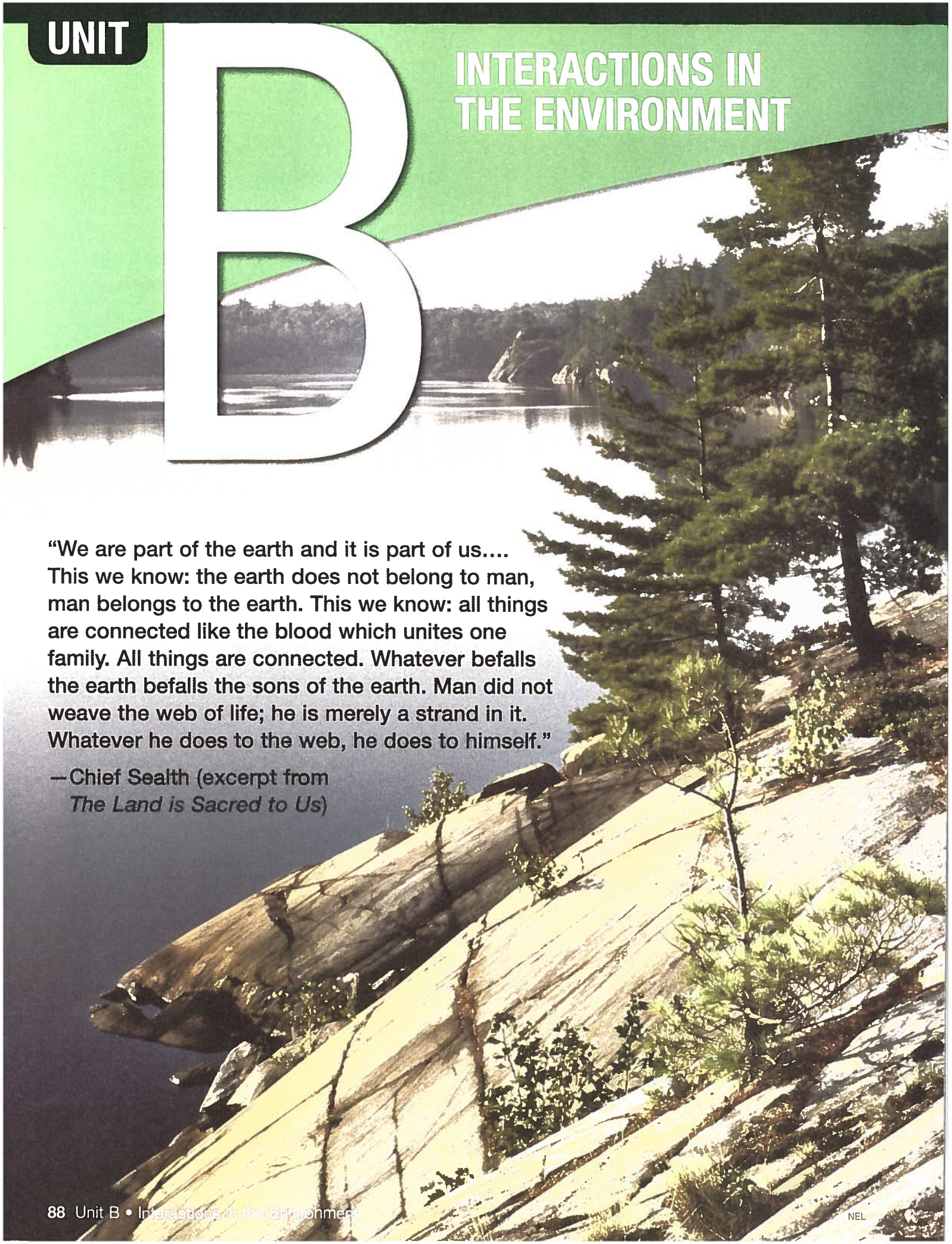
UNIT

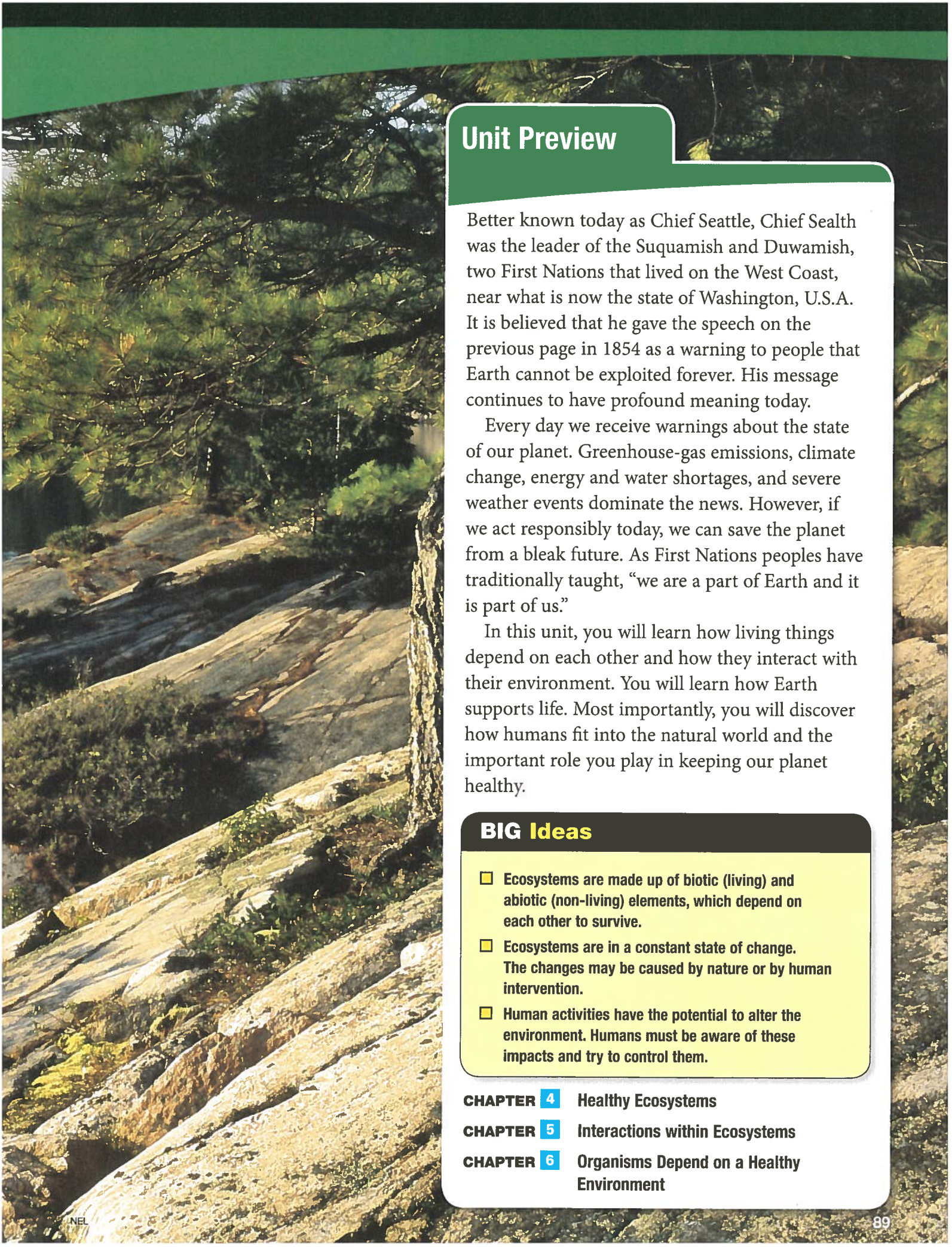
B

INTERACTIONS IN THE ENVIRONMENT



"We are part of the earth and it is part of us.... This we know: the earth does not belong to man, man belongs to the earth. This we know: all things are connected like the blood which unites one family. All things are connected. Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself."

—Chief Sealth (excerpt from *The Land is Sacred to Us*)



Unit Preview

Better known today as Chief Seattle, Chief Sealth was the leader of the Suquamish and Duwamish, two First Nations that lived on the West Coast, near what is now the state of Washington, U.S.A. It is believed that he gave the speech on the previous page in 1854 as a warning to people that Earth cannot be exploited forever. His message continues to have profound meaning today.

Every day we receive warnings about the state of our planet. Greenhouse-gas emissions, climate change, energy and water shortages, and severe weather events dominate the news. However, if we act responsibly today, we can save the planet from a bleak future. As First Nations peoples have traditionally taught, "we are a part of Earth and it is part of us."

In this unit, you will learn how living things depend on each other and how they interact with their environment. You will learn how Earth supports life. Most importantly, you will discover how humans fit into the natural world and the important role you play in keeping our planet healthy.

BIG Ideas

- Ecosystems are made up of biotic (living) and abiotic (non-living) elements, which depend on each other to survive.
- Ecosystems are in a constant state of change. The changes may be caused by nature or by human intervention.
- Human activities have the potential to alter the environment. Humans must be aware of these impacts and try to control them.

