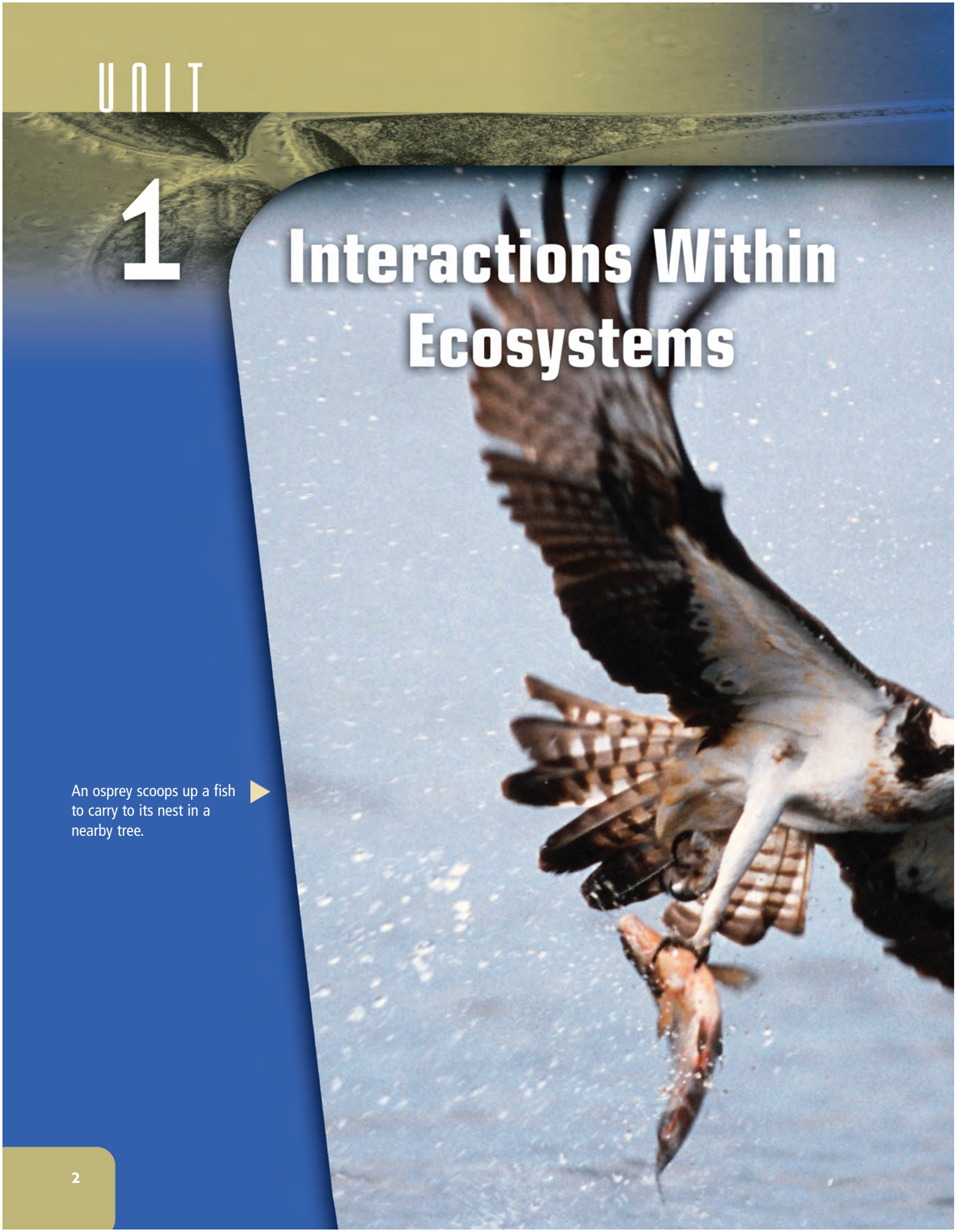
UNIT

1 Interactions Within Ecosystems



An osprey scoops up a fish to carry to its nest in a nearby tree.

Key Ideas

1 **An ecosystem is all the living and non-living things in a particular place.**

1.1 Types of Ecosystems
1.2 Abiotic Parts of an Ecosystem
1.3 Biotic Parts of an Ecosystem

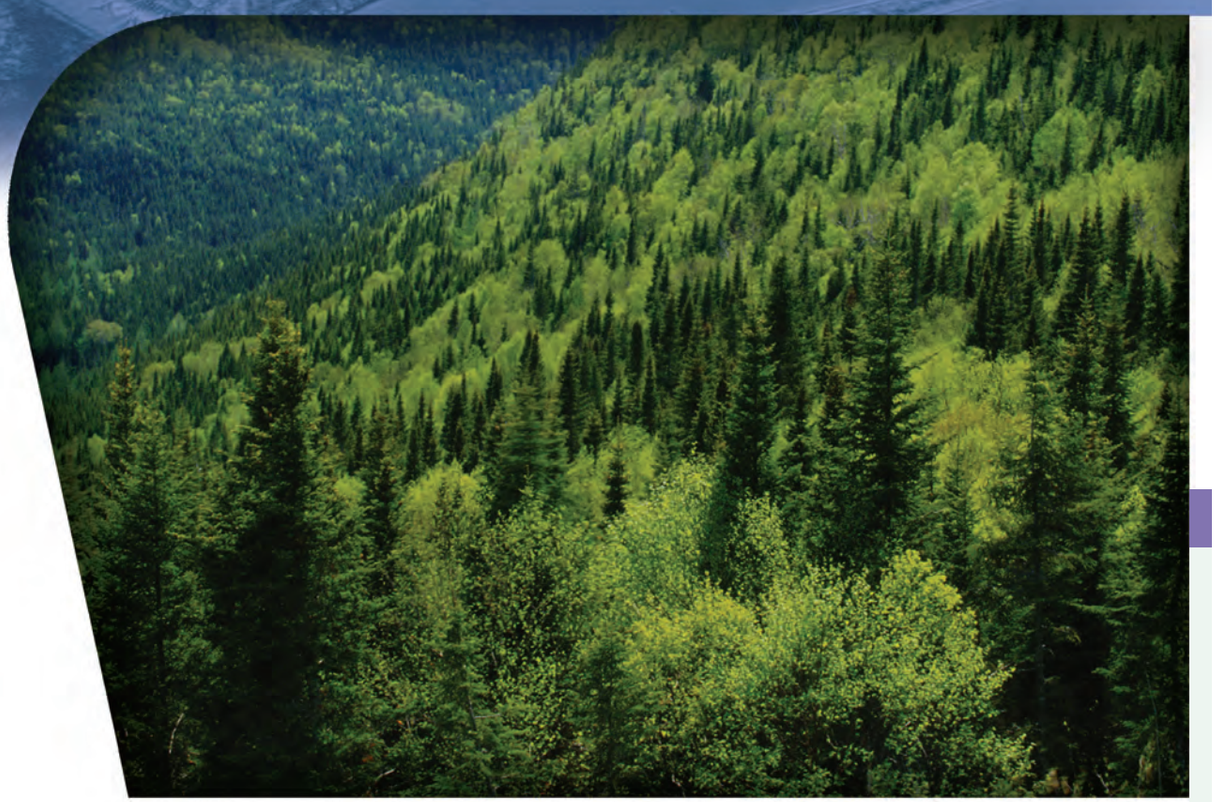
2 **Living and non-living things interact in ecosystems.**

2.1 Types of Interactions
2.2 Roles of Organisms in Ecosystems
2.3 Food Chains, Food Webs, and the Transfer of Energy
2.4 Cycles of Matter in Ecosystems

3 **Natural events and human activities cause changes in ecosystems.**

3.1 Natural Disturbances and Succession
3.2 The Impacts of People on Ecosystems
3.3 Monitoring and Managing Ecosystems

Getting Started



How would you describe this forest?

