UNIT 1

Interactions and Ecosystems

It almost looks as though this whooping crane is jumping for joy. Although this "dance" is actually a courtship display, whooping cranes do have reason to jump for joy — they are lucky to be alive. In the 1940s just 22 whooping cranes could be found in the world. Today, their numbers are slowly increasing, but whooping cranes are still an endangered species. These majestic birds spend their summers in northern Alberta and the Northwest Territories. Like all living organisms, whooping cranes interact with their environment. They need food, water, and a clean environment in which to live. In this unit you will examine some questions about living things and their environment. Why do organisms live where they do? How do they interact with one another and with their environment? How and why do they become extinct?

Humans interact with the environment and with other living things, and we need a healthy environment too. Unfortunately, some human activities affect ecosystems in negative ways. It was largely due to people's actions that the populations of whooping cranes declined, but people have also helped their populations recover. In this unit you will learn how we can observe and monitor changes in ecosystems, and how we can measure the impacts of our actions. As well, you will learn how people are working to improve our environment and to help reverse some past mistakes.

Unit Contents

UNIT 1

Preview

Focussing Questions

- How do human activities affect ecosystems?
- What methods can we use to observe and monitor changes in ecosystems?
- How can we assess the impacts of our actions?

How do organisms — including humans — interact with the environment? In Topics 1–3 you will look at how living things interact with one another and with the environment in which they live. You will see how we have learned from our past mistakes. You will also examine some of the choices we can make to improve our environment.

In Topics 4 and 5, you'll explore the roles that organisms play within an ecosystem. You will find answers to questions such as: What are the links in a food web? What happens if an ecosystem changes? How do nutrients, water, energy, and even pollution cycle through ecosystems?

Environments are always changing. Sometimes they change naturally and sometimes as a result of human activities. Environmental monitoring can help us reduce negative impacts on the environment. Scientific monitoring can also help us develop strategies for reducing our impact in the future. You will examine these concepts in Topics 6 and 7.

Looking Ahead

Read pages 82 – 83, "An Issue to Analyze: Beyond the Curb: Is Recycling Really Reducing Garbage?" As a class, organize a debate about whether to continue a Blue Box recycling program.

- Start a newspaper clipping file in which to keep news stories related to recycling and disposal of garbage in your area.
- Contact your city's or town's municipal office to gather information (such as amount of garbage collected locally, and what is done with recyclable items) to use in the debate.
- Invite key people in your area who are involved in recycling to present information to your class.

TOPIC 1

Interactions Within an Ecosystem

Imagine you are a swift fox living in the Alberta prairie. Your world consists of the open prairie where you nibble on grasses and berries and prey on grasshoppers, mice, or even the occasional rabbit. As you travel through the prairie you are alert for other creatures such as eagles, hawks, or wolves that might kill you for food. These are some ways that you and the other animals you share the prairie with interact with one another. You also interact with the prairie itself. The prairie is the place where you dig your dens, find your food, and raise your young. **Ecology** is the study of the relationship between living organisms and their environment. An **ecologist** is someone who studies these relationships. An ecologist studying swift foxes, for example, might study where they build their dens, what they eat, or how they raise their young.

Ecologists also explore the relationships between humans, animals, and the environment. Imagine … these tiny foxes almost entirely disappeared from Canada. In fact, until they were recently reintroduced, the last swift fox in Alberta was seen in 1928. What happened to these creatures? This is the sort of question that ecologists can help us answer. It turns out that hundreds of swift foxes were accidentally killed in the early 1900s when people were using poison to control the wolves and coyotes that preyed on them. As well, swift foxes lost most of their natural home — the native prairie grasslands — when this land was taken over for agriculture and other human developments such as cities. Now, humans are helping the swift fox. New programs are reintroducing swift foxes to the Prairies, and groups of concerned citizens are working with ecologists to ensure that swift foxes have the type of home that they need.

This Topic introduces you to ecology — the interactions between organisms, including people, and the places where they live.

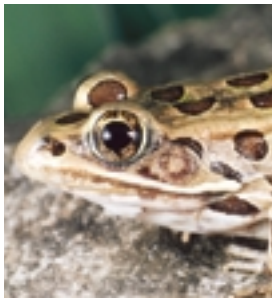
Word CONNECT

Ecology comes from the Greek word meaning "home." In your Science Log write a sentence describing what you think the word "home" refers to.

Pause & Reflect

Look at the animals in the photographs. Did you know that these animals live in Alberta? Throughout this unit you will be asked to study the ecology of an Alberta animal. You will investigate how it interacts with other animals and with its environment. You will also learn how people interact with this animal. Take some time now to choose an animal. (It could be one of the animals shown here, but it does not have to be.) You can choose an animal with which you are familiar, or one you know nothing about, but it should live in Alberta. Note the name of your study animal in your Science Log. By the end of this unit, you will be an expert on this creature.

whooping crane



northern leopard frog

woodland caribou

badger

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus7

To learn more about the swift fox and the Swift Fox Reintroduction program in Alberta, visit the above web site. Click on **Web Links** to find out where to go next. In your notebook, draw a swift fox. Then draw the creatures that eat the swift fox and the food that the swift fox eats. Draw arrows from each creature to its food.

The Needs of Living Things

Imagine you are a cave dweller — long before the days of television, grocery stores, and the invention of the wheel! What are the things you would need to survive? (Remember that you are an animal and you have basic survival needs very similar to other animals.) If your list of basic needs includes food, a place to live (your **habitat**), air to breathe, and water to drink, you would be absolutely right. These are the basic needs that all living things require and you share these basic needs with everything from a sloth to a sunflower to a spider.

- Living things need food. Animals eat food, while plants make it. Food gives living things energy. Food also provides nutrients such as fat, protein, and carbohydrates, which help living things to grow, repair, and reproduce themselves.

- Living things need water. Water covers most of our planet and it also forms a large part of living things. You are almost two-thirds water! Living things cannot function properly and will eventually die without water.

- Living things need a suitable habitat. In almost every corner of our planet — from the frigid Antarctic ice to the dusty, dry desert — there are living things. Many creatures, such as the mountain goat, live in a particular sort of environment without any type of shelter. Others, including humans, beavers, and wasps, build protective shelters.

- Living things exchange gases. When this whale, and other animals, breathe in and out, its body is getting rid of the gas carbon dioxide and is breathing in oxygen. All living things exchange gases. Plants, for instance, use carbon dioxide to make food and "breathe" off oxygen. Other living things, including fungi and bacteria, need oxygen too.

When you take a breath, put on a warm coat, wave to friend, or move away from a buzzing bee, you are interacting with your environment and with other living things. Living things are always interacting with each other and with the non-living things in their environment. Take a closer look at how an animal meets its basic needs in the next activity.

