UNIT A

ECOSYSTEMS

CHAPTER 1 Ecosystems support life.

CHAPTER 2 Energy flows and matter cycles in ecosystems.

CHAPTER 3 Human survival depends on sustainable ecosystems.

Preview

Have you heard any recent news about the environment? Does there seem to be a lot of bad news about pollution, endangered species, and global warming? Do you ever wonder whether you should worry about these things? Could these things really affect your life?

No organism lives alone. On Earth, every living thing interacts with other living things and with the non-living parts of its environment. Your survival, and the survival of every other living thing, depends on these interactions.

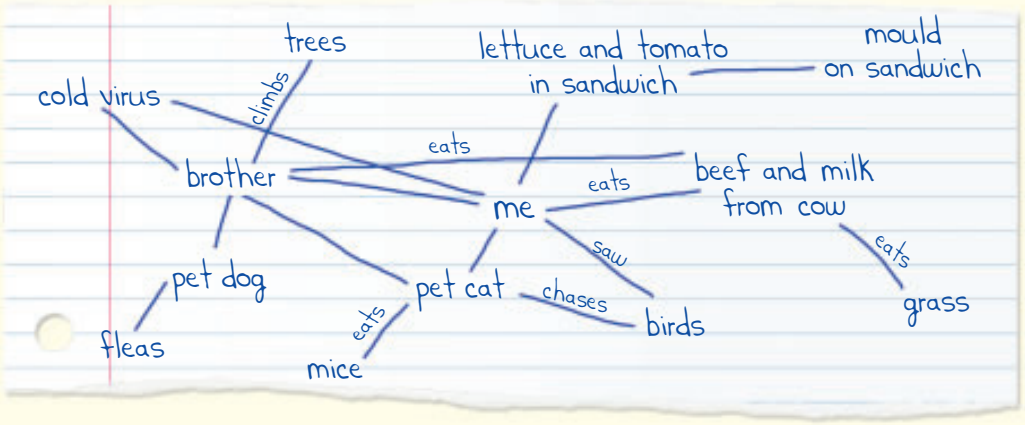
In this unit, you will learn how living things affect their surroundings and are affected by their surroundings. You will learn how plants and animals, including humans, depend on one another and how they interact with their environment. By learning about these interactions, you will discover how you fit into the living world.

TRY THIS: RECORD ENCOUNTERS WITH ORGANISMS

Skills Focus: observing, inferring

With a partner, record all the different organisms you have encountered over the past week. Draw a web and use arrows to show which organisms may have been interacting with each other. Did you encounter any dead or decaying organisms? Do you think you encountered any microscopic organisms? Remember to include yourself in your web, as well as the food you have eaten.