CHAPTER 4 Healthy Ecosystems

CHAPTER 5 Interactions within Ecosystems

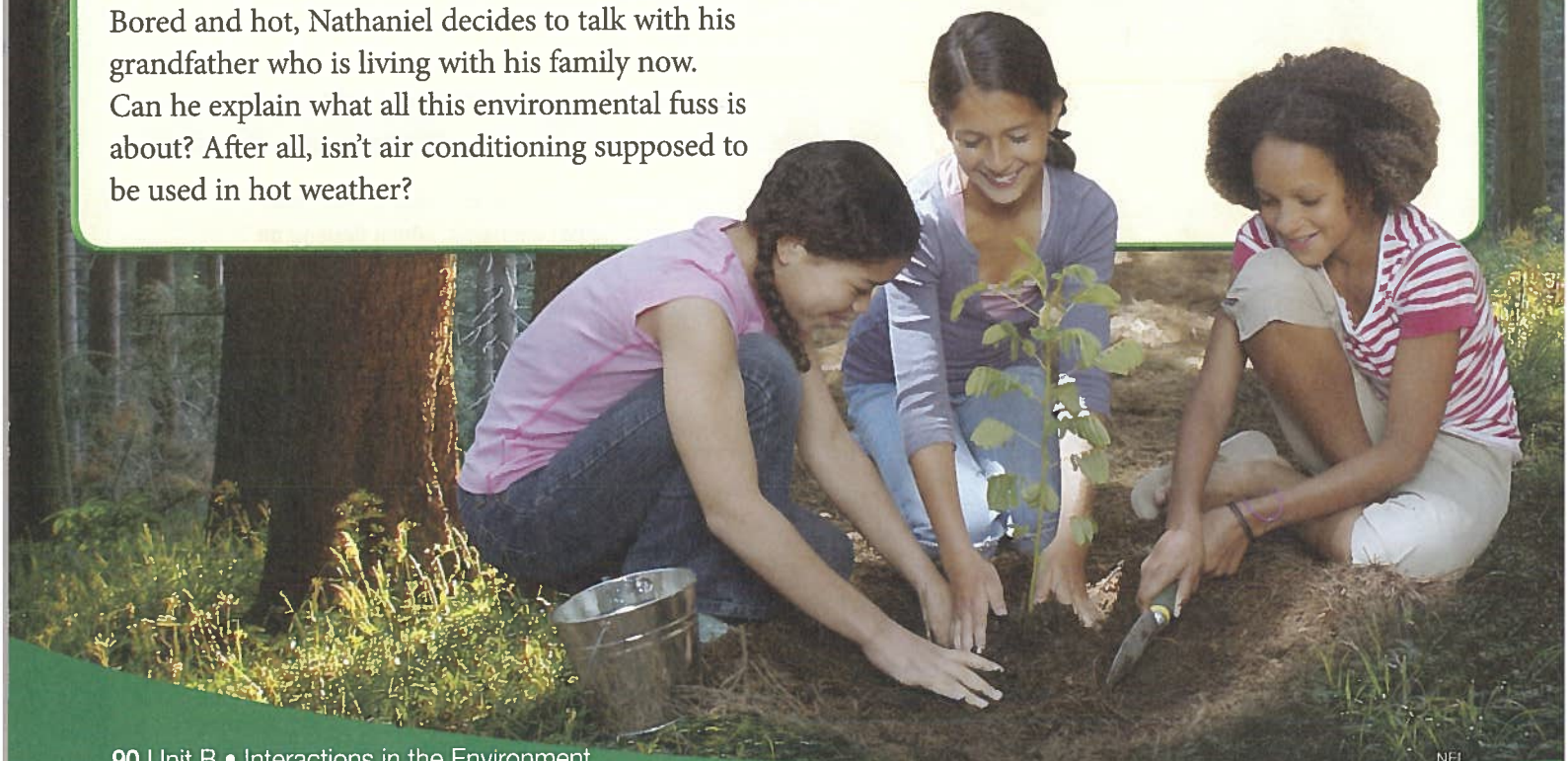
CHAPTER 6 Organisms Depend on a Healthy Environment

Discover Science and Technology

A WALK IN THE PARK

It is a sweltering, humid August day and Nathaniel is stuck in the city. A smog alert has been issued. The mayor has asked everyone to minimize use of air conditioners, lights, household appliances, and to keep cars off the road as much as possible. Bored and hot, Nathaniel decides to talk with his grandfather who is living with his family now. Can he explain what all this environmental fuss is about? After all, isn't air conditioning supposed to be used in hot weather?

Nathaniel's grandfather is also feeling uncomfortable in the heat, but he has an idea. He suggests that they walk down to the local park. Nathaniel reluctantly agrees. He puts on his baseball cap and off they go.



As they walk to the park, Grandpa reflects on Nathaniel's question. "Where I spent my childhood, there was no need to worry about water, air, or heat. We could drink out of the river, and the air was fresh and clean. Cool breezes and large trees in our backyard kept us comfortable in the summers. We were surrounded by nature." Nathaniel and his grandfather finally reach the park. Nathaniel immediately feels cooler as soon as they walk into the wooded area. The hum of traffic and loud noises are replaced by the sound of their breathing and an occasional bird call.

They find a secluded place to sit and Grandpa continues. "The last couple of generations have been unkind to the environment. People thought that technology would solve all our problems and took nature for granted. Instead, we have created new problems. We are creating too much waste, polluting the air, and ruining the land."

Grandpa says, " Do you know that this area used to be covered in weeds and grass? There were no trees. Now, it has become a park, thanks to some very dedicated volunteers. They planted native vegetation and returned the land to its original, natural state. Insects, birds, and wild animals have returned here. People enjoy this place."

"But there is nothing to do here," responds Nathaniel.

"This may not have the excitement of a computer game, or the action of a mall," continues Grandpa, "but if you are quiet enough and you take the time to observe, there is actually quite a bit happening here."

Sure enough, after several minutes of gazing at the trickling river, Nathaniel spots a muskrat swimming by! He has never seen one before!

"I wonder if I could join the volunteer group that helps keep this place so beautiful?" he asks. Nathaniel has totally forgotten about the heat.

LINKING TO LITERACY

Environmental Print

Our environment "speaks" to us through signs and symbols everywhere: signs on stores, menu boards in drive-throughs, billboards, road signs, and even signs in natural settings like parks and nature trails. Readers need to be able to read messages in all places so that they can follow directions, instructions, and rules and regulations.

Read the sign on this page. Discuss the following with a partner or small group:

- How is this sign related to what Grandpa talks about in the story?
- After reading the sign, describe in your own words what naturalization means to you.
- What other signs might be posted in the park? Think about messages for park users to protect the environment, learn about plants and animals, and help them enjoy the park.

What Is the Connection?

In Grade 6, you learned about plants, animals, and the relationship between living things and the natural environment. You have also experienced these things in your daily life. In any natural environment, each component is important and affects the other components. Components of a natural environment include sunlight, soil, water, air, plants, animals, and other living things.

1. Select one of the components listed above. In your notebook, explain how the component affects the other components.
2. Form a group of six. As a group, create a concept map showing the connections between the different components (Figure 1). Once you have marked a connection, include a label indicating what the connection is. For example, in Figure 1 the label "plants need sunlight to grow" indicates the connection between sunlight and plants. Each component may have more than one arrow.
3. Each group will then share their ideas with the rest of the class. You may want to show your concept map to the class and act out your findings in a skit. Your teacher will record all the ideas.
4. Based on the ideas from the concept maps, write a paragraph explaining how the different components in a natural environment depend on each other. Be sure to use what you learned in previous grades in addition to what you noted from the concept maps.

LINKING TO LITERACY

Concept Maps

A concept map helps you make connections between words, pictures, and concepts or ideas. Connect these with arrows. Next, add words along the arrows to explain each connection.

Concept maps are used for different purposes. On this page, you are asked to create a concept map to brainstorm what you already know about a topic. Can you think of other reasons for using a concept map?

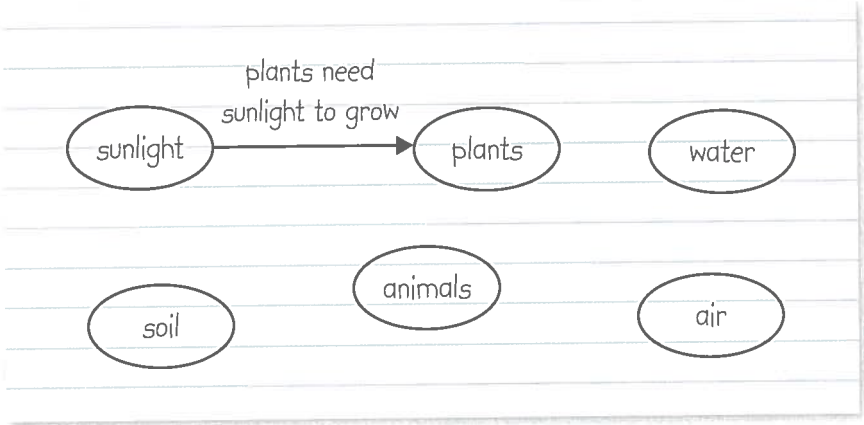


Figure 1

Unit Task Preview

Naturalizing Your Community

Natural environments benefit all living things. Sometimes we do not take care of our natural environment as much as we should. How do you think you can help a natural environment near your home or school? Can you help an environment like the volunteers did in "A Walk in the Park"?

It is important for you to start thinking like a naturalist while you read through this unit. Naturalists defend and protect nature, and they also educate others about ways they can help preserve local species and habitats. Thinking like a naturalist will help you to prepare for the Unit Task.

In this Unit Task, you will select an area in your community that would benefit from "naturalization"—adding plants and changing the landscape in a way that will attract local animals and also make it attractive to humans.

You will analyze the area you select and create a plan to naturalize the area in a way that reflects the local natural environment. You will study your selected area and identify factors that must be considered to ensure the plan will be successful. The plan must involve both living and non-living elements, as well as the needs of the people in the area.