Word Connect

The word "ecology" comes from two ancient Greek words that mean home (*eco-*) and study (*-logia*). Ecology, therefore, is the study of our home, planet Earth.

Suppose you went into a forest like the one in the photograph, looking for animals. Where would you look? What would you expect to see? Apart from animals and trees, what other living things might make their home in a forest?

Now imagine you must describe the forest to a friend. As well as telling your friend about all the living things you observed, you might also say that the forest was dark and cold. Perhaps you noticed the soil underfoot. Maybe you saw a small stream or a pond in the forest. As you study the science of ecology in this unit, you will learn how different parts of the environment such as animals, plants, soil, and water all affect one another.

Natural occurrences such as forest fires, storms, or droughts cause changes in the ways that living things interact with each other and with their environment. Human activities can also cause changes, often in negative ways.

In many parts of the province, forests are being logged for timber. Some people are concerned about logging projects because of the potentially damaging impact on native organisms.

What effects might the removal of trees have on other plants and on animals living in the forest? How might logging affect the soil and streams?

Towns and farmland exist today in areas where forests once grew. What kinds of plants and animals live in towns and on farmland? What changes do you think might take place in a farmer's field if the farmer abandons it?

internet connect

Find out more about the effects of logging on organisms in Newfoundland and Labrador at **www.discoveringscience.ca.**

What Is an Ecosystem?

Find Out ACTIVITY

How is a forest like a lake? Forests and lakes are two examples of ecosystems. In this activity, you will think about a local area that you have observed. Using this knowledge, your class will build a list of terms that help describe ecosystems.

Materials

- large sheet of paper
- pen or pencil
- ruler

What to Do

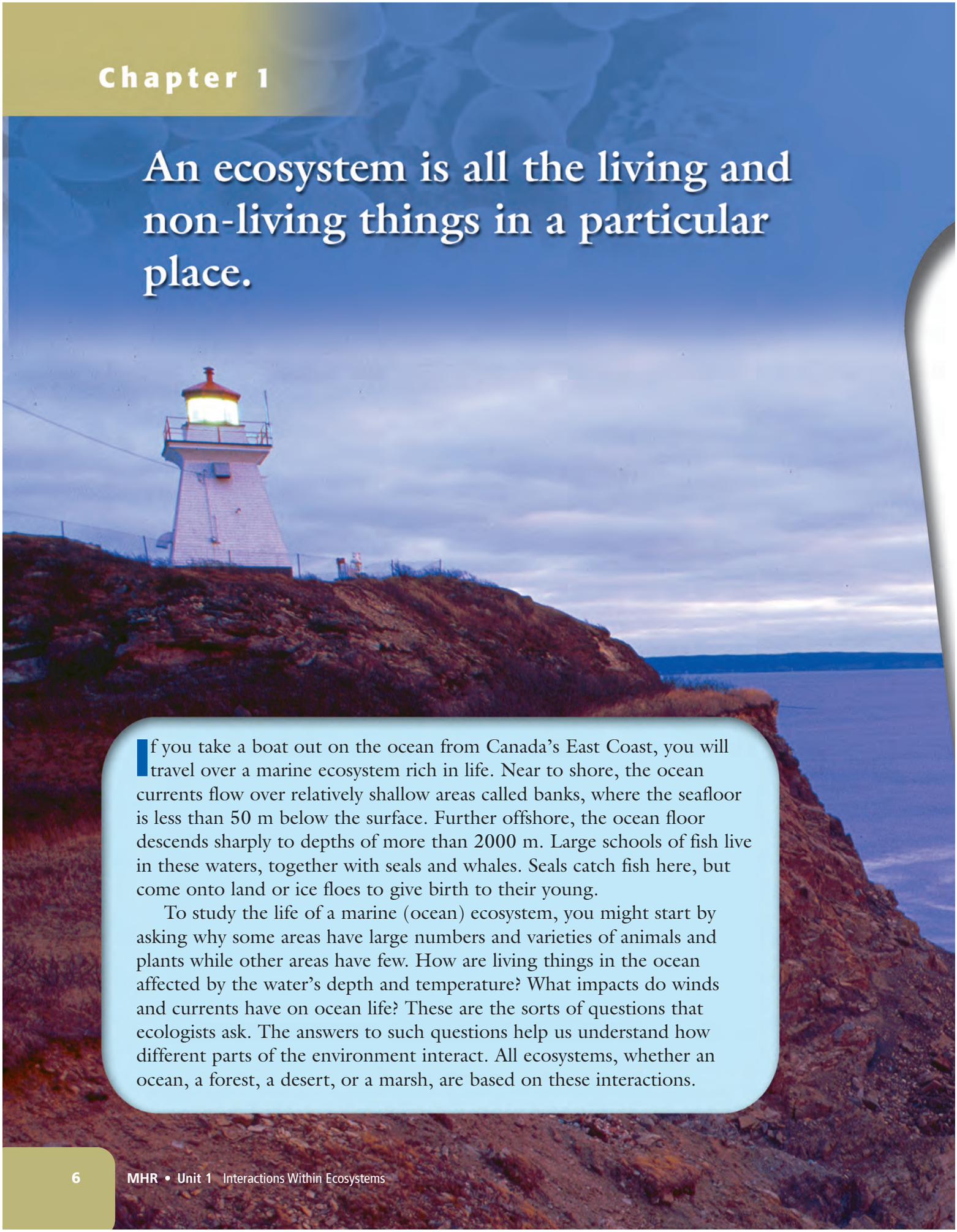
1. As a class, choose a local area to analyze. Write the name of the area at the top of your sheet of paper.
2. Divide the sheet of paper into two columns. Label one column "Living Things." Have a brainstorming session to make a list of all the living things you may have observed in the area, or that you think might live there. Write each suggestion in the column.
3. Label the second column "Local Conditions." Brainstorm a list of conditions found in the area. For example, is it wet or dry? Hilly or flat? Record each suggestion.

What Did You Find Out?

1. The prefix *eco-* means home. Based on this fact and the ideas you have shared with your class, write your own definition of the term *ecosystem.*
2. Could one of the living things on your list also live in a different ecosystem? Give an example. (**Hint:** For example, could a coniferous (evergreen) tree live in a prairie ecosystem? Could a prairie grass such as wheat grow in a forest ecosystem?)
3. Could one of the conditions on your list also be found in a different ecosystem? Give an example. (**Hint:** For example, would you expect to find damp conditions in an arctic ecosystem? Would you expect it to be chilly in a forest ecosystem?)
4. Name another ecosystem in which you would expect to find *none* of the living things on your list.

Chapter 1

An ecosystem is all the living and non-living things in a particular place.



