any snacks you had.

Think back to subsection 1.1. Which needs have been met by the foods that you have consumed? Add these needs to your chart.



You and Other Animals Are Food Consumers

Store owners and advertisers often call people consumers. That's because we buy and use goods and services produced by companies or other people. This is the common-language meaning of the word consumer. In science, the word consumer has another meaning. A **consumer** is any organism that has to seek out and eat, or consume, other living things for food. According to this definition, you are certainly a consumer. So is a raccoon, a cat, a moose, a bear, a hyena, a grasshopper, a seal, an elephant, and a praying mantis. In fact, all animals are food consumers.

Scientists often find it helpful to classify consumers based on the kinds of food they eat. Animals like cats, hyenas, seals, and praying mantises, which consume mainly animal food, are called **carnivores**. Animals like moose, elephants, and grasshoppers, which consume mainly plants and plant-like living things, are called **herbivores**. Animals like humans, bears, and raccoons, which consume other animals as well as plants, are called **omnivores**.

Food Consumers Depend on Food Producers

Plants and plant-like living things play a vital role in nearly all ecosystems on Earth. That's because plants can do something that you and other food consumers cannot.

Animals must find food to eat to get the matter and energy they need to survive. Green plants can nourish themselves. Such organisms are known as **producers**. They can make their own food to supply the matter and energy they need to survive.

Figure 2.2 A snake consuming a frog

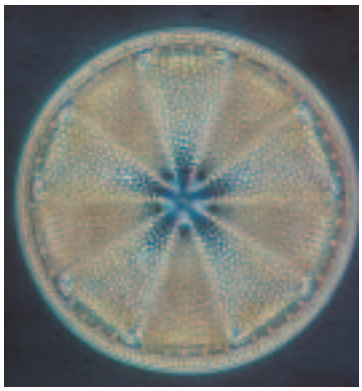


Figure 2.3a) Diatom

Figure 2.3b) Flowering cactus

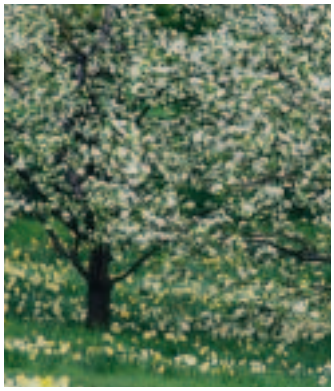


Figure 2.3c) Apple blossom

Figures 2.3a) – c) All these living things are producers. Which do you think are important for land-based ecosystems? Which are important for water-based ecosystems?

The Process of Photosynthesis

Plants need two raw materials to make their food. Raw materials are materials in their natural state. They have not been manufactured, treated, or prepared. The two raw materials that plants need are water and carbon dioxide. Water comes from the soil, and carbon dioxide comes from the air. However, plants also need energy to make their food. Their energy source is the sun.

Plants absorb the sun's energy through their leaves. Inside the leaves, this energy is used to rearrange the particles that make up water and carbon dioxide. Two products result from this rearrangement: food and oxygen. The food is in the form of sugars and starches. These nutrients allow the plant to grow. The oxygen is released back into the air. This food-making process is called **photosynthesis**. Figure 2.4 shows the steps in photosynthesis.