Find Out ACTIVITY

Just the Basics

All organisms, including humans, share the same basic needs. Find out about an animal that lives near you to determine how these living things meet their basic needs for survival.

Materials

sheet of paper
pencil
shoe box or other small cardboard box
art materials

Procedure

Performing and Recording
Communication and Teamwork

1. Divide a sheet of paper into three columns. In the first column list the basic needs of living things.
2. Brainstorm in a group and make a list of how you can meet the basic needs for survival. Record this list into the second column of your data sheet.
3. Choose either (a) or (b).
   - **(a)** As a group, look for animals in your schoolyard or other nearby outdoor area. Carefully turn over rocks or logs, look for animals in ponds or ditches, or watch for birds flying nearby. Choose one animal and observe it closely without disturbing it.
   - **(b)** Use resources in a library or on the Internet to determine the basic needs of the animal you chose as your study animal in the Pause & Reflect on page 7.
4. Record how your study animal meets its basic needs in the third column of your data sheet. For example, what type of environment does your study animal prefer and what type of food does it eat?

5. Use the cardboard box and the art materials to make a diorama showing the basic needs of your study animal. Display your dioramas in the classroom.

What Did You Find Out?

Analyzing and Interpreting

1. Compare the list of your needs with the list of your study animal's needs. How are they the same? How are they different?
2. List five changes that might affect the survival of your study animal. Think of small changes, such as someone riding a bike through its habitat, to large changes, such as a drought.

Computer CONNECT

Create a web tutorial about the needs of living things. Include information on how different organisms, such as a swift fox or a burrowing owl, meet their needs using the environment around them. Include a quiz with an answer key.

Adaptations

What do you think the bird in Figure 1.1 eats? Fish, small creatures, or flying insects? How does its bill compare to those of other birds? A robin's bill is different from a duck's, and an owl's is different from a hummingbird's. All of these bills are used to gather food, but they are **adapted**, or well-suited, to the food that the bird eats.

Living things are adapted so that they "fit" their surroundings. This ensures that they can survive in the environment in which they live. For example, many of the bones in a bird's body are hollow. This characteristic makes the bird lighter so it can more easily fly. The fit between an organism and its environment is called adaptation. An **adaptation** is an inherited characteristic that helps an organism survive and reproduce in its environment (see Figure 1.2). Sometimes characteristics that help animals survive in their environment are learned during the animal's lifetime. For example, humans learn to look both ways before crossing a street. This helps humans survive, but it is not an adaptation because it is not inherited; humans are not born knowing to look before crossing a street.

Figure 1.1 This curlew uses its long bill to probe for tiny organisms.

Figure 1.2 Robins' feet are an example of an adaptation. Like other perching birds, robins have feet with three front toes, one long hind toe, and a specialized tendon that automatically locks their hind toes around a branch when they land.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus7

You have identified the needs of living things for survival, and one of those needs is food. Find out about some of the different ways in which animals obtain food by visiting the above web site. Click on **Web Links** to find out where to go next. Write about three of the ways you found, and make sketches to describe your findings. What would happen if the food these animals are best able to gather were suddenly in short supply? Would the animals be able to feed on something else?

Figure 1.3 These organisms are born with flippers that enable them to swim well.

Figure 1.4 These organisms have learned how to make flippers so that they can adapt their feet to a water environment.

Humans are able to survive — at least for short periods of time — in a wide variety of habitats. We have even ventured into space and the deep sea. Humans have used advances in science and technology to expand the different types of environments in which we can live. Can you think of other ways that we have used science and technology to enable us to live in habitats in which we would not normally be able to survive?

DidYouKnow?

Earthworms have developed special features over time that help them survive in their underground environment. They breathe directly through their thin skin, their bodies are long and thin and have no limbs, and they are able to eat soil. Earthworms cannot survive the drying heat of the Sun because their skin must stay moist in order for them to breathe properly. When rain falls, it floods their burrows, and earthworms must come to the surface to breathe. If they stay underground, they will drown. If they are away from soil when the rain stops, however, they cannot dig back into their burrows, and they dry out and die. This explains why there are so many dead earthworms on the pavement after a rain shower.

INQUIRY

INVESTIGATION 1-A

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Tools for the Task

You have seen that organisms are adapted, or well-suited, to their environments. Some animals eat a varied diet, while others eat very specific types of food. Would these animals be able to cope with change?

Question

Can animals switch to a different type of food if their usual food is in short supply?

Hypothesis

Form a hypothesis about whether an animal will be able to survive if its usual food supply is restricted.

Apparatus

- toothpicks
- kitchen tongs
- clothespins
- spoons
- small plastic bags
- clock or watch

Materials

- rice
- cereal in the shape of rings (such as Cheerios™)
- elastic bands
- raisins

Procedure

1. Your teacher will divide your class into four groups. Each group represents a different animal that uses a different type of utensil (toothpick, kitchen tongs, clothespin, or spoon) to feed.
2. Scatter piles of "food" (rice, cereal, elastic bands, or raisins, ten pieces in each pile) randomly throughout the room. There should be an equal number of each type of food pile and only one food pile per student.
3. Each of you will be given a plastic bag — your "stomach." Do not eat any of the food.
4. You will all start in the same location and you will have 30 s to gather one pile of food.
5. At the end of this round, **record** the type of food gathered by each animal. If an animal cannot gather a pile of food, it does not continue to the next round.
6. Repeat step 4 until no food remains.
7. Scatter the piles of food again as in step 2, but use only half the number of piles of raisins.
8. Repeat step 4 until no food remains.

Analyze

1. How do particular adaptations of animals affect what they eat?
2. Based on your observations, which type of "animal" was better able to cope with changes in food supply?
3. Is an animal's ability to eat a variety of food an adaptation? Explain your answer.

Conclude and Apply

4. Why do some animals die even when food seems to be abundant and varied?

Ecosystems

Did you know that there are more individual things living in the rotting log in Figure 1.5 than there are people on Earth? Bacteria, tiny worms and other animals, fungi and plants are all thriving in this small piece of decaying wood. Larger organisms use the log as well. A salamander might hide under the bark and woodpeckers visit for a meal of insects. The log is an example of an ecosystem. An **ecosystem** is the interactions between living and non-living things in a particular environment. The ecosystem of a rotting log is formed by the interactions between the organisms living in and on the log and the soil, temperature, and other non-living features around the log. A forest is also an ecosystem. All of the living things, such as trees and animals, and all of the non-living things, such as the sunlight and the air, are interacting.

Pause & Reflect

In what ecosystem does your study animal live? Find out as much as you can about its ecosystem and record your findings in your Science Log. Use a graphic organizer such as a spider map to organize your research.

Figure 1.5 A rotting log is like an apartment building for forest-dwelling organisms, and interactions constantly occur in their home.