Unit Task By the end of the Interactions in the Environment unit, you will be able to demonstrate your learning by completing this Unit Task. As you work through the unit, continue to think about how you might meet this challenge. Read the detailed description of the Unit Task on page 168, and look for the Unit Task icon at the end of selected sections for hints related to the task.

Assessment

You will be assessed on how well you

- show your knowledge and understanding of the local ecosystem
- develop a reasonable plan to naturalize your area
- propose practical solutions for naturalizing your area
- evaluate the impact your plan will have on living things that will inhabit the area, as well as on humans living nearby

CHAPTER

4 Healthy Ecosystems

KEY QUESTION: What are the essential elements of a healthy ecosystem?

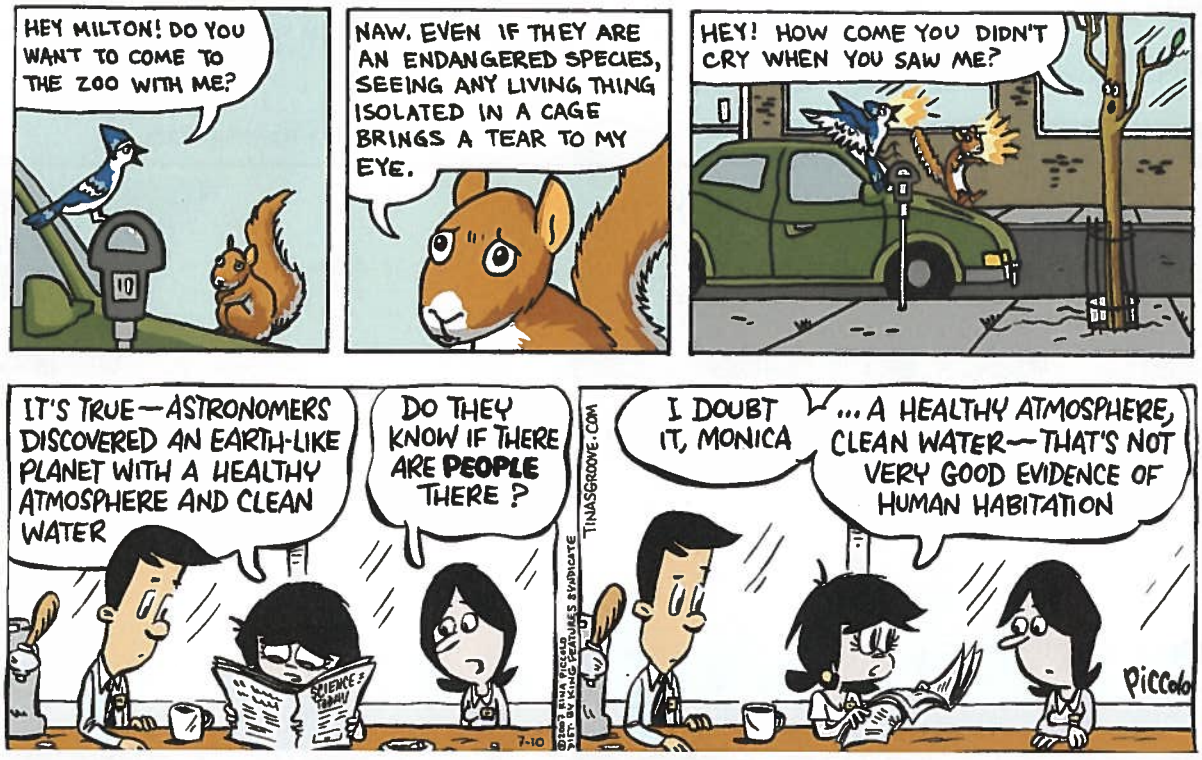
Looking Ahead

- Ecosystems are made up of living and non-living elements.
- The living things in an ecosystem depend on each other and on non-living elements for survival.
- Living and non-living elements interact with each other in many different ways.
- The skills of scientific inquiry can be used to investigate the living and non-living elements in a model ecosystem.
- Humans are part of ecosystems and affect ecosystems.

VOCABULARY

biotic element	ecology
organism	habitat
micro-organism	nutrient
species	competition
population	predator
community	prey
abiotic element	mutualism
ecosystem	

GETTING A CHUCKLE FROM THE ENVIRONMENT



"Of course our company cares about the environment! We just switched our entire factory to energy-efficient bulbs."

LINKING TO LITERACY

Text Genres: The Comic Strip

Comic strips can be written as very sophisticated texts. They require readers to make connections between illustrations, text, and what they already know about a topic. Sometimes a message is hidden and the reader must "read between the lines," or make an inference to figure out the comic strip's meaning.

Read each of the comic strips on this page.

1. How does the cartoonist use humour in each comic strip?
2. Read the words in the last comic strip. What message does the written text give you? How does the picture help you to "read between the lines" to see a different message?
3. What is Milton's opinion of zoos? Whose point of view might be in favour of the benefits of zoos?

4.1 What Is an Ecosystem?

Point Pelee National Park, located at the southernmost tip of Ontario, is one of the smallest national parks in Canada (Figure 1). Although the park covers only 15 km^2, it contains many different types of plants and animals. Thousands of monarch butterflies stop and feed in the park before continuing their migration to Mexico in the fall (Figure 2). Many birds also stop in the park during migration. The park receives over 350 000 human visitors a year, all eager to discover its treasures. People visit from around the world to see the birds that come to the park each year.

To learn more about Point Pelee,
Go to Nelson Science

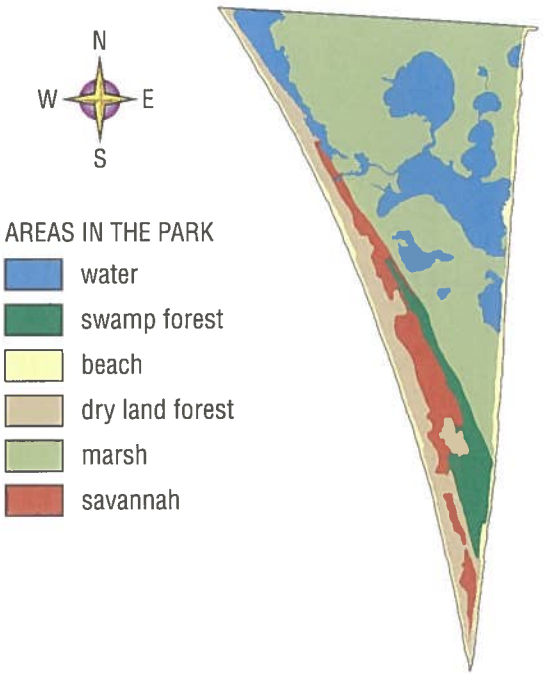


Figure 1 Point Pelee is a sand spit that juts out into Lake Erie.

Figure 2 A monarch butterfly feeding before travelling south to Mexico

Why is Point Pelee so attractive to both wildlife and people? For wildlife, the park provides food and shelter. For humans, it is a place to watch birds, hike, and enjoy nature. This tiny area of land has a mixture of forests, woodland, and swamps. It also has an untouched marsh full of cattails, dragonflies, and other plants and animals. The beach area is home to hop trees and shorebirds. Finally, there are grasslands filled with milkweeds, wildflowers, birds (such as the savannah sparrow), and even prickly pear cacti. Like other parks throughout Ontario, Point Pelee is not only a place where living things can find food and shelter, but it is also a place where humans can learn more about nature.

The Living Parts of the Environment

Living and non-living things can be found almost everywhere on Earth. The living parts of an environment, such as plants and animals, are **biotic elements**. Biotic elements in an environment affect one another. For example, the plants that grow in a particular environment will affect the survival of other living things. Living things are also known as **organisms**. Organisms that can only be seen with a microscope, such as bacteria and some algae, are known as **micro-organisms**.

Organisms that look similar to one another and that can mate to produce more of the same type of organism are called a **species**. An individual monarch butterfly is a member of the monarch butterfly species (Figure 3(a)). All the members of one species in an area are called a **population**. The thousands of monarch butterflies that fly to Point Pelee in the fall form a population (Figure 3(b)). When populations of different species live in the same area, they form a **community**. For example, the grassland community of Point Pelee includes the monarch butterfly population, as well as common milkweed, Eastern kingbird, and American coyote populations (Figure 3(c)). Each species within this community plays an important role.