If you take a boat out on the ocean from Canada's East Coast, you will travel over a marine ecosystem rich in life. Near to shore, the ocean currents flow over relatively shallow areas called banks, where the seafloor is less than 50 m below the surface. Further offshore, the ocean floor descends sharply to depths of more than 2000 m. Large schools of fish live in these waters, together with seals and whales. Seals catch fish here, but come onto land or ice floes to give birth to their young.

To study the life of a marine (ocean) ecosystem, you might start by asking why some areas have large numbers and varieties of animals and plants while other areas have few. How are living things in the ocean affected by the water's depth and temperature? What impacts do winds and currents have on ocean life? These are the sorts of questions that ecologists ask. The answers to such questions help us understand how different parts of the environment interact. All ecosystems, whether an ocean, a forest, a desert, or a marsh, are based on these interactions.

What You Will Learn

In this chapter, you will

- **identify** examples of local ecosystems
- **describe** the abiotic (non-living) and biotic (living) parts of an ecosystem
- **explain** how different parts of an ecosystem affect each other

Why It Is Important

Understanding ecosystems is a first step to solving problems in the environment, such as pollution and the decline in fish populations.

Skills You Will Use

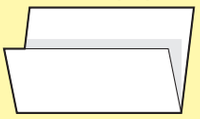
In this chapter, you will

- **record** information using instruments effectively and accurately
- **organize** and display data using tables and graphs
- **communicate** your ideas using scientific terms

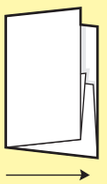
FOLDABLES™
Reading & Study Skills

Make the following Foldable to take notes on what you will learn in Chapter 1.

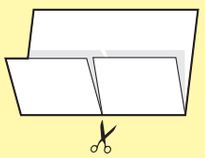
STEP 1 **Fold** an 8.5" × 11" sheet of paper as shown, so that about one third of its length is folded upwards. This should leave a tab 8-10 cm long exposed at the top of the sheet.



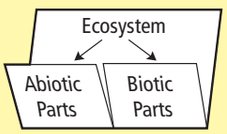
STEP 2 **Fold** the sheet in half width-wise.



STEP 3 **Unfold** the sheet and **cut** the bottom tab along the fold line as shown.



STEP 4 **Label** the Foldable as shown. **Draw** arrows from "Ecosystem" to "Abiotic Parts" and "Biotic Parts" to show the relationship between them.



Organize As you read this chapter, complete the Foldable by recording information, providing examples, and defining terms under the appropriate tabs.

1.1 Types of Ecosystems

All ecosystems include abiotic (non-living) and biotic (living) things. Ecosystems such as oceans and deserts may cover huge areas. Other ecosystems are quite small, such as a rock pool or a rotting log. Each ecosystem can be described by the types of organisms that live in it and by the conditions found there.

Key Terms

abiotic
adaptation
biotic
ecosystem
habitat
organism

During a walk in your local park you may observe robins, squirrels, maple trees, and grass. If you stop and look more closely, you may also notice spiders, ants, and moss. In a microscopic view of the soil, you could also observe bacteria, fungi, and tiny worm-like nematodes. All of these are examples of living things, or **organisms.**

You can find organisms in almost every environment on Earth, from the tops of mountains to the ocean floor, and from hot deserts to polar ice. Each type of organism has **adaptations,** which are inherited characteristics that help it survive in its environment. For example, the webbed feet of a duck are adaptations for swimming.

The particular place where an organism lives is its **habitat.** A habitat includes all of the things that the organism needs, such as suitable food, a source of water, and shelter. For example, an earthworm's habitat is the soil. A turtle's habitat is a pond or lake. The habitat of a toadstool is a rotting log.

Figure 1.1 This green frog's habitat includes abiotic and biotic parts.

Abiotic and Biotic Parts of the Environment

The green frog in Figure 1.1 takes a break from swimming in the water and rests near the shoreline of a pond. Water, rocks, sunlight, and air are all examples of non-living or **abiotic** parts of the frog's environment.

Frogs hunt for beetles, spiders, and worms. A young frog may in turn be hunted and eaten by a heron. All of these animals are examples of the living or **biotic** parts of the frog's environment. The biotic environment also includes plants, fungi, and micro-organisms. You will study some of the ways in which abiotic and biotic parts of the environment interact in more detail in the next chapter.

Studying Ecosystems

From the title of this chapter, you already know that an **ecosystem** consists of all the abiotic and biotic things in a particular place. You also know that different places have different types of organisms and different conditions. For example, a lake ecosystem includes frogs and fresh water, while a marine ecosystem includes cod and salt water. You would not expect to find frogs in the sea or cod in a lake. You can see some examples of ecosystems in Atlantic Canada on the following pages.

As well as having different types of organisms and conditions, ecosystems also vary in size. For example, a forest ecosystem can cover many hundreds of square kilometres. Within this forest there may be a river ecosystem where trout and water plants live. Beetles and toadstools are part of an even smaller ecosystem that exists only in a rotting tree trunk on the forest floor (Figure 1.2).

Figure 1.2 Not all ecosystems are large. For example, this rotting tree is an ecosystem. It is home to many organisms that are adapted to get the food and shelter they need from a rotting tree.

Maybe you have turned over a rotting log and have seen some of the small organisms that were living under it scurrying for cover. These organisms normally live in cool, dark, damp conditions. By moving the log, you have exposed them to sunlight and wind. These conditions can cause drying out of the organisms. If they cannot move back to a suitable habitat, these organisms may die. In a similar way, if people drain a bog or cut down part of a forest, they will change the conditions and alter the interactions in the ecosystem.

Reading Check

1. What is the difference between the abiotic and biotic parts of your environment?
2. What one word describes all of the following: ant, frog, mushroom, and black spruce?
3. Complete this sentence: Inherited characteristics that help an organism survive in its environment are called _____.
4. Give an example of a change in conditions that could affect an ecosystem.

1-1A What Do Living Things Need for Survival?

Think About It

A cod, an owl, and a fiddlehead fern are three very different organisms, but they all have similar basic needs from their environment. In this activity, you will develop a list of the things that organisms need to survive.

What to Do

1. Work with a partner or in a small group. Brainstorm all the things that you think every living thing requires in order to survive. Record your ideas as a list on a sheet of paper.
2. When you have finished, half of your group will join half of another group to exchange ideas. You will explain your own list of ideas to the classmates who join your group.
3. Re-join your first group. Decide if you want to add, change, or remove items from your list.
4. As a class, produce a chart that lists the needs of living things.

What Did You Find Out?

1. As a class, discuss the list you have generated. Are there any organisms that can survive without some of the items on your list? If so, give examples.
2. Using your list, suggest a change in the environment that might affect the survival of a particular organism. Name the organism, and then describe the change and its effect on the organism.

Ecosystems in Atlantic Canada

Common examples of ecosystems in Atlantic Canada include coastlines and oceans, freshwater ecosystems (rivers, lakes, and ponds), the Arctic, and forests. You will be introduced to each of these ecosystems below.