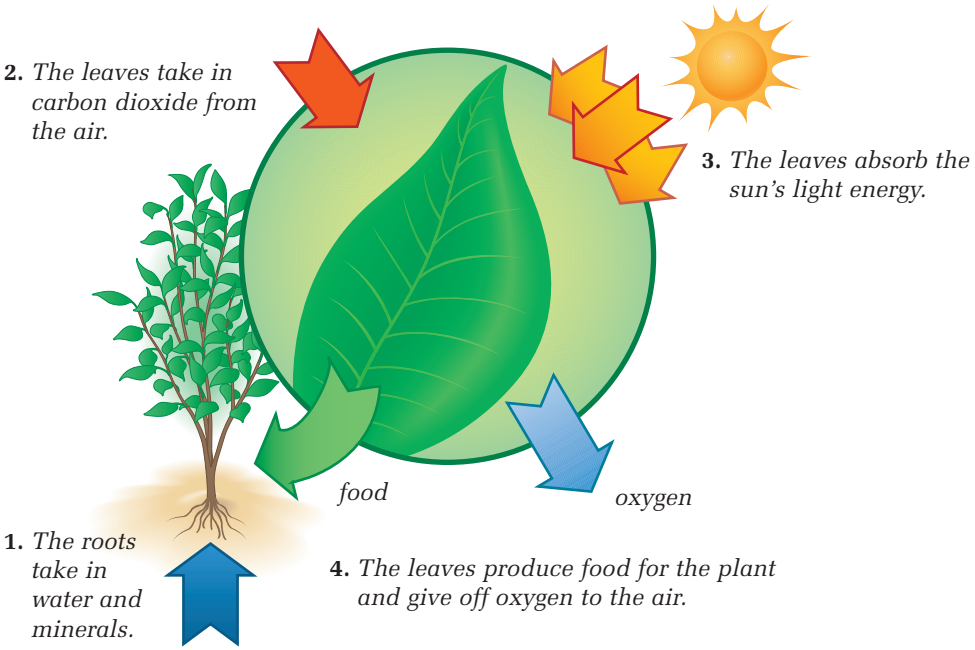


Figure 2.4 The process of photosynthesis

The Importance of Photosynthesis

The process of photosynthesis can also be written as a word equation as shown in Figure 2.5.

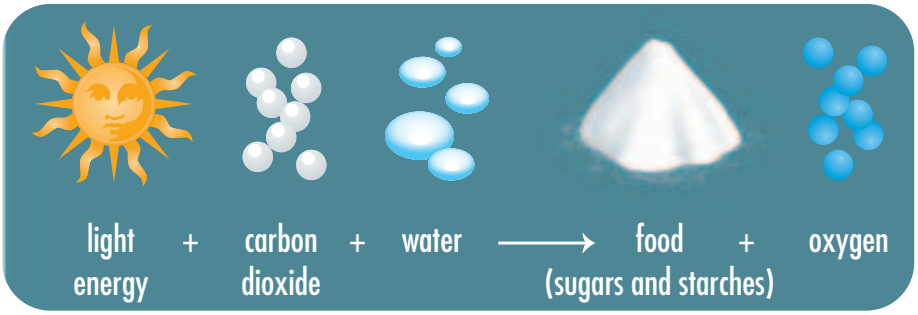


Figure 2.5 Word equation for photosynthesis

This process is important to your life for two main reasons:

- Photosynthesis converts the sun's energy into chemical energy in plants and stores it in the form of sugars and starches. Your body can use this stored energy when you eat plants, plant-based products (e.g., bread), or plant-eating animals.
- Photosynthesis provides the oxygen in the air you breathe.

Photosynthesis also plays an important role in ecosystems. It is the only process that allows other living things in an ecosystem to use the sun's energy. Through photosynthesis, plants produce the food and oxygen that all food consumers need to survive. That's why scientists call plants and plant-like living things *producers*.

Oxygen Is for More Than Just Breathing

You have learned that photosynthesis is important for making food in plants and for producing oxygen. Food is the source of matter and energy that animals and plants need to survive. Both animals and plants need oxygen. That's right—plants need oxygen too.

Nearly all living things need oxygen to release the energy that is stored in their food. **Cellular respiration** is the process responsible for this release of energy. Cellular respiration is a chemical reaction that occurs within the cells of all living things. It combines food and oxygen to produce carbon dioxide, water, and energy. The food is in the form of the sugar glucose. The energy and water are used to carry out life functions. The carbon dioxide is given off (in plants) and exhaled during breathing (in animals). Figure 2.6 shows the word equation for cellular respiration.