biotic element: any living thing found in the environment

organism: a living thing

micro-organism: a living thing that is small and must be viewed with the help of a microscope

species: a group of similar organisms that can mate and reproduce more of the same type of organism

population: a group of organisms of the same species in a given area

community: a group of populations of different species in a given area

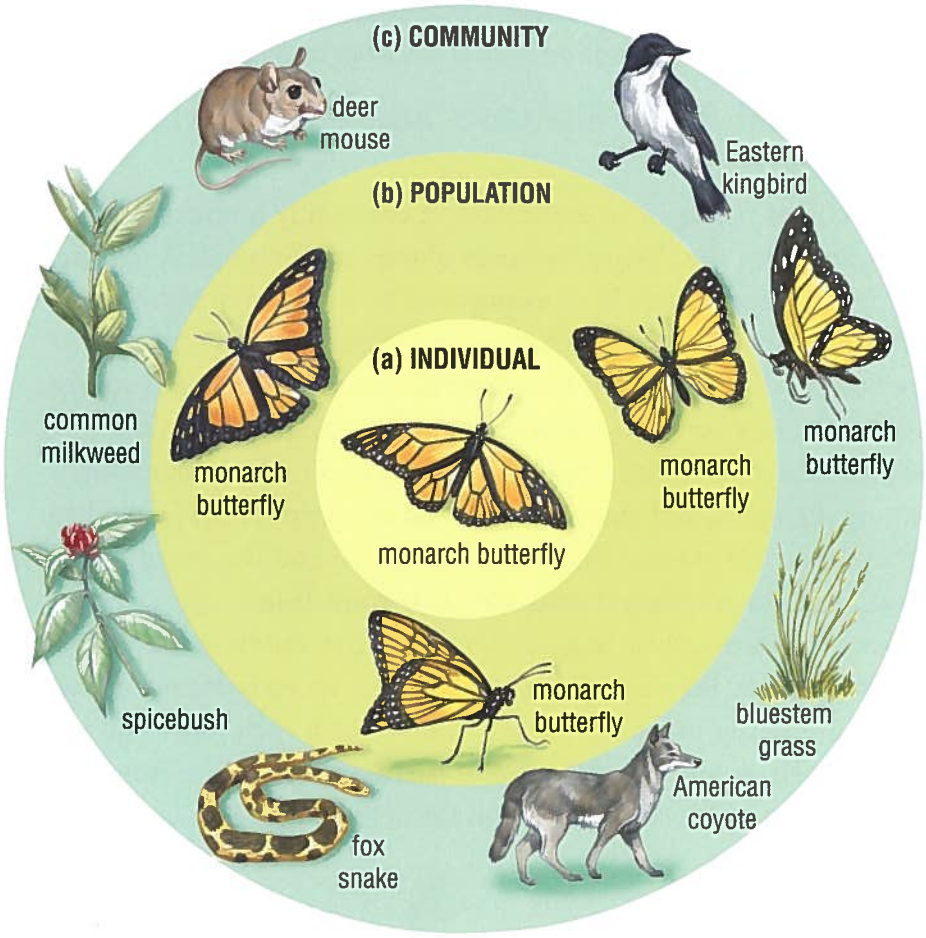


Figure 3 This nested circle diagram shows how each individual of a species is part of a population, and each population is part of a community.

LINKING TO LITERACY

Word Origins: Roots, Suffixes, and Prefixes

Knowing what words mean can help you to better understand science texts. For instance, the roots *bio-* and *biotic* mean "life." When you read about biotic elements, you will know that these are living things. *Micro-* means "small," therefore a micro-organism is a small organism. *Eco-* means "to do with the environment" and *-logy* refers to a field of study. See if you can use these terms to help define words found later in Section 4.1.

The Non-Living Parts of the Environment

abiotic element: any non-living component of the environment

The non-living things in parts of an environment are **abiotic elements**. They include sunlight, air, rain, snow, sand dunes, rock, and water (Figure 4). Abiotic elements provide many of the things that organisms need to survive. Plants, for example, need air, water, and sunlight to grow.

Figure 4 What abiotic elements on the beach of Point Pelee can you identify from this photo?

Abiotic and Biotic Elements Interact to Form Ecosystems

The biotic elements in an environment constantly interact with each other and with the abiotic elements of the environment. A fox snake eating an Eastern mole is an example of an interaction between two biotic elements. Wind that changes the shapes of sand dunes on the beach is an interaction between two abiotic elements. A sunfish making its nest on the bottom of a marsh is an interaction between a biotic and an abiotic component of the marsh. The interactions among the biotic and abiotic parts of an environment are called an **ecosystem**. The grasslands, beach, and marsh and the living things in these areas form different ecosystems in Point Pelee.

ecosystem: the network of interactions that link the living and non-living parts of an environment

An ecosystem can be large or small, but the abiotic and biotic parts always interact. For example, a rotting log is an ecosystem. All the organisms living in, or on, the log interact with each other and with the log itself. A forest is also an ecosystem, but it is large. It is made up of all the organisms living in it and the abiotic elements of the forest that affect them.

A large ecosystem often contains many smaller ecosystems (Figure 5). All the ecosystems that exist within a larger ecosystem are interconnected. For example, a deer that lives in a forest ecosystem might get its water from a creek ecosystem.

The study of relationships between living things, non-living things, and their environment is called **ecology**.

ecology: the study of relationships between organisms, and between organisms and their environment

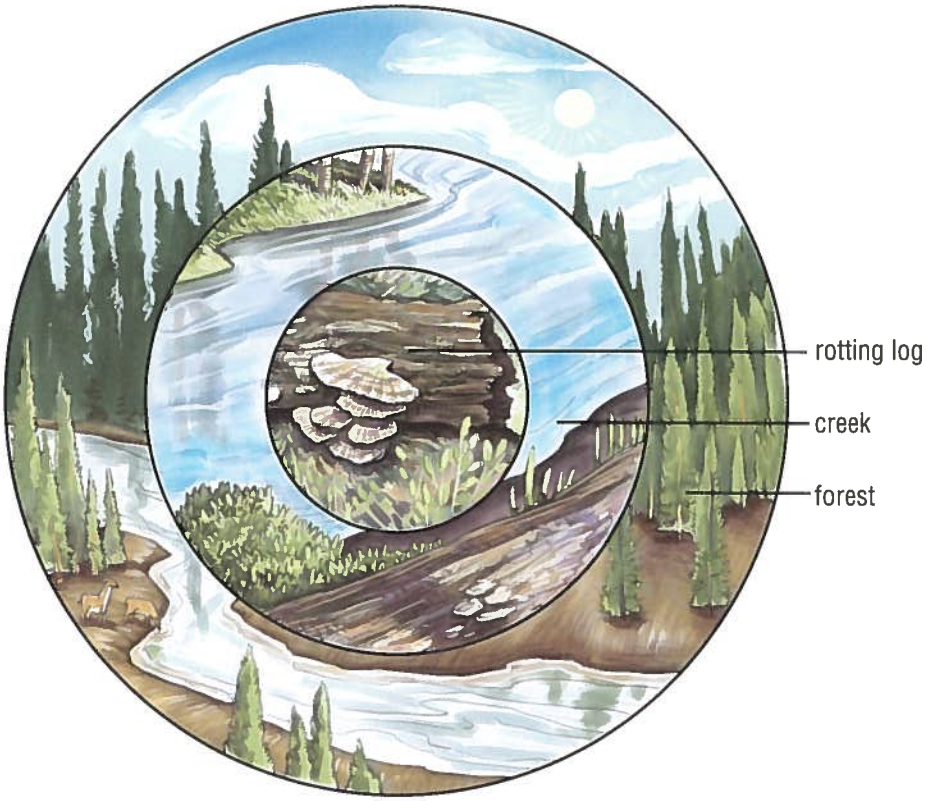


Figure 5 Ecosystems often contain smaller ecosystems.

LINKING TO LITERACY

Main Ideas

Readers who recognize main ideas and keep them in mind as they read are more successful at understanding the text that they are reading.

Read the last paragraph on the previous page, the text on this page, and look at the illustration and photo. Then re-read the first line of the last paragraph on the previous page. What main idea is discussed in that paragraph? What is the main idea in the last paragraph on this page?

Humans are also part of ecosystems. Visitors entering Point Pelee (Figure 6) may accidentally introduce things into the environment, such as trash, or they may tread on plants by mistake. Visitors may also scare away animals by making too much noise. People may also bring seeds, plant parts, and insects into ecosystems on their shoes or clothing. This can introduce new species. You will learn more about introduced species in Chapter 6.

Figure 6 Humans can affect the ecosystems that they interact with.

Unit Task Ecosystems have abiotic and biotic elements that interact. How can this knowledge help you with the Unit Task?

CHECK YOUR LEARNING

1. Draw diagrams of some of the living and non-living elements of Point Pelee. Draw lines to indicate the interactions between the living and non-living parts. Describe those interactions.
2. Describe in your own words the difference between species, population, and community. Give examples.
3. Name three human interactions that may happen in an environment such as Point Pelee.
4. Explain how a rotting log can be an ecosystem.
5. Give an example of a smaller ecosystem existing within a larger ecosystem.

4.2 The Needs of Living Things

LINKING TO LITERACY

Scanning

Scanning is a way of previewing the section to get an idea of what it is about. Look at the title of this section. Now look at the subheads. What do you think are the needs of living things?

Can organisms live in every environment found on Earth (Figure 1)? Think of what you need to survive. You need a warm place to live, food, water, and air. All organisms have basic survival needs. If these needs are not met within their environment, the organism cannot live there. The physical space where an organism lives is called its **habitat**. An organism can only live in a habitat where its basic needs are met.

habitat: the environment where an organism lives

Figure 1 Death Valley National Park in California is one of the hottest and driest places in North America. How do living things survive in such a harsh environment?

Sunlight

Sunlight is a basic need for life. Most of the energy that makes life possible comes from the Sun (Figure 2). Plants and animals need energy to grow and reproduce. Plants use sunlight to make their own food (sugars), which are then used to perform life functions. The amount of sunlight that an area receives can determine what is able to live there. For example, dandelions grow best in bright sunlight (Figure 3(a)), while ferns prefer shade (Figure 3(b)). Sunlight can shine through water only to a certain depth. Therefore, plants can only exist close to the surface in underwater ecosystems because they need sunlight to produce food.

Figure 2 Almost all the energy that makes life possible on Earth comes directly or indirectly from the Sun.

Figure 3 Different organisms have different needs. Dandelions require lots of sunlight to grow (a), whereas ferns grow best in shade (b).