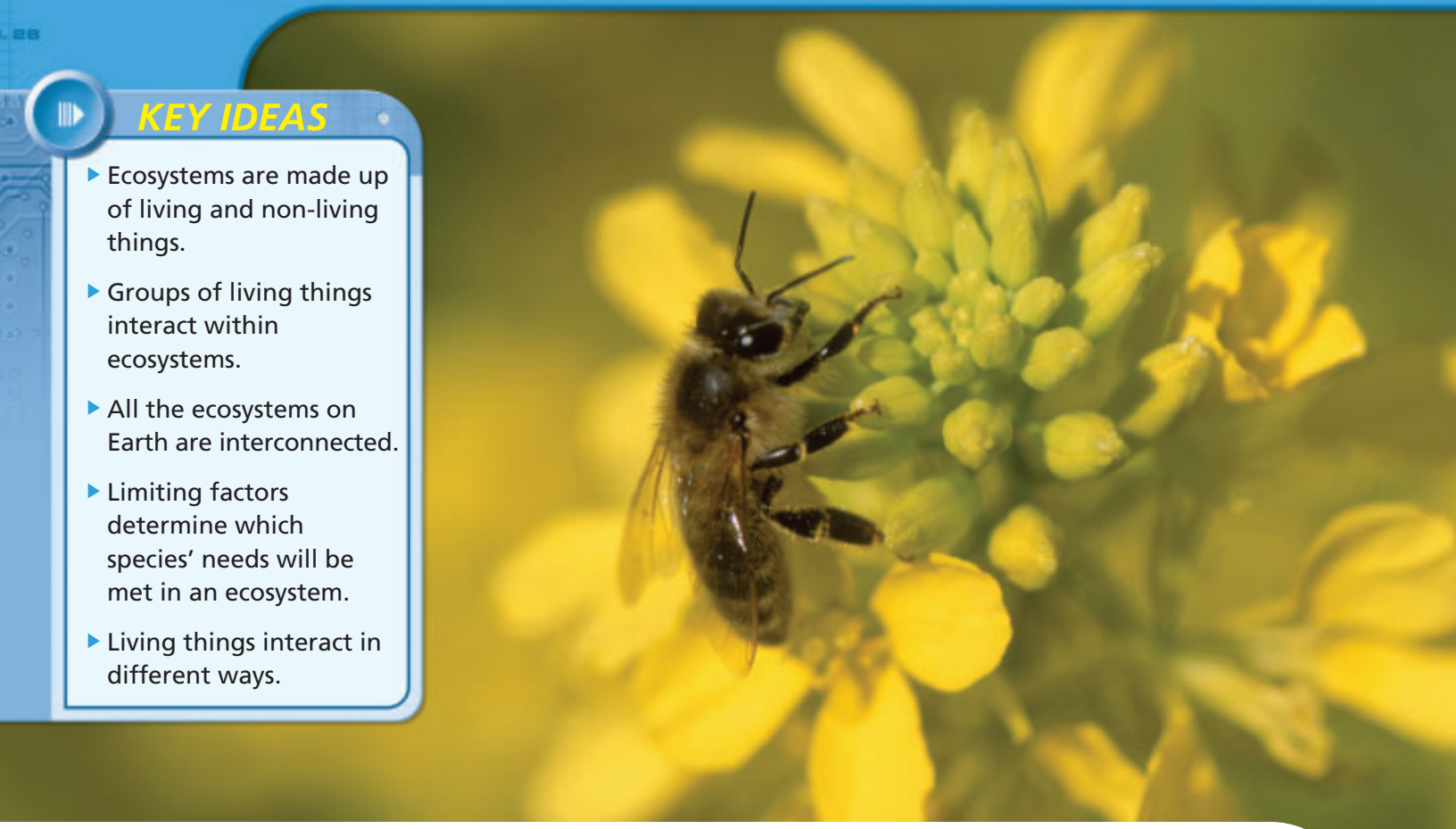
By the time you finish your web, it may look like a spider's web. Join with another pair of students to compare your webs. How many organisms do you have in common? Did they identify the same interactions you did or different interactions?



The Khutzeymateen Valley, near Prince Rupert, British Columbia.

CHAPTER 1

Ecosystems support life.



KEY IDEAS

- Ecosystems are made up of living and non-living things.
- Groups of living things interact within ecosystems.
- All the ecosystems on Earth are interconnected.
- Limiting factors determine which species' needs will be met in an ecosystem.
- Living things interact in different ways.

LEARNING TIP

As you read the first two paragraphs, try to answer the questions using what you already know.

How large is the world of this bee? What does it need in its environment in order to survive? How is the bee affected by other living things? How does it affect other living things? How might the bee affect your life? Can it affect your life even if it lives hundreds of kilometres away?

How large is your world? How are the things you need to survive like the things the bee needs to survive? How do other living things in your environment affect you? How do you affect them? How do your actions affect the bee's chances of survival? Can your actions still affect the bee if you live hundreds of kilometres away?

In this chapter, you will learn about the connections among living things. You will also learn about the connections between living things and their non-living environment.

What Is an Ecosystem? 1.1

The Khutzeymateen [K'TZIM-a-deen] Valley (**Figure 1**) is a large, undisturbed area of wilderness in one of British Columbia's coastal rain forests. The valley is a traditional hunting and fishing area for the Gitsiis people. It is an area of high rainfall, with rugged mountains, creeks, and a large river than runs down to the ocean. "Khutzeymateen" is a Tsimshian [SIM-she-an] word that means "a confined space for salmon and bears." The Khutzeymateen Valley is home to more than 50 grizzly bears. In 1994, it became the first grizzly bear sanctuary (protected area) in Canada. It is also home to salmon, beavers, wolves, otters, birds, insects, trees, shrubs, and many other living things. All these living things depend on the environment for survival.

Figure 1
Khutzeymateen Provincial Park provides a protected area for grizzly bears.

LEARNING TIP

Important vocabulary words are highlighted. These are words you should learn and use when you answer questions. These words are also defined in the glossary at the back of this book.

LEARNING TIP

It is easier to remember scientific terms if you understand the root words. The Greek word *micro* means "small." Therefore, micro-organisms are simply small organisms. Can you think of other science words that start with "micro"?