Figure 1.3 Cold, salty winds from the ocean affect the shape and growth rate of these trees growing near the coast. These clumps of weather-beaten conifers, such as spruce, fir, pine, and larch, are locally known as "tuckamore."

internet connect

You can learn more about ecosystems in Newfoundland and Labrador from the Internet. Start your search at **www.discoveringscience.ca.**

Coastlines and Oceans

A challenging habitat exists where the Atlantic Ocean meets the land. These long stretches of rocky coastline are sometimes covered by water, yet are exposed to air as the tides move out. Among the organisms you can find here are large brown seaweeds and numerous small animals such as barnacles, mussels, starfish, and rock crabs. All of these organisms are able to attach themselves to the solid rock surfaces to avoid being washed away by the sea.

A cold ocean current, called the Labrador Current, flows southward along the east coast of Canada. This current affects the local climate, bringing cool summers and fogs to the region along the coast. Figure 1.3 shows how strong winds from the ocean can affect vegetation growing near the coastline.

Organisms living in the ocean must be adapted to cold temperatures, moving currents, and the salt content, or salinity of the seawater. Larger animals such as cod, seals, and whales swim through the water, while many small organisms such as jellyfish, microscopic plants, and the eggs and young stages of some animals simply drift with the flow of water. The maximum depth to which sunlight penetrates water is between 100 and 200 m, depending on the clarity of the water. Below this depth, it is pitch dark and marine plants cannot survive. On the other hand, some types of bacteria and animals are adapted to live and thrive in these hostile conditions.

Freshwater Ecosystems: Rivers, Lakes, and Ponds

Rain and snow supply water to freshwater ecosystems such as rivers, lakes, and ponds (Figure 1.4). Have you ever noticed how some places become very muddy and full of puddles after a heavy rain, while other areas dry out quickly? The difference depends on the type of soil and rock under the surface of the ground. The amount of water that is stored in the soil in turn affects the growth of plants. For example, willows and tamarack generally grow only where drainage is poor and there is plenty of water in the ground.

Freshwater ecosystems include habitats for many types of fish such as lake whitefish and sticklebacks, as well as for other animals such as beavers, muskrats, ducks, and geese. Frogs, insects, snails, and other small animals make their homes in the water, together with various species of water plants.

Arctic

The northernmost tip of Labrador has an arctic ecosystem (Figure 1.5). This region has very low temperatures and little precipitation, making it a cold desert. In winter, the nights are long and the days are short. A metre below the surface of the ground, the soil is permanently frozen and is called permafrost. There is not enough moisture to support trees. Plant growth includes low shrubs, mosses, lichens, and small flowering plants. Animals found here include caribou, musk ox, wolves, arctic foxes, arctic hares, and lemmings. Many birds fly north to this ecosystem in spring to lay their eggs and rear their young. In the fall, they return south because they cannot survive the arctic winter.

Figure 1.4 Freshwater lakes, such as Western Brook Pond in Gros Morne National Park, form where the underlying rock and shape of the land prevent water from quickly draining away.

Did You Know?

Lakes occupy more than 8 percent of the land area of Newfoundland and Labrador. This is slightly greater than the overall average for Canada.

Figure 1.5 This arctic ecosystem has shallow ponds in summer but the ground is frozen a metre below the surface.

Figure 1.6 A thick layer of peat, the dark band under the surface soil, has been exposed by this road cut in Terra Nova National Park, Newfoundland and Labrador.

Suggested Activities

Find Out Activity 1-1B on page 13
Find Out Activity 1-1C on page 14

Connection

Section 1.2 has more information on the characteristics of soil.

Forests

Forest ecosystems cover much of the province of Newfoundland and Labrador, except where poor soils and exposed conditions are not suitable for trees to grow. Summers in these areas are cool and winters are wet. Common forest trees include balsam fir, white birch, black spruce, and mountain ash. Animals living in these forests include moose, caribou, black bear, lynx, red fox, pine marten, and mink.

Poorly drained areas in shallow hollows sometimes develop into bogs and marshes. In these habitats, dead plant material decays very slowly, as it is often covered by water. The build-up of dead plant matter sometimes produces peat (Figure 1.6). Heavy precipitation in the southern Avalon Peninsula of Newfoundland has created extensive wetlands called blanket bogs.

Reading Check

1. "Ocean," "forest," and "arctic" are all examples of what?
2. List four abiotic factors that affect the survival of organisms in an ocean ecosystem.
3. Why is the arctic ecosystem a cold desert?
4. What conditions produce peat?

1-1B Scrutinizing Soil

Find Out ACTIVITY

In this activity, you will observe and analyze a sample of soil.

Question

What are the abiotic parts and the biotic parts of a soil ecosystem?

Safety

- Do not handle any organisms with bare hands.
- Return all organisms to the place where you found them.
- Handle the glass jar with care.
- Handle the scissors carefully.
- Keep electrical connections for the lamp away from water or moisture.

Materials

- large wide-mouthed jar
- large plastic funnel
- desk lamp with flexible arm
- pie plate
- hand lens and/or dissecting microscope
- scissors
- 2 damp paper towels
- fine-mesh plastic pot scrubber
- garden soil or leaf litter
- paper towel
- paper for drawing

What to Do

1. Place a damp paper towel in the bottom of the jar. Place the funnel in the mouth of the jar.
2. Cut a small square (3 cm by 3 cm) of mesh screen from the pot scrubber. Place this screen over the opening in the neck of the funnel.

3. Fill the funnel with garden soil or leaf litter.
4. Place the lamp over the funnel and turn it on. Turn out all the other lights in the room and leave the lamp on overnight.
5. The next day, remove the funnel from the jar. Empty the contents of the jar onto a damp paper towel in the pie plate. If the contents include small animals that can move quickly, cover the pie plate with clear plastic wrap to prevent them from escaping.
6. Observe the organisms using a hand lens, or a microscope if available. Sketch at least one organism.
7. Observe a small sample of soil from the funnel. Describe the appearance of the soil.
8. When you have completed your investigation, ensure that the soil organisms are returned to the place where they were collected.

What Did You Find Out?

1. Why do you think organisms moved from the soil into the jar?
2. What characteristics of the soil might be important to the organisms living there?

1-1C Creating an Ecosystem

Find Out ACTIVITY

You have been learning about ecosystems and about their biotic and abiotic parts. Although you can observe ecosystems all around you, you can learn a great deal more if you focus on one ecosystem over time and examine it in detail.

Question

What components are necessary to create a successful model ecosystem in the classroom?

Safety

- Do not handle any organisms with bare hands.
- Handle the glass bowl with care so that it does not break.

Materials

- water
- gravel or small rocks
- twigs
- seeds and/or small plants
- potting soil
- clear glass or plastic bowl

Design Criteria

A. Your model ecosystem should contain at least four different plants.

B. Add at least one abiotic element in addition to the essential ones with which the biotic elements can interact.

What to Do

1. With your group, decide what type of ecosystem you will be creating. Conduct research to find out which biotic and abiotic features are usually found in this type of ecosystem. Plan how you will construct your model.

(a) What kinds of seeds and plants will you use? Why? Do they normally grow near each other in nature?

(b) What do the plants in your ecosystem need to stay alive? Must you add anything to your ecosystem over time, such as water?

(c) What location in your classroom will you choose for your ecosystem? Why? What might be the effect of choosing this location over another one?

2. Prepare a labelled sketch of your model. Write a hypothesis about what will happen in your ecosystem. After obtaining your teacher's approval, build your model.