Skill FOCUS

For tips on how to use graphic organizers, turn to Skill Focus 2.

Understanding how ecosystems function is all about understanding connections. In the last activity, you explored what might happen when food is in short supply in an ecosystem. All parts of an organism's world are connected. If one part is affected — climate, availability of water or food, or habitat — the organism will need to adjust somehow. Some organisms adjust well, and others do not.

When we know how an ecosystem functions, we can learn about the effects of changes on the ecosystem. Some ecosystems are easy to explore, but other ecosystems are more challenging. For example, if the ecosystem is too small or too big for us to observe easily, we cannot always know what living and non-living things are present. In order to study ecosystems, scientists often study one aspect of an ecosystem. They then work with other scientists to piece together the overall picture of how the ecosystem functions.

Figure 1.7 Ants and aphids have a symbiotic relationship.

Figure 1.6 A remora exists in a symbiotic relationship with a shark.

Interactions in Ecosystems

Imagine a great white shark cruising toward you through tropical waters. As a human, your only thought would be to get away. Yet one small fish, called a remora, cannot get close enough! It uses suckers on its head to attach itself firmly to the shark's skin and then dines on bacteria and micro-organisms that are unhealthy for the shark. **Symbiosis** occurs when two species live closely together in a relationship that lasts over time. The odd association between the fearsome shark and the little remora is an example of a symbiotic relationship called mutualism. **Mutualism** is a relationship between two different organisms, in which each partner benefits from the relationship.

Symbiotic relationships are common in the natural world. For example, aphids on a rosebush have a symbiotic relationship with the rosebush as they feed on it. Ants and aphids have a symbiotic relationship too (Figure 1.7). The ants protect the aphids from predators, and in return they drink the sweet liquid that aphids excrete.

There are three types of symbiotic relationships. Along with mutualism, there can be parasitism and commensalism. **Parasitism** is a symbiotic relationship in which one organism benefits and the other organism is harmed. Typically, one of the partners lives on or in the other organism and feeds on it. One of the organisms, the **parasite**, meets its needs at the expense of the other organism, the **host**.

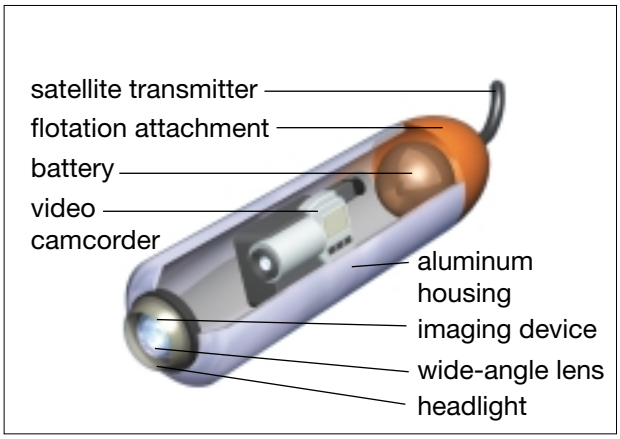
The tapeworms in Figure 1.8, for example, can live in the small intestine of human beings and may grow as long as 10 m. They benefit by absorbing the nutrients from the humans' food. The hosts, the humans, are harmed because they do not get the nutrients from the food they eat. Tapeworm eggs live in meat or fish, so it is important to properly cook your food so that the heat will destroy the eggs.

Figure 1.8 Tapeworms are common parasites that live inside other animals' intestines.

Figure 1.9 An orchid plant attached high up on a tree trunk.

Commensalism is a symbiotic relationship in which one partner benefits and the other partner appears neither to lose nor to gain from the relationship. For example, many species of flowering orchid, like the one in Figure 1.9, live high up, attached to the trunks of trees. The orchids benefit by having a safe place to live and a constant source of water from rain dripping down the tree trunks. The trees seem neither to benefit nor to lose from the presence of the orchid.

In 1986 scientist-filmmaker Greg Marshall watched a shark with a remora clinging to its side. He realized that if a camera could be attached to the side of the shark in a similar way, it would give an amazing close-up view of the shark's movements and behaviour. Thus was born a device called the "crittercam." It is a small battery-operated video camera that can be attached to the side of a shark by a small metal dart. The dart pierces the outer layer of the shark's hide without harming the shark. Shark food is thrown into the water to attract the shark close enough to a boat so that the crittercam can be attached. After a time, the crittercam is automatically released from the shark, tracked by radio signals, and retrieved.



Impacts on Ecosystems

Symbiotic relationships are just a few of the ways in which organisms interact with one another in ecosystems. Recall that ecosystems are made up of organisms interacting with all of the parts, living and non-living, in an environment. As a result, all organisms have some kind of impact when they interact in their ecosystem.

Figure 1.10 A beaver dam drastically changes the ecosystem in which the beavers live.

Some animals have a large impact on their ecosystem. For example, a beaver cuts down trees to eat and to make dams. The dam drastically changes the ecosystem in which the beaver lives. The stream below the dam dries up, and the fish that lived in it can no longer survive. The animals that eat the fish can no longer live in the ecosystem either, so they must move to another ecosystem. Above the dam, a new pond has appeared. The presence of a pond has changed the types of animals that can live in that ecosystem. The impact of the beaver on its ecosystem has improved conditions for some organisms while making the environment unsuitable for others. The small act of a beaver cutting down some trees and creating a dam resulted in some surprising events.

Pause & Reflect

Consider how your study animal interacts with its ecosystem. Does it have a symbiotic relationship with another organism? With what other organisms does it interact? Does it have any behaviours that change the ecosystem? Record your thoughts in your Science Log.

Find Out ACTIVITY

Chain of Events

Have you ever thought about how one small event sets an entire chain of events in motion? Usually a small event will have only a small effect, but sometimes the results can be surprising.

Procedure Performing and Recording, Communication and Teamwork

1. With a partner, read the following poem and discuss what it means. If you have any difficulty, invite other pairs of students to share their ideas.

For want of a nail, the shoe was lost;
For want of a shoe, the horse was lost;
For want of a horse, the rider was lost;
For want of the rider, the battle was lost;
For want of the battle, the kingdom was lost.
And all from the want of a horseshoe nail.

2. Relate the ideas in the poem to the world around you. Think of some different ways in which living and non-living things affect each other. Could a chain of events change those interactions?

3. Make up your own chains of events, starting with one small event. Include at least eight events in your chain. For example, you could start with the following event: There was no milk left when you went to have breakfast this morning, so …

4. What need was being met in your chain of events in question 3? What was the final impact of obtaining that initial need?

Extension

5. Write a poem about how different kinds of living things depend upon one another and on the environment around them.

TOPIC 1 Review

1. **(a)** List the basic needs that all organisms share.

(b) Imagine that you are a white-footed mouse, living in a prairie grassland ecosystem. What are some different ways you can meet your needs?