Animals obtain energy indirectly from sunlight. Some animals consume plants, which have already produced energy-rich sugars using sunlight. Eating plants provides the animals with energy. These animals may then be consumed by larger animals, and energy is transferred. In this way, the energy produced in a plant may be transferred to a plant-eating animal, such as a deer, and then to another animal that consumes the deer.

Sunlight heats Earth's surface and provides warmth. Many animals such as snakes depend on this warmth to raise their body temperature so they can move more quickly. In Canada, there are more hours of sunlight in the summer than there are in the winter. Changes in the number of hours of sunlight trigger seasonal events such as bird migration and the flowering of plants.

Air

Air is another basic need for life. Air is made up of many gases, including oxygen, carbon dioxide, and nitrogen. Humans and many other organisms breathe in air to obtain oxygen, which they need to perform life processes (Figure 4). Plants absorb carbon dioxide from the air. They need carbon dioxide to produce sugars. In addition to sugars, plants produce oxygen. Oxygen production by plants is one of the most important processes on Earth. Without the oxygen input from plants, there would not be enough oxygen in the air for most organisms to perform their life functions. In one way or another, all organisms depend on the oxygen produced by plants. You will learn more about this in Chapter 5.

The gases found in air are critical for living things to survive. Canadian environmentalist Dr. David Suzuki stresses the importance of air: "You can't see it or grab it or hear it, but it's just about the most precious thing in the world."

To learn more about the David Suzuki Foundation, Go to Nelson Science

Figure 4 This moose cow is breathing air to obtain the oxygen its body needs.

Water

All organisms need water to survive (Figure 5). Animals need water to digest food and to form body fluids, such as blood, that distribute water, minerals, gases, and food particles throughout their bodies. Plants need water to grow and produce their food. Organisms vary in their need for water. Some need salt water, while others need fresh water. Some need very little water and others need a lot.

Many organisms live in water. Water contains dissolved oxygen and carbon dioxide. Water plants, such as seaweed and pond lilies, absorb carbon dioxide from the water, and animals, such as lake trout and clams, absorb oxygen from the water.

Figure 5 Water covers 74 % of Earth's surface. Adult humans are composed of about 60 % water.

Food

nutrient: a substance that an organism needs to grow and maintain its body

Food provides organisms with nutrients (Figure 6). A **nutrient** is a substance that an organism needs for energy and to grow and maintain itself. Nutrients include sugars and starches, fats, proteins, vitamins, and minerals, such as phosphates and nitrogen. Plants that live on land absorb nutrients from the soil and surrounding environment. Animals obtain nutrients from the food they eat as well as from the environment.

Figure 6 Plants obtain nutrients from the soil and surrounding environment. Humans can obtain nutrients from the plants they grow as crops.

Ideal Temperature Range

In everyday terms, temperature is a measure of the warmth or coolness of a place or object. Temperature is affected by the interactions of sunlight, soil, air, and water.

Temperatures on Earth can range from –88 °C to 50 °C. Most organisms have an ideal temperature range in which they can live. If temperatures are too hot or too cold for any length of time, then the organism may not be able to survive. For example, brook trout prefer water temperatures between 4 °C and 20 °C and will only lay eggs when the water temperature is below 13 °C (Figure 7).

Figure 7 Brook trout will lay eggs only when the water temperature is ideal.

TRY THIS: Identify the Best Living Conditions

SKILLS MENU: performing, communicating

When you purchase a plant from a store, the plant comes with instructions on how to care for it (Figure 8). You can use this information to determine the best growing conditions for the plant. Visit a plant nursery or pet store or conduct research on the Internet to help you with the following activity.

Equipment and Materials: markers; scissors; bristol board

1. Choose an organism to study. This organism could be a plant or animal from an ecosystem in your area, or a pet.
2. Research the needs of the organism you have chosen.

Go to Nelson Science

A. Design a "best living conditions" list of instructions for your organism.

B. What are the most important considerations you have to take into account?

C. Are conditions for plants and animals similar? Explain.

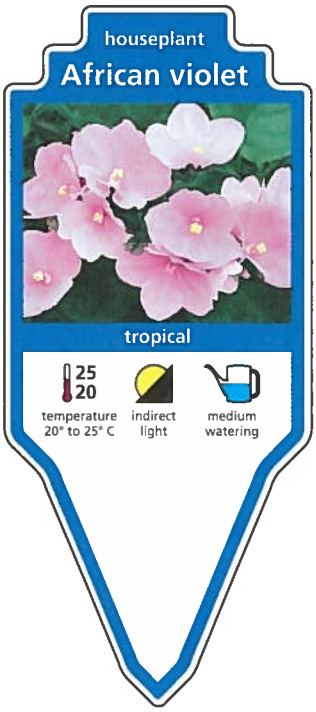


Figure 8 Plant tags provide information on how to care for the plant.

Many abiotic elements determine which organisms can live in a particular location. For example, few plants can survive in Canada's Arctic because of the cold temperatures, long periods without sunlight, and lack of nutrients in the soil.

Unit Task Living things need sunlight, air, water, food, and ideal temperatures to survive. How might this information help you in the Unit Task?

CHECK YOUR LEARNING

1. **(a)** List the basic needs of all living things.
   (b) Explain why organisms need these factors to survive.
2. Explain why sunlight is a basic need for both plants and animals.
3. Describe the different ways that different organisms need water to survive.
4. Name two ways that plants affect human survival.

Designing Your Own Model Ecosystem

SKILLS MENU

- ☐ Questioning
- ☐ Hypothesizing
- ☐ Predicting
- ☐ Planning
- ☐ Controlling Variables
- ☐ Performing
- ☐ Observing
- ☐ Analyzing
- ☐ Evaluating
- ☐ Communicating

An ecosystem exists in an area when the living (biotic) and non-living (abiotic) parts of the environment interact. In this activity, you will study biotic and abiotic elements by creating your own model ecosystem (Figure 1). You will observe any changes that occur in your model ecosystem, as well as any interactions among the biotic and abiotic elements.

Figure 1 A model ecosystem

Purpose

To design and build an ecosystem and observe the interactions among the living (biotic) and non-living (abiotic) elements.

Equipment and Materials

- clear plastic container, such as an aquarium, large jar, or 2 L plastic drink bottle
- light source
- hand lens or magnifying glass
- thermometer
- gravel
- aquarium-grade charcoal
- garden soil
- 2 to 4 small plants
- small animals such as earthworms and isopods (pillbugs)
- water
- dry leaves

clear plastic container

light source

hand lens or magnifying glass

thermometer

gravel

aquarium-grade charcoal

garden soil

2 to 4 small plants

small animals such as earthworms and isopods (pillbugs)

water

dry leaves

Notify the teacher of any allergies that you have. Wash your hands upon completing your ecosystem. Treat animals with care and respect. Do not use mercury thermometers.

Procedure

SKILLS HANDBOOK 2.B.6.

1. Use the equipment and materials listed to design a model ecosystem. You can use other items if they are necessary for your design.
2. Make sure that your ecosystem includes the following: good soil drainage, plants and animals, adequate space for the organisms, moisture (water), a way for fresh air to enter and leave, a means of recording temperature, and a way to keep the animals from escaping from the container.
3. Have your teacher approve your design before you begin constructing your model.
4. Build your ecosystem. Record the number and type of plants and animals that you place in your ecosystem.
5. Place the container in a sunny location or under artificial light. Your ecosystem should receive 6 to 8 hours of light per day.
6. Observe your ecosystem regularly. Use a table similar to Table 1 to record your observations. In addition to completing Table 1, use diagrams to illustrate your observations. Describe any changes seen in the organisms or in the activities that the organisms are doing. Record the temperature of the soil, as well as its condition (dry, moist). You may need to add water to maintain moisture in the ecosystem.

Table 1 Ecosystem Observations

Date	Temperature	Soil condition	Changes

7. Continue observing and maintaining your ecosystem for at least three weeks. Add water as needed.
8. At the end of three weeks, take apart your ecosystem. Release any animals into an appropriate natural habitat, and clean up the remaining materials.

Analyze and Evaluate

(a) What are the abiotic elements in your ecosystem? What are the biotic elements?

(b) Use your observations to explain the interactions between the biotic and abiotic elements in your ecosystem.

(c) Was your model ecosystem design successful? Explain. How might you design it differently?

(d) Using your inference skills, describe three interactions that you believe were occurring in your model ecosystem, but that you did not observe directly.

(e) Is your classroom an ecosystem? Explain.

Apply and Extend

(f) Study your observations and diagrams of your ecosystem. What might happen to the ecosystem if you removed it from the light source for a long period of time? Stopped watering it for a long period? Took away another biotic or abiotic element?

(g) Using the Internet and other sources, research *Biosphere 2*. Imagine that you are designing a similar project. What types of organisms would you include in your biosphere? How would you provide for the needs of all living things in your biosphere?

Go to Nelson Science

Unit Task Now that you have designed your own model ecosystem, how might you use this new knowledge in completing the Unit Task?

4.4 Interactions among Living Things

Recall from Section 4.1 that a population is all the members of a particular species found in one area. Biological populations vary in size. They can be large, such as an ant colony (Figure 1), or small, such as a single pair of breeding woodpeckers in a woodlot (Figure 2).

Figure 1 The tens of thousands of ants that live in this ant nest are an example of a large population.

Figure 2 The two red-bellied woodpeckers shown here represent a small population.

TRY THIS: Counting Populations

SKILLS MENU: performing, observing, analyzing, communicating

SKILLS HANDBOOK 2.B.7.

The size of populations and number of populations in a specific area can vary greatly. In this activity, you will compare the size and number of plant populations on your school grounds.