3. Observe your model over an agreed-on period of time. Take careful notes on a regular basis. If you discover problems, try to solve them.

4. As you study your model, write any questions that occur to you about the interactions that are taking place. You might be able to find the answers in the next investigation.

What Did You Find Out?

1. (a) Did your model succeed as you had planned in step 1? Why or why not?

(b) Did you experience any problems? If so, were you able to resolve them? How?

2. Compare your model with other groups.

(a) Which model worked best?

(b) Which model had the most problems? Why?

(c) How might you improve your model if you designed it again?

Check Your Understanding

Checking Concepts

1. List two examples of abiotic parts of a forest ecosystem and two examples of biotic parts of a forest ecosystem.
2. What abiotic factors might affect a dandelion growing in a lawn? Explain why you think so.
3. What biotic factors might affect a dandelion growing in a lawn? Explain.
4. (a) Name two abiotic parts of your environment that you have interacted with today.
   (b) Describe two interactions that you have had with these abiotic parts.
5. (a) Name two biotic parts of your environment that you have interacted with today.
   (b) Describe two interactions that you have had with these biotic parts.
6. Describe the habitat of
   (a) a grasshopper
   (b) a seaweed.
7. Choose an animal that lives in one of the ecosystems in your province, and describe how it is adapted to live there.
8. (a) In what kind of ecosystem would you expect to find the habitat of a beaver?
   (b) Identify three biotic parts of its ecosystem that would be important for a beaver.
   (c) Identify three abiotic parts of its ecosystem that would be important for a beaver.

Understanding Key Ideas

9. "Ecosystems extend over many kilometres." Explain why you agree or disagree with this statement, using examples.
10. Imagine that you are a polar bear. What are some of the ways in which you meet your needs for survival in your habitat?
11. Dandelion seeds form "puffballs" that are spread by the wind. How are these seeds adapted to the dandelion's typical habitat?

Pause and Reflect

Many school labs use an aquarium as a model for learning about ecosystems. Suggest three things that you think you could learn about ecosystems by observing an aquarium that has both plants and animals living in it.

1.2 Abiotic Parts of an Ecosystem

Abiotic parts of an environment include such things as temperature, light, air, water, soil, and climate. Each type of organism is adapted to a particular set of abiotic conditions. Organisms can only survive within a certain range of conditions.

Key Terms

range of tolerance

Why does the right plant in Figure 1.7 look so much more healthy than the left plant? You probably know that a plant needs particular conditions to survive and to stay healthy. Too much sunlight, and its leaves may burn. Too little light, and the leaves may turn yellow. Too much water, and the roots may rot. Too little water, and the plant may droop and wilt. Some plants need acidic soils, while others do not.

Figure 1.7 The potted plant on the left is drooping because it has received too little water.

Different plants are adapted to different abiotic conditions. For example, most ferns grow best where it is cool, shady, and humid. Cacti grow best where it is warm, bright, and dry. Suppose it is a sunny day with a light breeze and you move a potted fern from indoors to outside. Later in the day you notice that the fern is drooping and the edges of its leaves are curled and brown. By moving the fern, you have placed it in a different

set of abiotic conditions. The thin leaves of the fern quickly lose moisture from the effects of the sun and wind. If it is left outside for too long without regular watering, the fern may die.

Range of Tolerance

Palm trees grow in the tropics but not in the Arctic. Dwarf willows grow in the Arctic but not in the tropics. Like all organisms, these plants are adapted to the abiotic conditions of their particular environments. Each plant can only tolerate a certain range of abiotic conditions. For example, a plant may die if the temperature falls below 0°C or goes above 40°C. The range of conditions within which an organism can survive is called the organism's **range of tolerance.**

An organism may have a wide range of tolerance for one abiotic condition, such as temperature, but a narrow range of tolerance for another condition, such as how acidic the soil is. Each type of organism has a different range of tolerance for each factor. Taken together, these ranges determine where different organisms can live.

You can see the dramatic influence of abiotic conditions on plant growth in Figure 1.8. As you climb up a mountain, conditions change with altitude (height above sea level). Higher altitudes are significantly colder and drier than lower altitudes. The altitude at which tree growth becomes impossible is called the treeline. This marks the limit of the trees' range of tolerance.

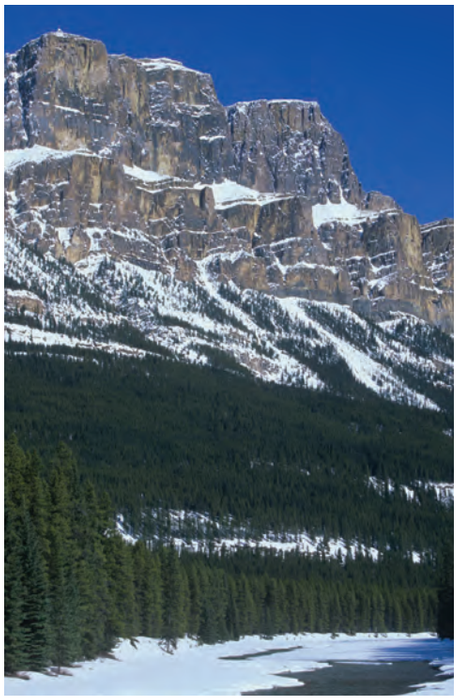


Figure 1.8 The treeline on this mountainside shows where conditions become unsuitable for tree growth.

Reading Check

1. What is a treeline?
2. Complete this sentence: For a tropical fish, a water temperature of 1°C is outside its _____ .

Abiotic Influences

What abiotic conditions are most important in your local ecosystems? How does each condition influence the organisms living there? The notes on the following pages give some examples of the roles of abiotic conditions in ecosystems.

Suggested Activity

Conduct an Investigation 1-2A on page 20

Light and Light Intensity

All plants and algae (plant-like organisms) need light to survive. They depend on light energy to produce their food by the process of photosynthesis. Without light, plants and algae cannot survive; they will starve.

Figure 1.9 Worms spend most of their life in dark conditions underground. What adaptations do they have for this habitat?

The amount of light that is available in an area limits the types of plants that can grow there. For instance, seaweeds and some types of water plants can grow at and near the surface of a lake or an ocean. However, the intensity (strength) of the light that can penetrate through water decreases as you go deeper below the surface. Water that is 200 m or more below the surface is completely dark. This is well beyond the range of tolerance of any plants. Deep caves and the deep waters of oceans and lakes are examples of environments that have no light, and therefore, no plants.

Unlike plants, many animals thrive in dark conditions, such as those living in caves, deep water, and in the soil (Figure 1.9). Others sleep in shelters during the day and only emerge at night. They have adaptations that help them remain active in low-light conditions, such as having keen senses of touch, hearing, or smell.

Changes in day length can affect both plants and animals. For example, the reduced number of daylight hours in the fall triggers some trees to shed their leaves and some animals to migrate south.

Figure 1.10 Organisms such as this northern alligator lizard need warm conditions to remain active.

Temperature

The northern alligator lizard in Figure 1.10 is using the sun's energy to raise its body temperature and allow it to become active. Many reptiles, amphibians, fish, and insects depend on sunlight for warmth. The rate of growth and reproduction of many micro-organisms, such as bacteria, also depends on temperature. Fruits such as strawberries only ripen when it is warm and will not develop in cold temperatures.