2. Compare the falcon's feet to the duck's feet in the photographs on the right.

(a) In what way are the duck's feet adapted for living in water?

(b) In what way are the falcon's feet adapted for catching food?

(c) Draw a sketch to illustrate how either the duck or the falcon uses its feet.

3. Describe two adaptations of a fish. Explain how these adaptations help the fish live in its environment.

4. Define symbiosis in your own words. Give one example of symbiosis from this Topic and one example from your own experience.

5. Think about a common organism that lives in your area. Think about some ways it might affect the environment in which it lives. List one positive and one negative effect the organism might have.

TOPIC 2

Human Impacts on Ecosystems

Figure 1.11 How do you think the changes shown in these photographs might have affected the plants and animals that live in this ecosystem?

When you look out the window, are you looking at the same scene that you might have seen 100 years ago? Probably not. As Canada's population increased, land was cleared for homes and farms and eventually some of these settlements grew into the cities and towns we know today. Trees were cut for fuel and buildings, roads were built and eventually paved, and native prairie was ploughed under to create farmland. Humans affect the environment around them as they meet their needs. What types of changes to the environment can you see in the two pictures in Figure 1.11?

People are animals too, and we are part of nature. To meet our basic needs we rely on the ecosystem around us, just as all living things do. People use **natural resources** — the materials and products that are found in nature — to meet our basic needs. Trees, water, oil, and minerals are examples of natural resources that we use. Many human technologies depend on natural resources. For example, one way that electricity is generated is by tapping the energy of rivers. Large dams, such as the one in Figure 1.12, are built and water is trapped behind the dam. Instead of the river flowing freely as it once did, the water flow is controlled by the people who operate the dam.

Figure 1.12 Dams such as this one have a major effect on surrounding ecosystems.

Skill FOCUS

For more information on Societal Decision Making, turn to Skill Focus 8.

Recall from Topic 1 how beaver dams affect river ecosystems. Human-built dams affect ecosystems as well since large areas behind the dam are flooded. Human impacts can be large or small. When one person cleared a plot of land to build a house 100 years ago, the impact to the ecosystem was minimal. However, as more people move to an area, more land is cleared and there is a greater demand for natural resources. If one person drives a car, the impact on the environment is not great. In reality, of course, millions of people drive cars and the number of people *and* cars in the world is rising every day. With cars come roads, parking lots, sprawling cities, and air pollution.

As the human population increases, more and more humans have needs that must be met. As their numbers grow, people have a greater impact on the ecosystems around them. Humans have the same habitat needs as other living things, but, unfortunately, our needs often conflict with the needs of other living things.

DidYouKnow?

Human impacts on living things are not always easy to predict. Did you know that leaving the lights on in Toronto highrise buildings results in the deaths of thousands of songbirds? The birds are attracted to the lights of the buildings and crash into the glass. Concerned citizens and biologists educated building tenants about this problem and now some building owners voluntarily turn off the lights when there are high concentrations of birds in the area, such as when birds are migrating through to their breeding grounds.

People and Nature — A Changing Relationship

The ways that people interact with the environment have changed over time. Before the widespread use of engines and machines, people had a relatively low impact on the environment. They used available plants and animals for food and clothing and lived in simple shelters. If they travelled, they did so on foot, on horseback, or perhaps using canoes. Everything people needed, they found in the environment around them. The Aboriginal person in Figure 1.13 lived on the west coast of Canada. The clothing in the photograph was woven from the bark of the red cedar tree. The shelters in Figure 1.14 were made from long poles cut from trees, covered with the skin of buffalo.

Figure 1.13 The Nuu-cha-nulth (Nootka) were able to weave cedar bark to make clothing.

Figure 1.14 This shelter, called a tipi, consisted of long poles cut from trees and covered with buffalo skins.

Now, of course, our clothes and food come from different parts of the world, we live in fairly large homes or apartments that have electricity and heat, and we often travel in cars, trains, or airplanes. We drink more than just water, eat more than just the plants and animals in our ecosystem, and buy all sorts of items that we enjoy using but do not need. Such lifestyle changes have increased our impact on the ecosystems in which we live.

Gathering Food in Alberta: Then and Now

A These are the skulls of buffalo killed at Head-Smashed-In Buffalo Jump. Aboriginal people living on the plains of Alberta used this site at Porcupine Hills to hunt buffalo by driving them over a cliff. Buffalo that were not killed by the fall were killed with spears and arrows. The carcasses of the buffalo were then dragged to nearby camps to be processed into meat, hides, tools, and other necessary items. All parts of the buffalo were used, and there was very little waste. The technology needed for this type of hunting was minimal, and therefore had little environmental impact.

B Early settlers on the Prairies often kept small mixed farms where they raised crops and livestock. Instead of moving around to different locations from season to season following food sources, early settlers developed the technology to raise their own food on their own farms and they became self-supporting. This lifestype had a larger impact on the environment than hunting buffalo because the farmland had to be modified to support the crops and the livestock.

C A feedlot contains a large number of cattle penned together and raised for meat. The cattle are fed a special diet to increase the amount of meat produced. Once the beef is processed, it is shipped out to consumers all over the country. This technology allows us to produce lots of food and transport it to many locations. The impact this has on the environment is very significant, however. For example, wastes from cattle go directly into the soil where they become concentrated. This changes the condition of the soil, and affects all of the organisms living in that environment.

When Is a Need a Want?

For the most part, Canadians do not have an ongoing challenge of finding food and shelter, so they have been able to turn their attention to their "wants" — things that make their lives more enjoyable.

For many of us, the line between "want" and "need" has become blurred. "I *need* new shoes, I *need* that new computer game, I *need* to call my friend." Meeting our needs and wants usually uses natural resources in some way. Each time we satisfy a need or a want that requires natural resources or energy, we are making a choice and having an impact on our environment. For example, take a look at the fruits and vegetables that you can find in your local grocery store year-round. Many of these foods are grown elsewhere and are shipped to local stores. Land was cleared, fuel was used, and air pollution was created to bring that food to you. Our impact would be quite different if we ate only locally grown food. Food is a basic need, but having food from distant locations available year-round is a luxury.

Off the Wall

Is it possible to make your own artificial ecosystem? The man shown here tried to. The years preceding the year 2000 were filled with rumours about how the world as we knew it would end at the stroke of midnight, December 31, 1999. The Y2K bug, as it was known, was based on the idea that computers would mistakenly recognize the year 2000 as the year 1900, so all of our technology would fail. Many people believed that "disasters" would happen (everything from failing computers, to overloaded hospitals, to loss of water, natural gas, and electricity). The man shown here buried 42 school buses under concrete, connected them to make an emergency shelter, and prepared to live inside the buses when the Y2K bug affected the world.