Equipment and Materials: metre stick; plant identification guide (optional)

1. In groups of three or four, measure out an area of 1 m^2 on your school grounds where vegetation is growing. This will be your study plot. All of the class study plots should be close together and in the same general location.
2. Find three plant species growing on your plot. Draw a sketch of each of these plant species. If you know the names of your selected plants, record them on your drawings. Your teacher may provide you with identification guides to help you identify the plants.
3. For each species of plant, count the number of individuals on your plot. Record your totals.
4. Compare your findings with other groups. Use information from your classmates' drawings to fill in the names of any species that are missing from your own drawings.
5. Create a master list of plants and their populations for the total area (all study plots) covered by your class.

A. Which plant species in your plot had the largest population? Which plant species had the smallest population?

B. When you compared your findings with other groups, were there any plant species that were found on all or most of the study plots? If so, name them.

C. Were there any plants on your study plot that were not found on other study plots? If so, name them.

D. When all the study plots were compared, which plant species was the most common? How do you know this?

E. Which plant, or plants, was the least common over all the study plots?

Although ecosystems vary in size, there is a limit to the number of organisms an ecosystem can support. Abiotic factors limit the number of organisms that can live in an ecosystem. For example, if there is little water, then only a few plants can grow. How organisms interact within an ecosystem also limits the number of organisms in an ecosystem. Two important biotic interactions are competition and predation.

Competition

Competition is the struggle that happens when organisms in the same habitat try to use the same resources. For example, plants that grow close together in one area compete for the same water, sunlight, and nutrients (Figure 3). If these resources are limited, some plants may become small and thin, and some may die. This leaves more water, sunlight, and nutrients for the remaining plants, which survive and grow strong. Competition controls the population size by limiting the number of organisms that can survive on the resources in the area.

competition: occurs when more than one organism tries to obtain the same basic resources in the same habitat

Figure 3 All these plants are competing for the same resources.

Animals also compete for resources. A pond may only be able to provide enough food and water for a certain number of frogs. If too many frogs live in the same area and compete for resources, there will not be enough food and water. Some frogs will move to another area or some may die. Humans are an example of an organism that competes with other organisms for resources. When farmers grow crops, they spray pesticides on the crops to stop other organisms from eating them. Farmers are able to control, or even eliminate, competing organisms.

Predation

predator: an organism that hunts other living things for food

prey: an animal that is hunted by a predator

An animal that hunts other animals for food is called a **predator**. The animal that is hunted by the predator is called the **prey**. A wolf (predator) eating a moose (prey) is an example of a predator–prey relationship (Figure 4). A moose eating grass is not an example of a predator–prey relationship because the moose does not need to hunt the grass.

Figure 4 These wolves are feeding on a moose they have hunted.

The population of predators is affected by the population of prey and vice versa. The number of predators can only increase if there is enough food to eat. If a predator population is increasing in size, the prey population will decrease in size because more predators are eating prey. Hence, predators keep the number of prey from increasing. However, if the prey population gets too low, there is not enough for the predators to eat. The predator population decreases; some individuals die from starvation and others may be too weak to produce young. As the predator population decreases, the prey population increases because there are fewer predators hunting them. This results in an up-and-down pattern of predator and prey populations in a particular habitat over time (Figure 5).

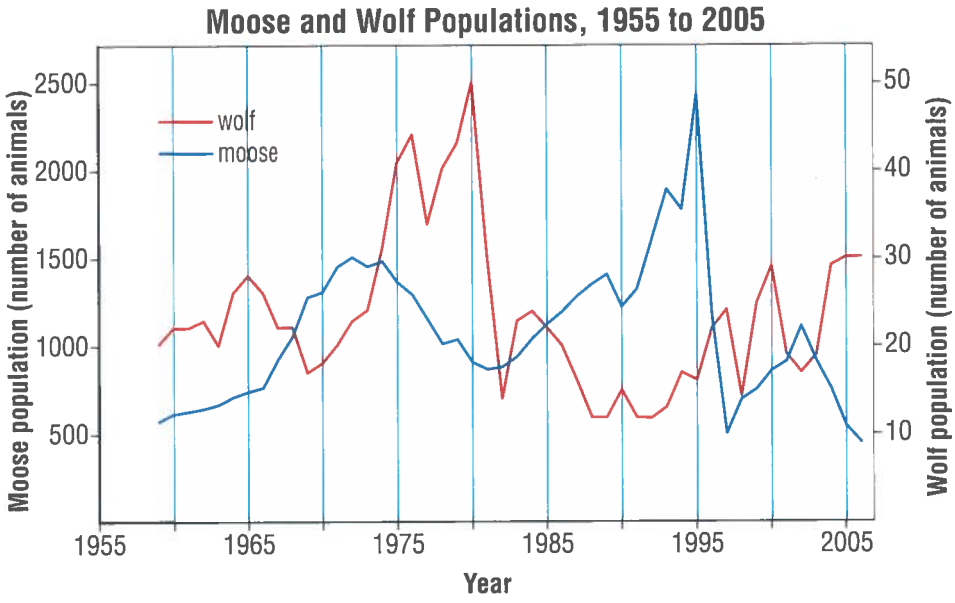


Figure 5 As the wolf population increased between 1970 and 1980, the moose population decreased in size. When the wolf population decreased in size, the moose population recovered.

The predator–prey cycle also affects plant populations. Most prey animals, such as moose and rabbits, feed on plants. When the prey population is large, the prey animals eat all of the available plants in the habitat. The plant population gets smaller, which can lead to starvation of the prey animals. Predators can now easily catch the weakened prey, which reduces the prey population. The plants then have a chance to recover because there are fewer prey animals eating them.

Mutualism

In competition and predation, one organism usually "wins" while another "loses." However, there are some interactions between organisms in which both organisms "win." **Mutualism** is an interaction between individuals of different species in which both individuals benefit. An example of mutualism can be seen when a bee visits a flower. The bee takes nectar from the flower for food, and picks up pollen from the flower while doing so. The pollen is then transferred to the next flower the bee visits. This transfer of pollen allows plants to reproduce. The nectar benefits the bee and the transfer of pollen benefits the flower.

mutualism: an interaction between individuals of different species that benefits both individuals

To try an interactive pollination activity, Go to Nelson Science

Another example of mutualism occurs between plants of the legume family and bacteria in the soil. Peas, beans, peanuts, and other legumes have swellings on their roots (Figure 6). These swellings contain special bacteria. The bacteria provide the plants with nitrogen, and the plants provide the bacteria with several nutrients that the bacteria need to survive. Both the bacteria and the legume plants benefit from the interaction.

Figure 6 The swellings on the roots of this field bean plant contain bacteria. The process by which bacteria provide plants with nitrogen is called "nitrogen fixation." The bacteria that do this are called "nitrogen-fixing bacteria."

Unit Task The interactions among living things affect their ability to survive. How might this knowledge help you with the Unit Task?

CHECK YOUR LEARNING

1. In your own words, explain competition.
2. Explain how competition affects the number of organisms that can live in a habitat.
3. **(a)** Give an example of a predator.
   (b) Give an example of a prey animal.
4. **(a)** Look at Figure 5. Describe what is happening to the wolf population and the moose population between 1985 and 1990.
   (b) In your own words, explain why this is happening.

AWESOME SCIENCE

Living Walls

You walk into one of the many tall buildings in the "concrete jungle" of a typical urban centre. As you enter, you hear cascading water, feel and smell the cool, fresh air, and then you see a green wall. Are those plants growing up the wall? Welcome to the world of living walls (Figure 1)!

Figure 1 The living wall at the University of Guelph contains over 1000 plant species.

When we think of air pollution, we usually think of the air outdoors. Indoor air can also be polluted. Sources of indoor air pollution include moulds, pet dander, plant pollen, and chemicals from paints and furniture. Living walls are an environmentally friendly way to improve the air quality inside office buildings. A living wall can remove up to 90 % of over 300 different pollutants from indoor air.

A typical living wall (Figure 2) is made of a material that allows air and water to flow through it. Two layers of this material are attached to each other and mounted on the wall. Plants are placed into holes in the material, where their roots grow and hold them in place. The bottom edge of the living wall sits in a pool of water. The water is pumped to the top of the wall where it trickles down. Fans placed behind the living wall pull air through the wall and send it to different parts of the building.

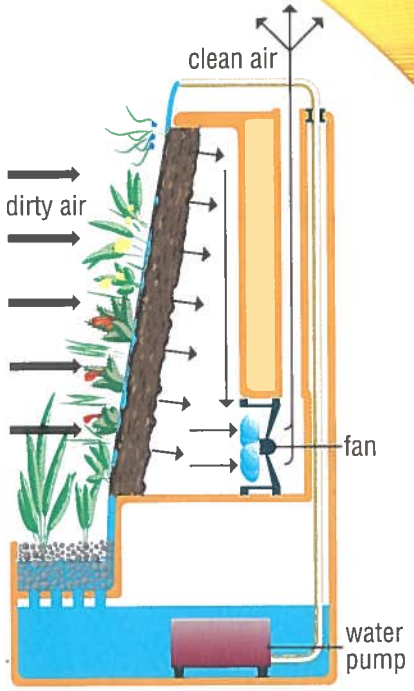


Figure 2 Cross-section of a living wall

How does a living wall clean the air? Most of the work is done by micro-organisms, which live on the plants' roots. As air passes through the wall, the micro-organisms consume the pollutants in the air and break them down into harmless substances. This process is known as biofiltration. For this reason, living walls are sometimes called "biowalls." In addition to providing a habitat for the micro-organisms, the plants also remove carbon dioxide, another indoor pollutant, from the air.