Soil

The biotic parts of soil consist of fragments of dead plants and animals as well as the solids and the liquids they excrete. This organic material decomposes and provides a source of nutrients to plants growing in the soil. The abiotic parts of soil consist of small particles of rock materials and pockets of air and water. Animals that live in soil, such as ants and earthworms, create small tunnels that allow air and water to move through the soil more easily. Plants anchor themselves in the soil with their roots. Plant roots help prevent soil from being blown away by wind or washed away by water.

Air and Wind

Animals and plants use oxygen from the air for respiration. Plants use carbon dioxide from the air for photosynthesis. Deprived of air, these organisms would die.

Birds, insects, and bats fly through the air, and many plants use the wind to disperse their seeds. In areas that have frequent strong winds, such as along the coast, plants are adapted to bend and not break in the wind. Windy areas also tend to be dry, as the wind evaporates moisture. Plants that grow along the coast must be able to withstand these dry conditions. They also must be able to tolerate salt from the salty spray that blows from the ocean across the coast. Plant-like lichens, for instance, are highly tolerant of salt and are often found growing on coastal rocks. In Figure 1.3 on page 10, you saw another example of how the cold, salty winds affect plant growth. Tuckamore grows in such low, tangled masses that it is difficult even for large animals such as moose and humans to move through it. Some small songbirds, on the other hand, can find food and nesting areas in the dense growth.

Explore More

The weather-beaten *tuckamore* of the Atlantic coast are found in other parts of Newfoundland and Labrador, as well as in other parts of the world. Where else can you find tuckamore? What is it called elsewhere, and why is this name fitting? Start your research at **www.discoveringscience.ca**

Water

All organisms require water, but some are adapted to spend long periods in dry conditions. Many organisms are adapted to live in water. Others, such as ospreys, hunt for food in water.

Water conserves heat and modifies the climate on the land nearby. While the cold Labrador current has a cooling effect on the air temperature, the warmer Gulf Stream current radiates heat and warms the air. When water freezes, the ice that it forms provides hunting grounds for polar bears (Figure 1.11) and breeding grounds for seals.

Figure 1.11 Polar bears travel over sea ice to hunt seals.

Reading Check

1. Light, temperature, and water are all examples of what?
2. List three abiotic parts of soil.

1-2A Field Trip to the Schoolyard Core Lab

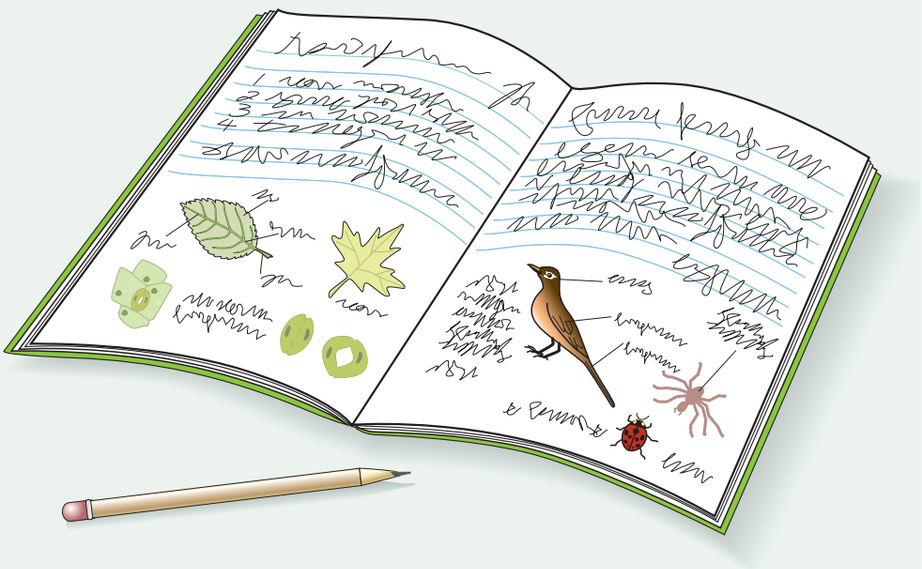
SkillCheck

- Observing
- Predicting
- Measuring
- Working co-operatively

You can find living things almost anywhere if you look carefully. Even if your schoolyard is mostly paved over, there is a good chance there will be dandelions and grass growing somewhere. Almost certainly there will be birds, insects, and small organisms living in the soil. The abiotic parts of the ecosystem affect each of these organisms.

Question

What abiotic and biotic factors can you observe and measure in your schoolyard ecosystem?



Safety

- Do not handle any organisms with bare hands.
- Handle the magnifying glass and thermometer carefully so they do not break.
- If you disturb the habitat, be sure to return it to its original condition.
- Do not harm organisms in your study site.

Materials

- notebook
- drawing paper
- pen or pencil
- magnifying glass

Inquiry Focus

- binoculars
- camera
- thermometer
- light meter
- wind-speed recorder
- field guides

Procedure

1. Choose an area of your schoolyard suitable for study, where you can observe some living plants and animals.
2. Brainstorm possible questions to investigate when studying the schoolyard ecosystem. For example, make a list of organisms you predict you might observe. How might the amount of sunlight affect the types of plants growing there? How might soil conditions affect animals such as earthworms?
3. In groups, decide how you will make and record your observations.
4. Prepare tables in your notebook to record the measurements you will take.
5. When you arrive at your study site, sit quietly and observe it. Record the general abiotic conditions and list any organisms you see. Note any signs of organisms such as spider webs, burrows, feathers, or seeds.
6. Walk slowly around your study site and record all of the organisms that you encounter. Use field guides to help you identify them if you have time. You may sketch or photograph organisms for later identification.

   NOTE: Do not pick or break plants or damage flowerbeds. If you turn over a rock or log to see what is underneath, replace it afterwards.
7. Record and measure some of the abiotic conditions where each organism is found. For example, what is the temperature of the air or soil? Is the location exposed to light or is it shaded? Is the area damp or dry? Is the soil sandy or clay-like?

Analyze

1. Make a list of all the organisms recorded by your class. Compare it with the list of organisms you predicted might be present.
2. Briefly describe how the abiotic conditions you recorded might affect one type of (a) animal and (b) plant.

Conclude and Apply

1. Explain why you might get different results if you conducted your study during the summer holiday.
2. Name an animal or plant that you know lives in your province but does not live in your schoolyard ecosystem. Explain why it does not live there.
3. Suggest some ways in which your schoolyard ecosystem might change if a pond was added to it.

1-2B Salty Seeds Core Lab

Find Out ACTIVITY

Consider a plant living by the coast. Cold winds blow salt spray onto the land where it is growing. It must be adapted to survive the cold, the wind, and the salt. Plants that cannot tolerate these conditions will not survive in this habitat. In this activity, you will make observations and measurements of how well one species of plant (a bean plant) tolerates one of these abiotic conditions (salt water).

What You Need

- 2 plastic drinking cups (or similar containers)
- 30 mL salt
- water
- stir stick
- 10 bean seeds
- 2 paper towels
- 2 plastic self-sealing bags
- masking tape
- marker

What to Do

1. Add water to the cups until each cup is half full.
2. Add the salt to one cup and stir. Label the cup "salt water." Label the other cup "fresh water."
3. Place 5 bean seeds in each cup. Leave the seeds to soak overnight.
4. Wrap each set of 5 bean seeds in moist paper towel. Place the towels and seeds in separate self-sealing bags. Label one bag "fresh water" and the other "salt water."
5. After two days, count the number of seeds in each bag that show signs of root growth (sprouting). Record these numbers.