Find Out ACTIVITY

Alberta Grown

What would happen if you did not have access to grocery stores? What would you eat? What foods did the Aboriginal people who lived in Alberta eat?

Materials

plant guide books suitable for your region

Procedure Performing and Recording

1. Consult a plant book and find five edible plants (or plants that were used as medicine) that grow in Alberta. (Also see the Internet Connect below.) Sketch the plant and describe the parts that are edible (roots, berries, leaves, bark, etc.). If possible, note how you would prepare the food.
2. Create a meal plan using only plants and animals from Alberta.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus7

To learn more about how Aboriginal people from Alberta used the plants in their ecosystem, visit the Internet site for the Native People's Garden at the Devonian Botanic Garden. Click on **Web Links** to find out where to go next. In your Science Log, note five plants Aboriginal people used, and how they used them.

Our demand for more consumer products often conflicts with the health of ecosystems and the plants or animals living there. Look at the photographs in Figure 1.15. How do these pictures show that we live beyond our basic needs? Of course most of us do not want to turn back the clock and give up all of the things we enjoy. We can however, make responsible choices. Today, many people are starting to question whether we need so much "stuff."

Figure 1.15 As North Americans we are lucky to have relatively comfortable lives. However, we consume far more than our share of the world's natural resources. We also create more than our share of pollution and impact on the land.

In our haste to satisfy our wants, we often forget the basic needs of plants and animals. For example, many people love to visit parks in the Rocky Mountains in order to camp and hike, but towns, campgrounds, and parking lots are at the bottom of the valley, which is the most important wildlife habitat for animals such as elk (Figure 1.16).

To satisfy people's desire for juicy, red tomatoes year-round, large greenhouses are being built on prime farmland just outside of Vancouver. This land is a very important habitat for thousands of shorebirds. Shorebirds rest here after flying hundreds, or even thousands, of kilometres enroute between their southern wintering grounds and their northern breeding grounds. Now, because so much of the land is being taken up by greenhouses, the shorebirds are left with very little habitat. These are just two examples of how the *wants* of people conflict with the *needs* of wildlife.

Figure 1.16 Sometimes, when we want to "go back to nature," our wants conflict with the needs of wildlife.

Figure 1.17 These "monster" greenhouses provide juicy, red tomatoes year round, but at what cost?

No Simple Answers

Figure 1.18 While letting wild fires rage through heavily used areas would not be practical, wardens now light and carefully control fires in certain areas to ensure there is adequate food for grazing animals.

You have heard about the terrible destruction caused by forest fires. Would it surprise you to learn that park wardens in Banff National Park deliberately set the fire shown in Figure 1.18? For years people have seen fire as having a devastating effect on the environment. Park wardens, along with the ecologists and biologists who work with them, however, found that naturally occurring fires can benefit the ecosystem. Periodic fires clear areas of small trees and leaves, needles, and other forest debris that gather on the ground. After a fire, new grasses and other plants sprout up and provide valuable food for elk, deer, and other animals that routinely graze in the valley bottoms.

Learning the benefits of fire is just one way to use scientific understanding in order to try to reduce human impact on the environment. Ecologists continue to study natural areas and natural systems to reduce our impact. For example, the peregrine chicks shown in Figure 1.19 have been helped by the actions of humans. Peregrine falcons were close to extinction in eastern Canada in the mid-1900s following the common use of the pesticide, DDT. Why? The use of this pesticide had some unfortunate side effects. One negative effect was that it caused the eggshells of many birds to become so thin and fragile that their chicks did not survive. DDT is no longer used in Canada. The ban on the use of DDT, and the programs such as the one shown here to help peregrine falcons achieve nesting success, are increasing the numbers of this majestic bird. Originally, peregrine falcons nested on cliffsides. Now they also use tall buildings for their nests — a human-made substitute.

Figure 1.19 Peregrine falcon chicks are being placed in a nest of a pair of peregrine falcons that have not been able to produce their own young.

Figure 1.20 The crates on the back of this horse-drawn carriage carry wolves that are being relocated to Yellowstone National Park in the United States, to replace wolves that had almost entirely disappeared from that environment.

Recall that part of the reason that swift foxes almost disappeared in Alberta was because they were accidentally poisoned. For years, natural predators such as wolves, coyotes, and cougars were seen as "bad" and unnecessary animals. They were thought to be dangerous and aggressive animals and were often shot on sight. As well, many of these animals were often poisoned. Unfortunately, when poisons were set out, they also resulted in the death of many other animals, including the swift fox. Now — again because people became concerned and learned more about the role of these animals in natural systems — these animals are regarded as an important part of ecosystems. Predators keep the numbers of deer, mice, rabbits, and other small animals in check. Without this sort of natural control, the population of these animals would increase to such an extent that vegetation would be threatened by overgrazing.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus7

Take a peek at a peregrine nest by visiting the site of the Canadian Peregrine Foundation (CPN). The CPN has live cameras focused on peregrines nesting on buildings in Etobicoke, Hamilton, and Ottawa. To view peregrines, visit the above web site. Click on **Web Links** to find out where to go next. Monitor the site for a few days and note the activity on the nest during that time in your Science Log.

INVESTIGATION 1-B

SKILL CHECK
- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Wetland Wonders 

Think About It

Wetlands are areas where the soil is wet for all or most of the year. Wetland areas drain slowly and are important parts of ecosystems, not only as wildlife habitat, but also because they capture, store, and slowly release water to surrounding areas. When wetlands are filled in, the flow of water can change, causing flooding in some areas and drought in others. As well, the critical wetland habitat is lost. Wetlands are one of the most endangered habitats in Canada. A developer wants to put a road through the middle of a wetland that is home to a variety of plants and animals. Can you come up with a solution that will help preserve the wetland habitat?

How Can Science Help?

Scientists who study water flow understand how changing or draining wetlands can harm them. As well, biologists have a good understanding of the needs of the plants and animals that live in wetland ecosystems. Together, these scientists can explain the problems that can occur if wetlands are drained, and they can make suggestions to reduce the impacts of development. To learn about wetlands, scientists carefully observe wetland areas and set up models of such areas in which they can test and monitor various conditions.

Safety Precautions

Wipe up all spills immediately.

Apparatus

2 rectangular aluminum foil baking pans
scissors
modelling clay
bucket
500 mL beaker
stopwatch or watch with a second hand
graduated cylinder
3–5 small sponges

Materials

water coloured with food colouring
plastic Ziplock™ bags

Procedure

1. Use the scissors to carefully cut a series of holes about the size of a dime at the bottom near one end of one of the baking pans.
2. Raise the end of the baking pan without the holes about 2 cm high using two balls of modelling clay under the pan. Put the end of the baking pan with the holes just over the edge of the table. Put the other baking pan on a chair under the holes so that it will catch any water draining from the first pan.