To learn more about living walls,
Go to Nelson Science

How Do Humans Fit into Ecosystems?

4.5

The girl in the *Tina's Groove* cartoon on page 95 said, "A healthy atmosphere, clean water—that's not very good evidence of human habitation." Humans have a bad reputation when it comes to protecting the environment.

A healthy ecosystem consists of interactions among living and non-living elements. Different species, including humans, interact with each other. Although we do not always interact directly with the natural environment, we are still part of ecosystems. We depend on resources such as sunlight, soil, water, and air for our survival, and we also depend on other species.

Humans tend to change the ecosystems they live in. For example, most of southern Ontario used to be forested land. When European settlers arrived, they cut down most of the forests to clear land for farms and towns. The wood was used for building materials and firewood. Today, southern Ontario is mostly made up of urban areas and farmland. Only a small amount of forest remains (Figure 1).

LINKING TO LITERACY

During Reading: Asking Questions

Good readers ask questions as they read to make sure that they understand a topic. Sometimes these questions lead to learning more about a topic. As you read about how humans fit into ecosystems, try to be an active reader. Ask questions and think about how you fit into ecosystems.

Figure 1 Humans have changed ecosystems to meet their needs. Much of the land in this photograph was once forest.

Like all organisms, humans compete with other species for basic needs in an ecosystem. Humans usually succeed because they have developed technology to help them. Humans change ecosystems to meet their needs. They take things from the environment to meet these needs. As a result, some species can no longer live in the same environment as humans. Humans have also introduced new elements to ecosystems, such as pollution. Pollution can affect all of the organisms in an ecosystem.

Farming

Humans can create ecosystems to grow food crops. Many technologies have been developed over the years to increase food production. For example, farmers often use fertilizers to promote plant growth. Many farmers also use pesticides to stop insects and other pests from eating the plants they grow (Figure 2).

These farming methods have other consequences. The excess nutrients from fertilizers and the toxic chemicals in pesticides can pollute the soil and water. Also, pesticide use harms other organisms in the ecosystem. For example, using pesticides to kill "pest" insects removes a food source for birds that feed on these insects. This causes bird populations to decrease. This, in turn, affects organisms that feed on the birds. Humans have also developed machines to help grow and harvest crops. Farm machinery contributes to air pollution.

To learn more about the impact of farming on the environment,
Go to Nelson Science

Figure 2 Although pesticides help remove insects from crops, they can also have negative effects on ecosystems.

Mining

Can you imagine a world without metal? Metals such as iron, steel, and aluminum are commonly used in farm machinery, automobiles, and household appliances. We rely on the use of metals in many areas of technology and industry. Nickel, for example, is a metal that is used in many different everyday items from batteries to braces (Figure 3).

We obtain metals by extracting metal ores (rocks that contain metal) from the ground. This is known as mining. Once a metal has been extracted, tailings (the remaining rock material) are left in large piles. Mine tailings contain toxic substances that can damage ecosystems. Tailings left out in the open after mining can release toxic chemicals into the surrounding soil. Over time, rain will carry these substances into nearby lakes, rivers, and oceans. This has a negative impact on the organisms living in those ecosystems.

Figure 3 The archwire in orthodontic braces is made of a mixture of nickel and titanium metals.

Nickel has been mined near Sudbury for over 100 years. Sulfur dioxide is one of the many toxic substances released in the mining process. Over the years, sulfur dioxide released from mine tailings caused severe damage to the land and water surrounding Sudbury (Figure 4). By the 1960s, the ground was so polluted that almost no native plants could grow in the soil. Without these plants, the native animals could not survive there either.

The mining companies reduced their emissions of sulfur dioxide and other toxic substances such as arsenic, cadmium, and mercury. By the late 1990s, sulfur dioxide emissions were reduced by 75 %. Since then, the land around Sudbury has started to recover, and native plants and animals have returned to the area. However, even at lower levels, sulfur dioxide and other toxic substances continue to pollute the air, water, and land.

To learn more about how Sudbury is recovering from environmental damage, Go to Nelson Science

Figure 4 Toxic substances can wash out of mine tailings and pollute the local water and land, which can poison local plants and animals.

Humans have developed many different technologies to make life easier and more comfortable. However, making and using these technologies often creates pollution. For example, automobiles, trains, and airplanes provide great benefits by transporting people and goods all over the world. However, they also pollute the air and water, and add solid waste to the environment. Humans have come to realize that current methods of making and using technologies are not healthy for the environment or for living things. Humans are now working hard to reduce the amount of pollution we produce. We are developing "green" technologies to help protect our environment.

CHECK YOUR LEARNING

1. Describe how humans change the ecosystems they live in.
2. What are the benefits and drawbacks of using fertilizers?
3. What are the benefits and drawbacks of using pesticides?
4. Mining has costs and benefits. Give examples of both the costs (disadvantages) and benefits (advantages) of mining.

SKILLS MENU

- ☐ Defining the Issue
- ☐ Researching
- ☐ Identifying Alternatives
- ☐ Analyzing the Issue
- ☐ Defending a Decision
- ☐ Communicating
- ☐ Evaluating

The Impact of Vehicles on the Environment

Vehicles, such as cars, vans, and trucks, have had an enormous impact on how we live our lives. Without automobiles, travelling even a few kilometres would take a very long time. We depend on emergency services to arrive within minutes (Figure 1(a)). Vehicles also provide many jobs to people, from those who make them to the mechanics who repair them. However, vehicles also cause air and water pollution (Figure 1(b)). Building roads for vehicles also contributes to the destruction of natural habitats for living things.

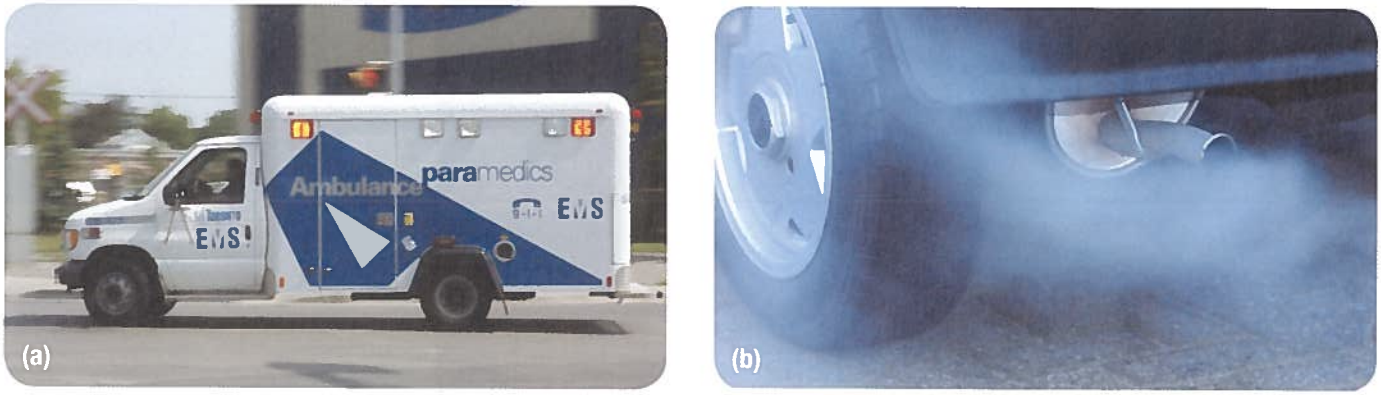


Figure 1 Vehicles can literally save lives (a), but they can also cause air pollution (b).

The Issue

An environmental organization wants to bring attention to how vehicles affect the environment, including ways they may benefit society and hurt the environment. They have hired you as a consultant. You have been asked to create a public awareness campaign presenting the impact of vehicles on the environment's ability to support life. Your campaign should address benefits, problems, and possible solutions.

To prepare for your campaign, you will research the impacts of vehicles on the environment. You will then select three impacts that most affect the ability of the environment to support life. These three impacts will be the basis for your campaign.

LINKING TO LITERACY

Critical Literacy

Describe the environmental organization's point of view. Is there a point of view that will not be represented by your work? Who is the audience that will be targeted by this campaign? Think of reasons why people might be resistant to your project.

Goal

To research the impacts that vehicles have on the environment and to create and present a public awareness campaign outlining these impacts.

Gather Information

Working in groups, investigate the impact vehicles have on the environment. In what ways do vehicles help us in our daily lives? What are the environmental impacts of building, using, and disposing of vehicles? What natural resources are used at any of these stages of a vehicle's life? What effects do vehicles have on the water, land, and air? Is habitat destruction involved at any stage?

Use the Internet, newspaper and magazine articles, conservation groups, and local community members to find information.

Identify Solutions

As you conduct your research, consider both the positive and negative effects that vehicles have on society. Research possible solutions to the negative effects of vehicles on the environment. Depending on the effect, possible solutions may include

- starting anti-idling campaigns
- choosing energy-efficient vehicles (hybrids, hydrogen fuel cells)
- promoting walking and biking when travelling short distances
- introducing stronger pollution controls
- introducing "no-vehicle" zones in cities

Make a Decision

Review the research of everyone in your group. Decide which three impacts most affect the ability of the environment to support life. Then, decide how best to communicate these impacts to a general audience in a public awareness campaign.

Communicate

Create a public awareness campaign to show your findings. The campaign can take the form of a commercial, brochure or pamphlet, public service announcement, billboard, or multimedia presentation. The campaign should clearly show each impact of vehicles on the environment. The campaign should also inform the public about what they can do to reduce the impact of vehicles on the environment.