The Living Environment

The Khutzeymateen Valley has both living and non-living parts. The living parts, such as plants and animals, are called **organisms.** Some of the organisms, such as bacteria and the tiniest algae, are too small to be seen with your eyes only. Organisms that are too small to be seen without the help of a microscope are called **micro-organisms.**

Each different type of organism—plant, animal, or micro-organism—is known as a species. Grizzly bears are a **species** (**Figure 2(a)**). All the members of one particular species in a given area, such as the Khutzeymateen Valley, are called a **population.** For example, all the grizzly bears in the Khutzeymateen Valley form a population (**Figure 2(b)**). When two or more populations of different species live in the same area, they form a **community** (**Figure 2(c)**). The community in the Khutzeymateen Valley includes populations of grizzly bears, coho salmon, red elderberry, Sitka spruce, and ravens.

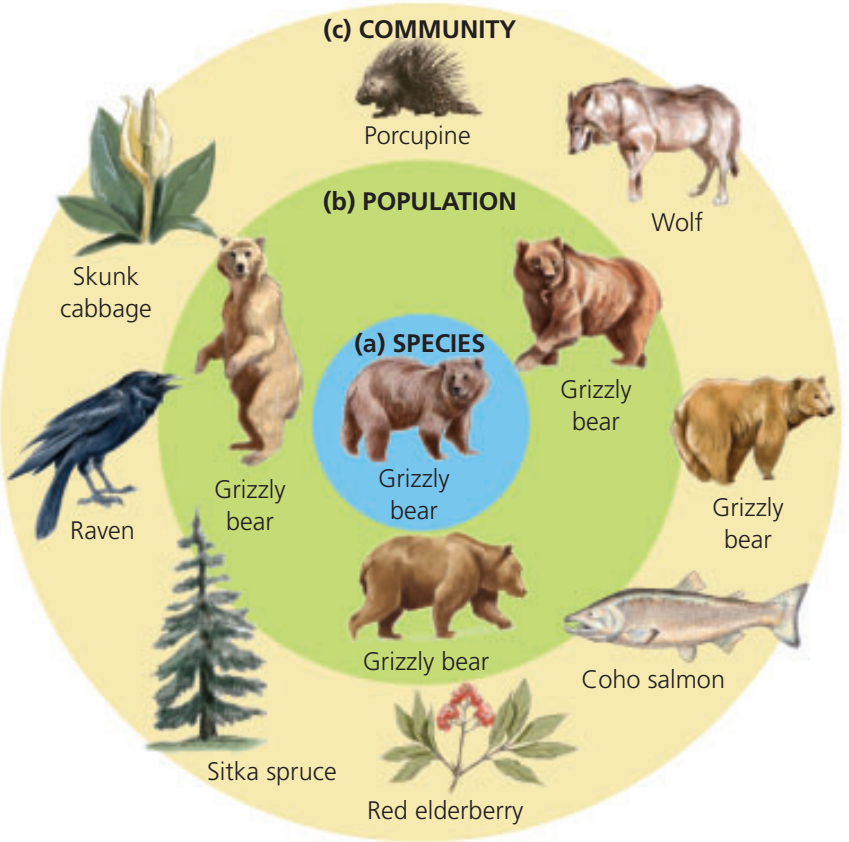


Figure 2

A nested circle diagram shows how parts fit into a whole. Each species is part of a population, and each population is part of a community.

The Non-Living Environment

The non-living parts of the Khutzeymateen Valley include the sunlight, rain and snow, soil, creeks and rivers, mountains, and temperature (**Figure 3**). These non-living parts of the environment provide many of the things that the organisms need to survive. Plants need soil, water, and sunlight. Animals need water, shelter, and an appropriate temperature range.

Figure 3
What non-living parts of the Khutzeymateen Valley can you identify in this photo?

The living parts of the Khutzeymateen Valley interact with each other and with the non-living parts of their environment. A grizzly bear eating red elderberries is an interaction between two living parts of the environment. Rain washing away soil is an interaction between two non-living parts of the environment. Sitka spruce trees using sunlight to grow is an interaction between a living part of the environment and a non-living part. The network of interactions that link the living and non-living parts of an environment is called an **ecosystem.**

CHECK YOUR UNDERSTANDING

1. List some living parts of the Khutzeymateen Valley on one side of a page in your notebook. List some non-living parts on the other side of the page. Draw lines to show interactions between the living and non-living parts of the ecosystem.
2. Choose a wild animal species in the Khutzeymateen Valley ecosystem. Draw and label a nested circle diagram like **Figure 2** to show this species in its population and community. Label your diagram using the terms "species," "population," and "community."
3. Describe an interaction between two living parts of the environment and two non-living parts.

