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.school.mcgrawhill.ca/resources/

To learn more about the swift fox and the Swift Fox Reintroduction program in Alberta, visit the above web site. Go to **Science Resources**, then to **SCIENCEFOCUS 7** 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.school.mcgrawhill.ca/resources/

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. Go to **Science Resources**, then to **SCIENCEFOCUS 7** 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 1.6 A remora exists in a symbiotic relationship with a shark.

Figure 1.7 Ants and aphids have a symbiotic relationship.

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**.

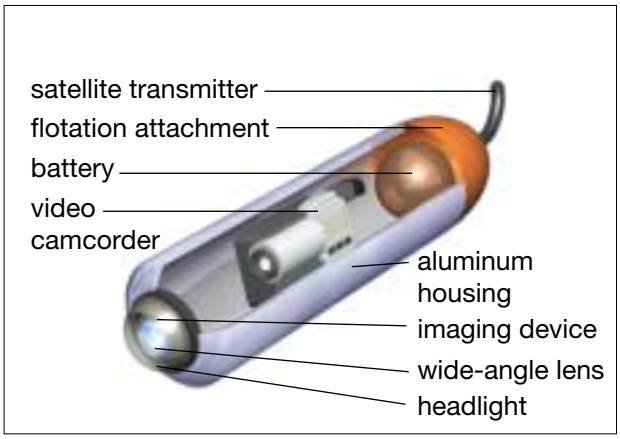
The tapeworms in Figure 1.8, for example, can live in the small intestine of human beings and may grow as long as 10 m. They benefit by absorbing the nutrients from the humans' food. The hosts, the humans, are harmed because they do not get the nutrients from the food they eat. Tapeworm eggs live in 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.