3. Pour 250 mL of water at one end of the pan and time how long it takes for the water to flow through the pan and drain into the second baking pan. Copy the data table below into your notebook, and record this number in the data table.

Number of sponges	Time to drain through (s)	Amount of water collected (mL)

4. Put one sponge in the pan with the holes and pour 250 mL of water into the pan. (The sponge is your wetland.) Time how long it takes for the water to flow through the first pan and drain into the second pan. Use the graduated cylinder to measure the amount of water that flowed through the pan. Record the time and the amount of water collected. Squeeze the water in the sponge back into the beaker.

5. Repeat step 4, adding one more sponge with every trial.

6. When you have the pan filled with sponges, create a "road" of modelling clay across the middle of the baking pan. Pour 250 mL of water in the baking pan and observe what happens.

Analyze

1. Describe how wetlands are like a sponge.
2. What happens when wetlands are paved over?
3. Describe what happened to your wetland when a road was put through the middle of it.
4. Could you think of an alternative to a road that would allow the developer to get through the wetland, but would still protect the wetland habitat?

Career CONNECT

What's the Count?

Linda Söber is an environmental biologist who helps governments and developers use their land in a way that preserves the existing wildlife. "I count each type of plant and animal I see. Once I know what's there, I can suggest ways to protect the natural environment." When studying an area, Linda does not look for just the animals themselves. She looks for tracks, droppings, nests or bedding sites, and fish eggs on plants along the water's edge or in a swamp. She also listens for identifying sounds of certain bird calls.

Developers often want to fill in wetland areas on their land to make solid ground on which they can build. Unfortunately, this destroys the wetlands and almost everything that lives there. According to Linda, wetlands have more wildlife than either fields or forests.

Do some research at the library or on the Internet, talk to somebody at a wetland reserve if there is one in your area, or contact a wildlife organization, such as Ducks Unlimited. Identify ten animals and plants that live in wetlands (also called swamps, bogs, or marshes). For each animal or plant, write a sentence about how filling in the wetland will affect it. Will filling in the wetland remove its food supply or breeding ground? What are some other ways that wetland animals could be affected?

TOPIC 2 Review

1. What are natural resources? Give two examples of natural resources and explain how humans use them to meet their needs.

2. Complete the following chart.

Activity	Impact on the environment	Positive or negative impact	Alternative action to lessen negative impact
Using plastic bags in your lunch			
Mowing your lawn and putting the grass clippings in the garbage			
			Riding your bicycle

3. Think of two activities you perform in a typical day, and describe two impacts that each activity has on your environment. Are these activities wants or needs?

4. Describe two native plants that grow in Alberta.

5. Describe the habitat needs of one Alberta animal.

6. How has the relationship between humans and their environment changed in Alberta since the time the first settlers arrived here?

TOPIC 3 Environmental Choices

Figure 1.21 How big is your ecological footprint?

Your Ecological Footprint

We all depend on nature. Sometimes we seem to be so far removed from nature that we forget this. We buy food from the grocery store, seek shelter in houses or cars when the weather is bad, and flush our waste down the toilet or put it out at the curb for collection. Remember, though, our food and shelter come from natural resources that Earth provided, and all of our waste goes back to Earth. We not only *depend* on nature, we are *part* of nature.

As you have seen in earlier Topics, all living things need food, water, shelter, and space in which to live. People in North America and other wealthy countries, however, use far more than their share of Earth's natural resources. They do not live in a sustainable manner. **Sustainability** means that the resources of nature are being renewed at least as quickly as they are used, and that all wastes are able to be completely absorbed. Today there are concerns over dwindling resources on Earth. People are concerned at the rate in which our forests are being cut down or fish are being harvested, for example. Are we living sustainably, or are we living far beyond the ability of Earth to provide what we want?

Figure 1.22
WANTED: Two more good planets to support Earthlings.

Impact Here and There

Each human has an individual impact on the environment. The difference lies in *how much* of an impact we have on our environment. For example, the surface of our planet covers 51 billion ha. (A hectare is just under the size of a city block.) If you take away the ocean, desert, mountaintops, and land covered in concrete or pavement, only about 8.9 billion ha of usable land remain. Imagine that you could obtain all of your basic needs from the space and resources this land contains. If this land were equally divided among the close to 6 billion people in the world, each person would have about 1.5 ha. In reality, though, the average Canadian would need about 4.3 ha of land. That is about the size of three city blocks. If everyone in the world continued to live as we do in North America, we would need at least two more planets the size of Earth to provide the resources and absorb the wastes.

One way to determine how much of an impact you have is to determine your **ecological footprint**. An ecological footprint is a calculation of the total area of land and water needed to supply all of the materials and energy that you use, as well as absorb all of the waste that you produce. Materials include food, water, and the supplies to build shelters and to manufacture all of the products that you use. The energy you use includes electricity, natural gas, as well as all of the energy required to manufacture, run, and transport items that you buy.

Figure 1.23 Which scene has a bigger ecological footprint?

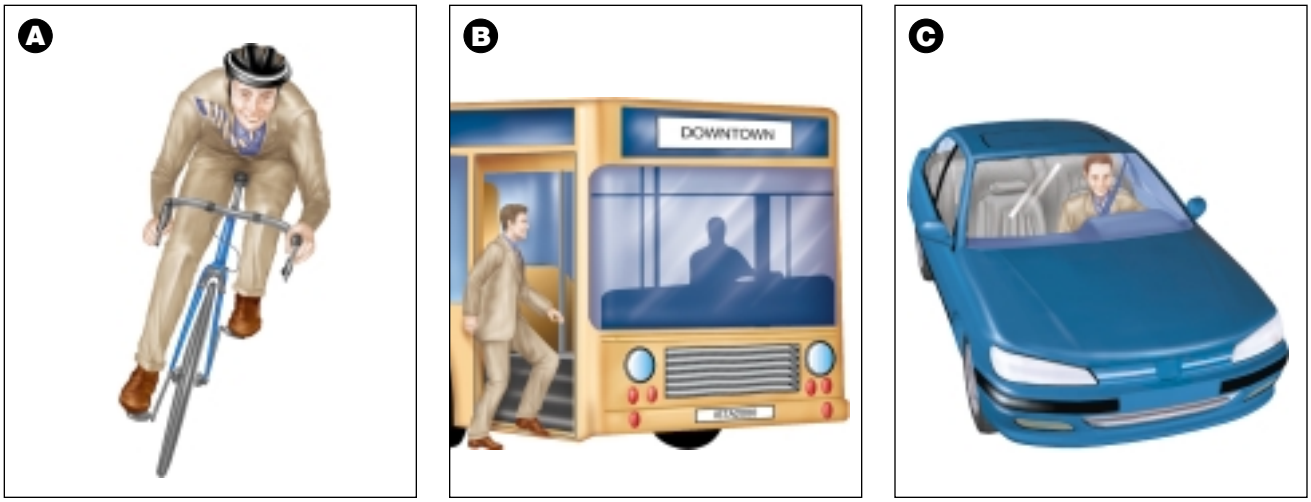


Figure 1.24 An individual can reduce his or her ecological footprint by making wise choices for daily activities.