Your class will represent the environmental group that hired you. Present your campaign to them, and explain why you chose the three impacts that you did. Be prepared to answer any questions they may have.

CHAPTER 4

SUMMARY

Healthy Ecosystems

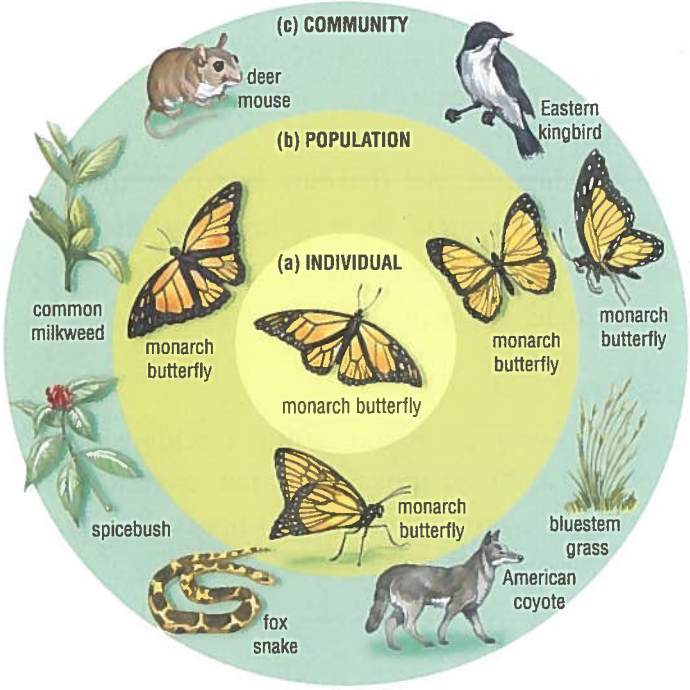
BIG Ideas

- ☑ **Ecosystems are made up of biotic (living) and abiotic (non-living) elements, which depend on each other to survive.**
- ☐ Ecosystems are in a constant state of change. The changes may be caused by nature or by human intervention.
- ☑ **Human activities have the potential to alter the environment. Humans must be aware of these impacts and try to control them.**

Looking Back

Ecosystems are made up of living and non-living elements.

- Biotic elements in ecosystems are living things, such as plants, animals, and micro-organisms.
- Abiotic elements in ecosystems are non-living things, such as sunlight, air, water, and temperature.
- Within ecosystems, living things can be organized into individual species, populations, and communities.
- All ecosystems, whether large or small, are interconnected. Some ecosystems contain smaller ecosystems within them.



The living things in an ecosystem depend on each other and on non-living elements for survival.

- All organisms have basic needs. An organism can only live in a habitat where its basic needs are met.
- The abiotic elements in a habitat often determine which organisms can live in that particular location. These include sunlight, water, air, and an ideal temperature range.

Living and non-living elements interact with each other in many different ways.

- Some organisms in an ecosystem compete for the same resources. Competition limits the number of organisms that can live in an ecosystem.
- The number of prey affects the number of predators that can live in an ecosystem. In a similar way, the number of predators affects the number of prey in the ecosystem.
- Mutualism is an interaction between two species in an ecosystem in which both species benefit from the relationship.

The skills of scientific inquiry can be used to investigate the living and non-living elements in a model ecosystem.

- Model ecosystems can be designed and built using everyday equipment and materials.
- Model ecosystems can be used to observe biotic and abiotic elements and the interactions between these elements.

Humans are part of ecosystems and affect ecosystems.

- Humans interact with living and non-living elements of the environment. They compete with other organisms for resources.
- Humans often win competitions with other organisms because humans can develop technology to help them survive. Farming and mining are two common techniques humans use to obtain resources from the environment.
- When humans take resources from ecosystems, they often leave pollution, which affects other organisms.

VOCABULARY

biotic element, p. 97
organism, p. 97
micro-organism, p. 97
species, p. 97
population, p. 97
community, p. 97
abiotic element, p. 98
ecosystem, p. 98
ecology, p. 99
habitat, p. 100
nutrient, p. 102
competition, p. 107
predator, p. 108
prey, p. 108
mutualism, p. 109

CHAPTER 4 REVIEW

The following icons indicate the Achievement Chart categories: K/U Knowledge/Understanding; T/I Thinking/Investigation; C Communication; A Application

What Do You Remember?

1. For each of the following, explain the difference between the two terms:
   (a) biotic and abiotic
   (b) individual and population
   (c) predator and prey K/U
2. Give two examples of biotic–abiotic interactions. K/U
3. (a) What is an ecosystem?
   (b) How is an ecosystem different from a habitat? Give an example of each. K/U
4. (a) What do all of the ecosystems in Table 1 have in common?
   (b) How are they different? K/U

Table 1 Ecosystems and Their Populations

Ecosystem	Some populations in the ecosystem
frozen ocean in Hudson Bay	polar bears, ringed seals, beluga whales, Arctic cod, Arctic char, krill, algae, plankton, Arctic terns, Arctic foxes
rotting log	salamanders, toads, millipedes, centipedes, bacteria, fungi, woodpeckers, earthworms, snails, bark beetles, mosses, lichens
urban vacant lot	dandelions, crab grass, thistles, clover, cats, deer mice, dogs, house sparrows, starlings, pigeons

What Do You Understand?

5. List all the biotic and abiotic elements in an area near you. Explain why this area may be an ecosystem. A
6. (a) Give an example of a predator–prey relationship that may exist in the ecosystem you studied in question 5.
   (b) Give an example of competition from your ecosystem. A
7. List some populations that form the community in the area you studied in question 5. A
8. Use an example to explain how competition limits the number of organisms that can survive in an ecosystem. A
9. (a) The graph in Figure 1 indicates that as snowshoe hare populations rise, lynx populations also rise. Between 1925 and 1930, the population of snowshoe hares dropped to a very low level. Explain how this might have happened.
   (b) Explain why the hare population then increased so dramatically. A

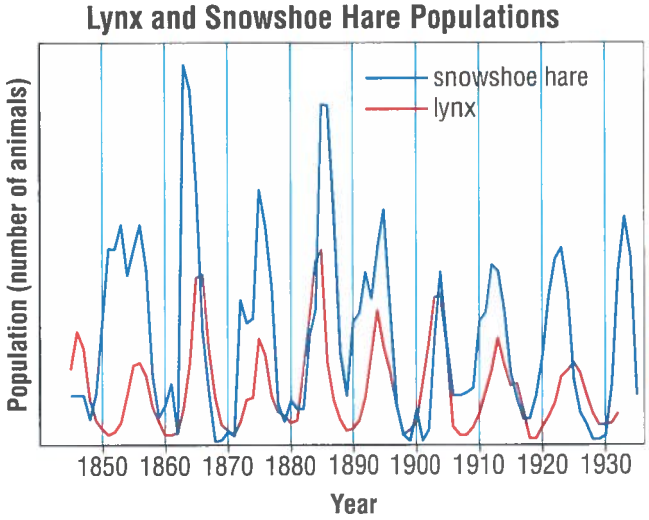


Figure 1

10. Humans are able to live in more types of environments than any other species. Explain this statement. A
11. (a) Make a list of organisms in your environment that you compete with. Explain how you compete with them.
    (b) Are humans as susceptible to environmental influences as other organisms are? Defend your answer. A
12. (a) Describe three human activities that can have a negative effect on an ecosystem.
    (b) For each negative effect that you described in part (a), describe a human activity that can reduce the negative effect. A

Solve a Problem!

13. Imagine you are a gardener. You are having trouble growing a certain species of plant in the area where you live (Figure 2).
    (a) Suggest possible reasons why this type of plant will not grow in your area.
    (b) What steps could you take to solve the problem? T/I A

Figure 2

14. You are the Environment Club team captain and your project is to help your school become certified as a "green" school. You notice that there are lots of old computers lying around that must be disposed.
    (a) Investigate how computers are used in your school and how they make life easier for students and teachers.
    (b) Investigate the environmental issues around the production and disposal of computers.
    (c) Create a set of standards for your School Board that outlines how computers should be purchased, used, and disposed. These standards should balance the needs of students and teachers, as well as the needs of the environment. A

Create and Evaluate!

15. (a) Research several First Nations stories (myths and legends) that promote the importance of the four elements—sunlight, water, earth, and air. Summarize these stories and create a visual display promoting the need to look after these elements.

Go to Nelson Science

    (b) Write your own legend or myth that promotes the idea that it is important to look after the environment. Exchange your legend/myth with a friend and evaluate each other's work objectively. How well does the legend/myth get your message across? C

16. Select an ecosystem found in Ontario. Your ecosystem can be an urban one (something found in a city) or a rural one (something found outside of the city or in the country). The ecosystem can be one planned by humans or a natural one. Create a poster about the ecosystem, identifying all of the abiotic and biotic elements in it. You should also identify the interactions between the different elements. Your classmates will then evaluate your poster and add any elements or interactions you may have missed. A C

Reflect on Your Learning

17. Think about the Big Ideas that you learned about in this chapter. List three questions that you still have about these Big Ideas.
18. List the three most important ideas you have learned about your local ecosystem. What is the most fascinating idea you discovered? Why?
19. Think back to the Key Question on the first page of this chapter.
    (a) In a brief paragraph, answer the Key Question. You may use diagrams.
    (b) Write one or two more questions about the topic of this unit that you would like to explore.