What Did You Find Out?

1. How did the amount of sprouting differ for the seeds kept in fresh water compared to the seeds kept in salt water? Describe any differences you observed in the appearance of the seeds from these two groups.
2. What abiotic factor was studied in this activity?
3. What variables were controlled (kept the same) for the two groups of seeds?
4. What variable was changed (manipulated)?
5. Predict whether seeds from another species of plant would respond to salt in the same way as bean seeds. How could you find out?

Check Your Understanding

Checking Concepts

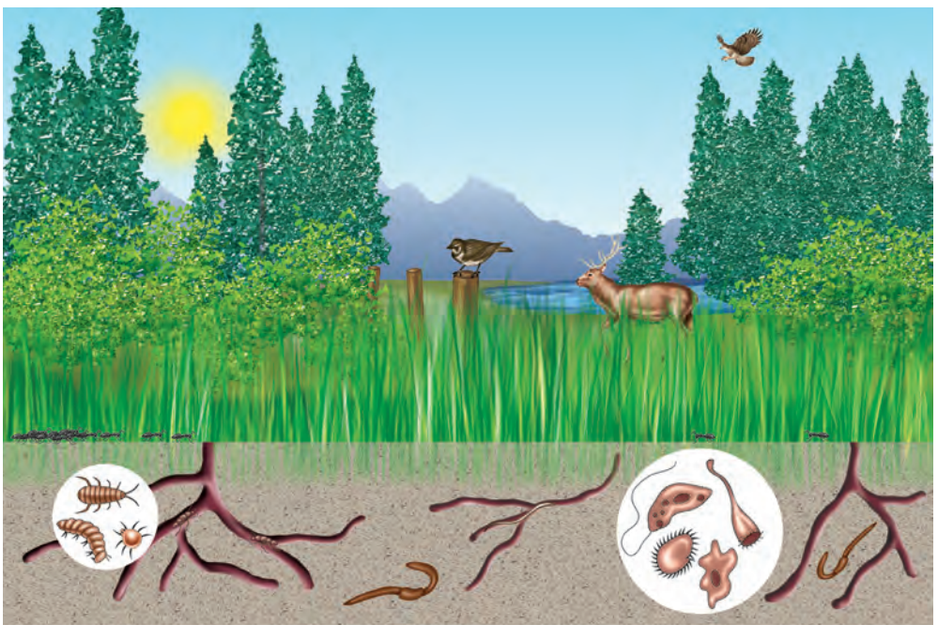
1. All mammals, as well as birds, maintain a constant internal body temperature. This temperature stays the same even when the outside air temperature gets higher or lower. How does the outside air temperature affect the internal body temperature of a reptile such as the northern alligator lizard?
2. How is a dandelion adapted to windy conditions?
3. Name two abiotic conditions found in soil.
4. Describe an interaction between any one of the organisms shown in the diagram below and one abiotic part of its ecosystem.
5. Name one abiotic factor that is important for the survival of tropical fish in an aquarium.
6. Using the term "range of tolerance," explain why swallows fly south from Newfoundland and Labrador during the winter.

Understanding Key Ideas

7. Explain why levels of sunlight may vary in different parts of a forest ecosystem.
8. Why are there no plants growing at the bottom of a deep lake?
9. Roses grow best in sunny conditions. What effect might it have on your roses if your neighbour builds a tall fence next to your rose garden?
10. You learned on page 17 why there is a treeline on the side of a mountain. Where else might you find a treeline? Explain.

Pause and Reflect

Choose an organism that you know something about. What might happen to this organism if a permanent change occurs in the environment to which it is adapted?



1.3 Biotic Parts of an Ecosystem

Ecosystems include many different species of organisms. Individual members of the same species living together in the same area at the same time form a population. Populations of different species interact in communities.

Key Terms

community
individual
niche
population
species

Figure 1.12 How would you begin to study this pond ecosystem?

Suppose you live near a pond and you want to study the pond ecosystem. You approach the pond quietly one summer morning and look around. You notice a dragonfly dart overhead, mosquitoes buzz nearby, and pondskaters skitter over the water surface. There are a few ducks on the pond, and some small birds chirping in the reeds. A splash and some ripples tell you there are fish in the water, and you notice waterweeds growing around the muddy edge of the pond. How can you begin to study all these things?

To tackle the biotic parts of the ecosystem—or, in other words, the organisms—consider ways to organize your observations. First, you may want to list all the different kinds or **species** of organisms that live in or near the pond. A species is a group of organisms that can reproduce among themselves to produce offspring of the same type that can also reproduce successfully. For instance, a mosquito can mate with another mosquito but not with a dragonfly. Mosquitoes and dragonflies are two different species of insects.

Levels of Organization

Wherever you encounter one mosquito, you are soon likely to encounter more mosquitoes. Each mosquito is an **individual** member of its species. A biologist may want to study an individual mosquito in more detail, but ecologists usually want to study the entire group of individuals of the same species that live together in one ecosystem at the same time. Such a group is called a **population.** For example, your pond may have a population of hundreds or thousands of mosquitoes and a population of seven or eight ducks.

Populations can vary in size depending on the time of year, the weather, and the abundance of food. For example, the population of ducks on the pond will increase in the spring when the ducks lay their eggs and raise their young.

The populations of mosquitoes, ducks, dragonflies, fish, waterweeds, and other species living in and around the pond interact with each other. For example, the ducks eat waterweeds, while mosquitoes may feed on the ducks. These interacting populations form a **community** of organisms.

The biotic parts of a community, together with the abiotic parts of the environment that affect the community, form an ecosystem. Figure 1.13 summarizes the different levels into which you can organize an ecosystem when you begin to study it.

internet connect

The cat-like Newfoundland marten is one of the most endangered animals in the world. The total population numbers about 300 individuals, all of which live on the island of Newfoundland. Find out more about this animal and its habitat. Start your search at **www.discoveringscience.ca.**

Figure 1.13 Organisms may be studied at different levels of organization in an ecosystem. What other populations might share this ecosystem with a population of caribou?

Niches

Within a community, each species uses the resources of the ecosystem in a slightly different way. For example, in the pond ecosystem shown in Figure 1.12, the ducks eat waterweeds and mosquitoe larvae while the kingfishers eat fish. Dragonflies catch insects while mosquitoes feed on blood. Some water plants float on the surface of the pond while other species of water plants are rooted in the mud on the bottom of the pond.

Like the firefighters and the teachers that live in your community, different species have different "jobs" or roles in their community. The role of a species includes where it lives, how it obtains its food, and how it affects its environment. These roles make up the ecological **niche** of a species.

Reading Check

1. What is a species?
2. Name three levels of biological organization that can be studied in an ecosystem.
3. What do interacting populations of organisms form?

1-3A Seabirds!

Think About It

Along the coast you can observe large numbers of big, whitish seabirds such as those shown below. Many people call all these birds "gulls." They appear similar at first glance, but usually large flocks include several different species. Each species has a different niche. To study details of the coastal ecosystem, such as changes in population size or food supply, you must be able to identify the species found there. In this activity you will classify each species of bird using a key to identification.