Look at the people in Figure 1.24. If they travel 10 km to work and back each day, his or her ecological footprint will vary depending on the method of travel. If the person travels by bike, the ecological footprint for that activity is 122 m^2. By bus, it is 303 m^2, and if the individual travels alone in a car, the ecological footprint is 1530 m^2. The ecological footprint takes into consideration the resources used to build the bike, bus, or car, the energy used, and the pollution that the bike, bus, or car creates.

At present, the ecological footprint of the average Canadian is very large. Most Canadians are using many more resources and creating much more waste than is sustainable. Just think of the amount of garbage you produce in your home and how much water you use. Imagine how different life would be if you lived in a country with far more people and far fewer resources. However, each person can reduce the impact on the environment and the size of her or his ecological footprint. The first step in reducing your impact is to be aware of the natural resources you consume during a typical day. The next step is to reduce the amount of energy you use, the number of products you buy, and the amount of garbage you produce. Your ecological footprint will shrink, and the impact you have on the ecosystems around you will be reduced!

Pause & Reflect

In your Science Log, explain why using carpools, taking short showers, wearing second-hand clothes, and living in an apartment rather than a large home would reduce the size of your ecological footprint. Add your own thoughts about why you would or would not want to do any of these.

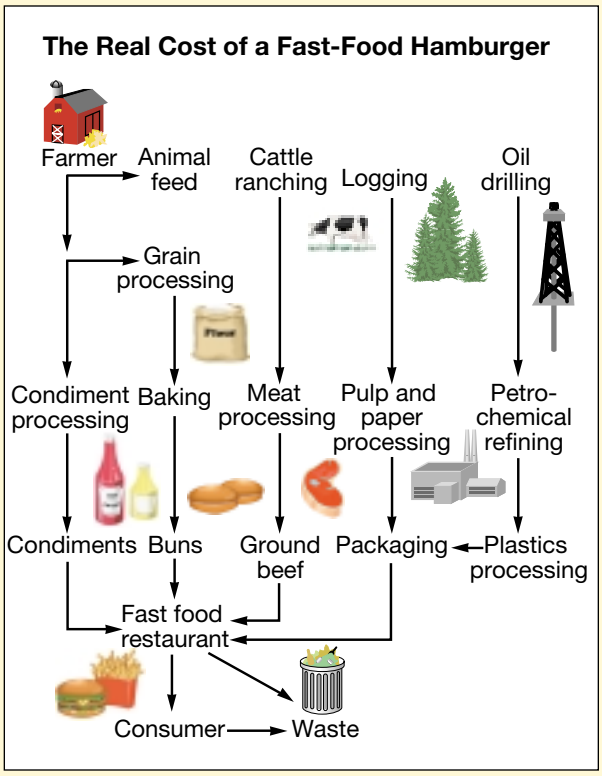
INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus7

It is possible to calculate the actual size of your ecological footprint if you have the appropriate information. Find out what information you need by visiting the above web site. Click on **Web Links** to find out where to go next. Collect the information and calculate the size of your, or your family's, ecological footprint.

Find Out ACTIVITY

Putting Your Foot in Your Mouth



Materials

coloured markers, large sheet of paper

buttons or other plastic chips

Procedure

1. Use the coloured markers to copy the chart *The Real Cost of a Fast-Food Hamburger* onto a large sheet of paper.
2. As a group, create a similar chart for a sandwich or hamburger made at home with store-bought ingredients. Consider all of the "costs" of each ingredient, including packaging, transportation to the store, transportation home from the store, electricity used, etc.
3. As a group, create a similar chart for a sandwich made at home with home-made ingredients (e.g., home-made bread, lettuce and tomatoes grown in a garden, etc.).

4. Use the poker chips to determine the real costs in energy and resources for each meal. For each "cost," place a poker chip on your chart. For example, in the above chart you would place two poker chips on farming, one for land used and one for energy used (fuel to run tractors, drive grain to market, etc.). This step would be the same for all of your charts to show the "cost" of producing the grain used in bread, or vegetables used in the sandwich or hamburger.
5. Compare the number of chips used in each of the three meals.

What Did You Find Out?

1. Which meal produces the largest ecological footprint? Explain your answer.
2. Why would a vegetarian meal have a smaller ecological footprint than a meal with meat?
3. List three practical ways in which people could reduce the ecological cost of their food. Explain how each of your suggestions reduces the environmental impact.

Reduce, Reuse, Recycle!

There are many ways in which you can help protect the environment from negative human impacts. These actions will also reduce the size of your ecological footprint. The 3 Rs — reduce, reuse, and recycle — will help you.

Figure 1.25 Recycling reduces stress on the environment.

Figure 1.26 Reduce, reuse, and recycle are three words to keep in mind and act upon if we wish to reduce our ecological footprint.

1. **Reduce** the amount of garbage you produce. For example, try to avoid buying individually wrapped items, disposable items, and overpackaged items. Take your own reusable bags or a knapsack to carry your purchases when you go shopping.

2. **Reuse** products rather than throwing them away. For example, buy products that you can use again and again rather than disposable ones. Use plastic containers to store leftovers. Give used clothing to other family members, sell it to a consignment store, or give it to charity. Take refillable containers back to the store and have them refilled instead of buying new products.

3. If you cannot reuse materials in their present form, look for ways to **recycle** them — turn them into something else. For example, compost kitchen scraps and yard wastes. Place newspapers, egg cartons, jars, cans, and other recyclable materials into recycling boxes, and set the boxes at the curb for pickup or take them to a recycling depot if you do not have curbside recycling. Whenever you have a choice, buy products made of recycled materials.

INVESTIGATION 1-C

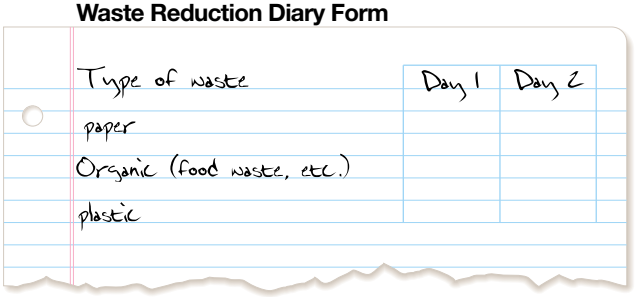
SKILL CHECK
- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Waste-Reduction Diary

Think About It

Many companies conduct waste audits to keep track of what they throw away in order to decrease waste. With the help of family members, classmates, or others, try a similar investigation to determine how much garbage you produce.