LEARNING TIP

Do not guess. Look back through the section to find the answers. Even if you remember the answer, it is a good idea to go back and check it.

1.2 Conduct an Investigation

SKILLS MENU

○ Questioning	● Observing
○ Predicting	○ Measuring
○ Hypothesizing	● Classifying
○ Designing Experiments	● Inferring
○ Controlling Variables	○ Interpreting Data
○ Creating Models	● Communicating

LEARNING TIP

It is not always a good idea to work quickly. Do not rush when you are making your observations. The longer you observe, the more you will notice. Learning slowly sometimes results in learning more. "Slow knowledge" is usually more detailed and complete.

Your Schoolyard Ecosystem

People who live in an area for a long time can get to know the environment very well. For example, many Aboriginal peoples have developed very detailed knowledge of their "home places." The first step in developing this knowledge is observation.

In this investigation, you will observe both the living and non-living parts of the environment near your school (**Figure 1**). You will observe some of the interactions that are taking place, and record your observations. As well, you will infer, or figure out from your observations, other interactions that you cannot see.

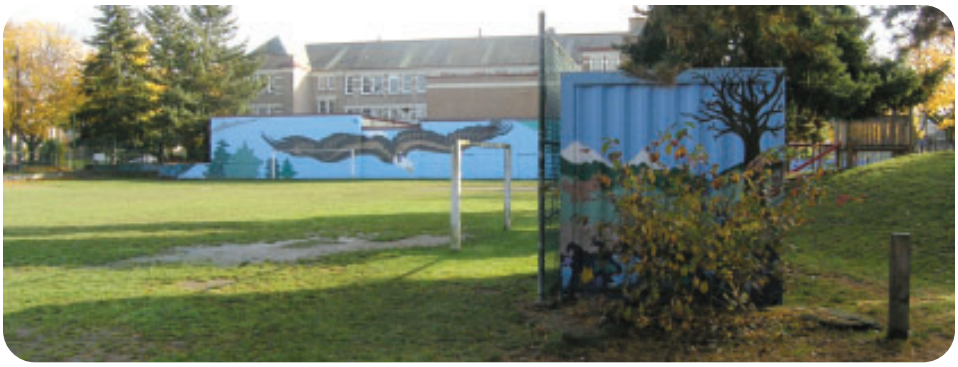


Figure 1
If you observe carefully, you will find many living and non-living things, even in an empty-looking schoolyard like this.

Question

Are there clear examples of interactions among the living and non-living parts of your schoolyard environment?

Materials

- large sheet of drawing paper
- coloured pencils
- hand lens
- field guides

Be aware of any allergies you may have to plants and animals. Watch for poisonous plants or animals that are found in the area. Hand lenses can concentrate the Sun's energy and start a fire. Do not leave a hand lens on dry grass.

Procedure

1 Choose a suitable area of your schoolyard to study. The area should be about 1 m by 1 m. If you are not able to use your schoolyard, use a nearby park, vacant lot, or field.

2 In your notebook, make a table like the one below.

3 Walk slowly around your study area to look for organisms. Remember to look for dead organisms (such as fallen logs) and signs of organisms (such as empty shells or feathers), as well. Record your observations in the first column of your table.

Note: Do not pick or break any plants or damage any flowerbeds. If you turn over rock or log to see what is underneath, be sure to replace the rock or log exactly the way you found it.

4 For each organism, record any connections to other living things in the second column of your observation table. For example, a plant may have small insects living on it. A spider may have the remains of its food in its web. Look closely, and use your hand lens.

5 In the third column, note any connections between each organism and the non-living parts of the environment. For example, is the soil sandy or is it hard clay? Is the area wet or dry? If the area is wet, where did the water come from?

6 If you have time, use your field guides to identify and learn about any organisms that are not familiar to you.

Schoolyard Observations

Organisms	Connections to other living things	Connections to non-living parts of the environments
earthworm		under rock
leaf 	small holes - probably eaten by insects	
bird, mostly brown, small	perched in tree	drinks water in puddle, stays in shade
black ants, 2mm long	carrying insect wing	go down cracks in ground

Analyze and Evaluate

1. Make a class list of all the species of organisms that were observed during this schoolyard study. Remember to include yourself. This is the community of living things that share your schoolyard with you.