What to Do

1. The drawing shows five species of gulls, two species of jaegers, and one species of tern. Study it carefully and then identify each bird using the key below.
2. When you have finished, confirm your identifications and learn more about each species by using field guides, photographs, and the Internet.

Identification Key for Atlantic Sea Birds

To use the key, start at number 1 and choose A or B, whichever best describes the sea bird you are trying to identify. Proceed to the next number as indicated until you reach the bird's name.

Appearance of bird.	Go to
1. A. Has brown head and neck with black cap. B. Does not have brown head and neck.	2. 3.
2. A. Bill is quite thick; body colour medium brown. B. Bill is not particularly thick; body colour dark brown.	Pomarine Jaeger Parasitic Jaeger
3. A. Slender bird with long narrow wings, forked tail, black cap, and pointed bill. B. Sturdy and robust bird with white head.	Common Tern 4.
4. A. White wing tips. B. Larger bird with darker wings.	Iceland Gull 5.
5. A. Black across back and wings. B. White or grey across back.	Great Black-backed Gull 6.
6. A. Black ring around yellow bill. B. Bill solid yellow or orange.	Ring-billed Gull 7.
7. A. Solid black wing tips. B. White spots in black of wing tips.	Black-legged Kittiwake Herring Gull

What Did You Find Out?

1. Name three things that helped you distinguish one species of seabird from another.
2. Where could you find out more information about gulls and other seabirds? Name three other sources of information.

Wild, Weird, Wonderful

www Science

Coldwater Coral Reefs

When you hear the words "coral reef" you probably think of warm tropical seas. Canada has its own coral reefs, however. They thrive in the deep, dark, cold waters off the coasts of Nova Scotia, Newfoundland and Labrador, and as far north as the Davis Straits.

Corals are marine animals that resemble small sea anemones. Reef-building corals live in colonies of numerous identical individuals called polyps. Each polyp produces a stony coral skeleton of calcium carbonate to protect its soft body.

Colonies of corals can grow very large over thousands of years, building reef ecosystems that are as diverse and complex as forests.

Scientists have known about cold-water corals for centuries, from chunks of reefs broken off and brought to the surface in fishing nets and lines. With new technology for underwater exploration, such as remote-operated submersibles, scientists have recently been able to study living reefs in their natural environment.

Cold-water corals depend on the constant flow of ocean currents to supply the microscopic organisms on which they feed. Their branching skeletons of calcium carbonate resemble bushes or trees, and help the polyps capture food more efficiently. These reef structures create an underwater forest-like habitat that shelters many other animals such as sponges, bristle worms, crabs, lobsters, clams, snails, octopuses, starfish, sea urchins, brittle stars, feather stars, and fish.

When scientists began their research on coldwater corals, they realized that fishing practices, such as bottom trawling, had already destroyed large areas of these unique reefs. Beginning in 1997, the Canadian government established marine protected areas (MPAs) to save parts of the reef from further damage. The first MPA was located in The Gully—a large submarine canyon off Nova Scotia with the highest diversity of coral species in Atlantic Canada.

Check Your Understanding

Checking Concepts

1. Name two plant species and two animal species.
2. What is the population size of students in
   (a) your classroom,
   (b) your school?
3. Give an example of a question that a scientist might answer by studying
   (a) an individual frog,
   (b) the frog population of a pond,
   (c) a pond community.
4. What are the differences and similarities between a population of herring gulls and a community of seabirds? Organize your answers in a chart.

5. Using a local example, create a series of pictures to illustrate four different levels of biological organization, from an individual to an ecosystem.
6. Is it possible for two organisms to live in the same habitat, but have different niches? Explain.

Understanding Key Ideas

7. Describe your niche in your community. How does it differ from the niche of a sibling or classmate?
8. A scientist measures the size of a wolf population at two different times during the year and finds that the population number has changed. Suggest one reason why the population may have increased and one reason why it may have decreased.
9. A home aquarium contains water, an air pump, a light, four identical water plants, two goldfish, and three water snails.
   (a) In a chart, list the abiotic parts and the biotic parts of this system.
   (b) How many species are in the aquarium?
   (c) How many populations are in the aquarium?
   (d) List all the contents of the aquarium that form a community.

Pause and Reflect

Write down a question you would like to ask about a local ecosystem, using at least one of the scientific terms you have learned. How would you set about answering this question?

Chapter 1

Chapter Review

Prepare Your Own Summary

In this chapter, you investigated examples of ecosystems in your province and discovered some of the different parts that make up an ecosystem. Create your own summary of key ideas from this chapter. You may include graphic organizers or illustrations with your notes. (See Science Skill 9 for help with using graphic organizers.) Use the following headings to organize your notes:

1. Ecosystems in Atlantic Canada
2. Abiotic Parts of the Environment
3. Biotic Parts of the Environment
4. Levels of Organization
5. Niches

Checking Concepts

1. Give an example of an organism and its habitat.
2. Name three examples of ecosystems found in Newfoundland and Labrador.
3. List five biotic parts of a marine ecosystem.
4. What abiotic factor has a large impact on a population of mussels living on a rocky seashore?
5. What is the difference between an individual organism and a species of organisms?
6. Make a chart that lists the needs of living things.
7. Compare the feet of a falcon (A) with the feet of a duck (B), shown in the photos.
   (a) In what way are the duck's feet adapted to a pond habitat?
   (b) In what way are the falcon's feet adapted to hunting small animals?

8. List four levels of biological organization in order, starting with the smallest.
9. Draw or find pictures of at least seven organisms you might find in a forest ecosystem.
10. Suppose you are teaching the topic of adaptation to a younger student. Write or draw an example you would use. What question might you ask to assess the student's understanding of adaptation?
11. Describe or make a model of an ecosystem that includes all the terms you have learned in this chapter.
12. Why is it important to correctly use scientific terms, such as species, when discussing scientific subjects?

13. Name five populations of organisms that might live in a pond community.
14. Describe an interaction between two of the species you named for question 13.
15. How is the polar bear in Figure 1.11 adapted to its abiotic environment?
16. Describe the niche of a polar bear.

Understanding Key Ideas

17. Ecosystems can exist within other ecosystems. Give an example that helps explain this statement.
18. A friend tells you: "I took a walk along the beach this morning and counted a population of 96 birds." Is this a scientifically useful statement? If not, give an example of a statement that would be more precise.
19. Assume that the wind blowing along the coast blows from a west direction to an east direction. Make a sketch to show the shape of a tree that is growing along this coast. Explain how you used the wind direction information to infer how you would draw the tree.

20. Name and describe two abiotic factors that might affect the growth of a group of pine trees growing near the edge of a rock cliff overlooking the Atlantic Ocean.
21. Suppose you want to encourage more butterflies to live in your neighbourhood. How would you go about increasing the butterfly population?
22. Choose and name a local ecosystem. Consider the biotic and abiotic parts of this ecosystem. Is there one abiotic part that has a greater effect on the biotic parts of the ecosystem than the others? Give reasons to justify your answer.

Pause and Reflect

You are asked to make a model of an ecosystem to help teach younger students. What would you put in your model and why? Make or draw such a model and include clear labels for each part.