Waste Reduction Diary Form



Procedure

1. Create your own waste-reduction diary using the sample shown above. Keep your diary for one week.
2. Place your waste-reduction diary on a bulletin board, refrigerator, or other place where all the participants in your investigation can easily use it.
3. Discuss the contents of your diary with the other participants. Each of them should record each item discarded.
4. Each day for a week, have all the participants keep track of what they put into the garbage. For example, if you throw away a magazine on Day 1, put a check mark in the paper column under Day 1. If another participant also throws away a magazine on Day 1, he or she puts another check mark in the paper column under Day 1.

Computer CONNECT

Use multimedia software to create a chart or other graphic organizer to show a product's journey from raw materials to disposal.

Analyze

1. At the end of the week, total the number of times the participants threw out the various items. Did some participants create more waste than others?
2. Compare how much waste was thrown away in the different categories. For example, how much paper was thrown out compared to organic waste?
3. As a group, choose one type of waste from your results, and create a flowchart similar to the one for the hamburger on page 32. Think of as many stages as possible, and add them to your flowchart.
4. What happens to waste once it leaves your home? Does it go to a landfill, a dump, or a recycling facility? Contact your municipal office to find out.

Conclude and Apply

5. List the needs and wants that resulted in the waste. For example, you needed food so you made a sandwich, and threw away the plastic bread bag and the packaging from the meat.
6. List five ways that you could have reduced the waste that you generated over the week.

Career CONNECT

Reducing Waste

Waste-management consultants are people who study and give advice on garbage disposal matters, including Blue Box programs. Mayors, councillors, and other members of community governments are also involved with Blue Box programs and waste management. Executives of manufacturing companies and executives of companies who turn recyclables into goods that will be resold need to work closely with waste-management specialists.

Use your library or the Internet to find out what kind of education is needed to become a waste-management consultant. What kind of background would you need in order to work in waste management? What skills are most important to be effective at this job? Find out if there are any waste-management consultants in your area. What types of companies do they work for?

Looking Ahead

The 3 Rs can help us to protect our environment for the future. Imagine you are writing a letter to a friend who lives far away in another country. Explain the 3 Rs to your friend. Be sure to show how they are helping in your community. Write the letter in your Science Log. You can use the points from your letter in the end-of-unit debate.

Making the Connection

When humans affect the environment, it is often because they do not understand it. For example, when early settlers ploughed the Prairies for farmland, they were not purposely trying to destroy the swift fox's home. At the time, people did not realize the importance of this land to the swift fox and the other animals that lived there. In a country as vast as Canada, one so full of natural resources, it is hard to imagine that a human population that is relatively small can make such an impact, but, of course, we can.

If we know more about the places in which we live, perhaps we can begin to lessen our impact. How much do you know about the natural world where you live? Find out in this next activity.

Figure 1.27 Although we depend on the natural world, we often ignore it.

DidYouKnow?

Technology has caused waste-management problems, but it can also help to solve them. For example, one creative company has recently found a way to turn plastics back into the material they were made from — refined oil. Researchers have also developed a process for making sweaters, like the one shown here, out of recycled soda bottles.

Find Out ACTIVITY

Mapping Home

Materials

large sheets of paper coloured markers

Procedure

1. Performing and Recording
   Communication and Teamwork

   On a large sheet of paper, use the coloured markers to make a map of your home by following the steps below. Use words and pictures on your map. Don't worry if you are not able to answer all of the questions. You will have a chance to find the answers later.

   (a) Draw your home in the centre of the page.

   (b) Draw the nearest body of fresh water.

   (c) Show the source of your drinking water.

   (d) Show where household wastes drain to.

   (e) Add any landforms, such as mountains or valleys.

   (f) Sketch three plants that are natural to the area.

   (g) Sketch three wild animals that are natural to the area. Choose one land animal, one bird, and one aquatic animal.

   (h) Show the direction in which the Sun rises.

   (i) Show one positive thing that is happening to the environment in your neighbourhood.

   (j) Show one negative thing that is happening to the environment in your neighbourhood.

2. Communication and Teamwork Share your map with your classmates. Discuss any questions that you had difficulty answering and add any new information to your map. If you still have questions that you are unable to answer, use the library or the Internet, or ask your teacher or another adult to help you find the answer.

What Did You Find Out?

1. How well do you think you understand the environment in which you live? Explain your answer.

2. What are some ways that you could increase your understanding of the environment in which you live?

TOPIC 3 Review

1. Make a list of your activities that influence the size of your ecological footprint. Choose two items on your list and explain in detail how they affect your ecological footprint.

2. What are the 3 Rs? Give one example of each R.

3. Create a survey to ask family, friends, and classmates about which environmentally friendly activities they participate in.

4. Imagine you have brought a chicken sandwich, an apple, and some orange juice to school for lunch. Where did you get the ingredients for your lunch? Imagine your great-great grandparent making the same lunch to take to school. Where would he or she have obtained the ingredients? How do these different ways of getting food differ in their impacts on the environment?

If you need to check an item, Topic numbers are provided in brackets below.

Key Terms

ecology
ecologist
habitat
adapted
adaptation
ecosystem
symbiosis
mutualism
parasitism
parasite
host
commensalism
natural resources
sustainability
ecological footprint

Reviewing Key Terms

1. In your notebook, match the description in column A with the correct term in column B.

A

- a long-lasting relationship between two organisms
- all of the interacting living and non-living parts in an area
- a relationship between two organisms in which one organism benefits and the other organism is harmed
- a scientist who studies interactions occurring in the environment
- materials and products found in nature and used to meet humans' wants and needs
- using resources no more quickly than they can be renewed and discharging wastes no more quickly than they can absorbed
- the total area that would be needed to provide the natural resources used by an individual
- an inherited characteristic that helps an organism survive in its environment

B

- adaptation (1)
- ecological footprint (3)
- ecologist (1)
- symbiosis (1)
- natural resources (2)
- sustainability (3)
- parasitism (1)
- ecosystem (1)

Understanding Key Concepts

2. Examine the illustration. Choose two organisms and list their needs. How do they meet their needs? (For example, the butterflies eat the nectar from the flowers in the flowerbeds.) (1)

3. Adaptations allow organisms to "fit" in their environments. Describe two adaptations that you can see in the illustration. Explain how they help the organisms. (1)

4. In your own words, define the term "ecosystem." Name three ecosystems in the illustration. (1)

5. Humans use technologies to meet their needs and their wants. List three ways that you use technology every day to meet your needs. Describe how one of those technologies uses a natural resource. Does this have an impact on the environment? Explain. (2)

6. Explain how Aboriginal people who lived in Canada 200 years ago had different impacts on their environment than you do today. Give specific examples to support your answer. (2)