2. Choose one animal or one plant to analyze in more detail. Draw the animal or plant in the centre of a large sheet of unlined paper, leaving plenty of space around your drawing. In the space, write several living and non-living parts of the environment that might affect your organism or be affected by it. Use your observations for this information, and ask your classmates if they have any additional observations. Use two different colours: one for the living parts and the other for the non-living parts. Use a line to connect each part of the environment to the organism at the centre. Identify the interaction along the line (**Figure 2**).

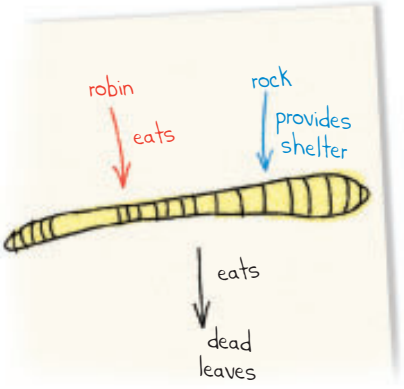


Figure 2
Identify the connections between the living and non-living parts of this worm and its environment.

Apply and Extend

3. Study your drawing of a plant or animal and its interactions. What might happen to the organism if you removed one of the other living parts of the environment? What might happen if you removed one of the non-living parts of the environment? Explain by describing the interactions.

CHECK YOUR UNDERSTANDING

1. Explain why you might get different results if you did your study
   - at night
   - in another season
2. You can sometimes "read between the lines" of your observations. Based on what you already know, you can suggest more things than you actually observed directly. We call this inferring. Give three examples of interactions that you did not see directly but were able to infer.

LEARNING TIP

For help with inferring, see "Inferring" in the Skills Handbook.

Ecosystems Within Ecosystems

1.3

Look at **Figure 1**. What do the two photos have in common?

Figure 1
A discarded bottle with rainwater in it, and a backyard koi pond, are both examples of small ecosystems.

Both photos depict small ecosystems that you might find near your home. Ecosystems can be as large as the Khutzeymateen Valley or as small as a discarded bottle or a koi pond. Ecosystems can be created or altered by humans, or they can be more natural, such as a wilderness area.

When you think about ecosystems, such as the koi pond and the Khutzeymateen Valley, keep in mind that an ecosystem is not really a place. It is a set of interactions among the living and non-living parts of the environment. Also keep in mind that there are ecosystems within ecosystems.

You could go to the Khutzeymateen Valley and study the interactions that occur in one rotting log, along one creek, or in the whole valley (**Figure 2**). In each of these ecosystems, you would find living and non-living parts interacting with each other. Although studying a small ecosystem is often more practical and convenient, you should never forget that it is part of a larger ecosystem.

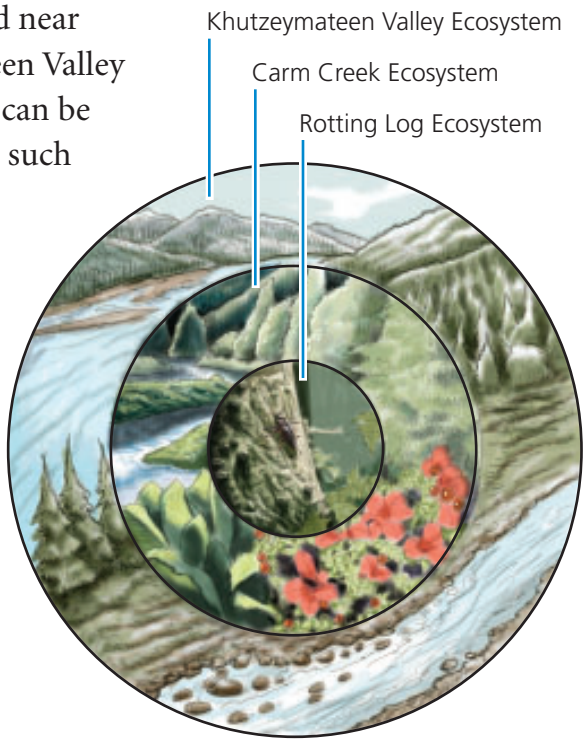


Figure 2
Nested circles are a good model for showing how smaller ecosystems are nested within larger ecosystems.

The whole Earth is one large ecosystem called the **biosphere.** The biosphere includes all the places on Earth where living things are found, from mountaintops to the deepest parts of the oceans. Since it is difficult to study all the interactions in such a large ecosystem, scientists divide the biosphere in various ways.

Scientists have identified large areas of Earth that have roughly the same temperatures and the same amounts of rain or snow. These large areas are called **biomes** (**Figure 3**).

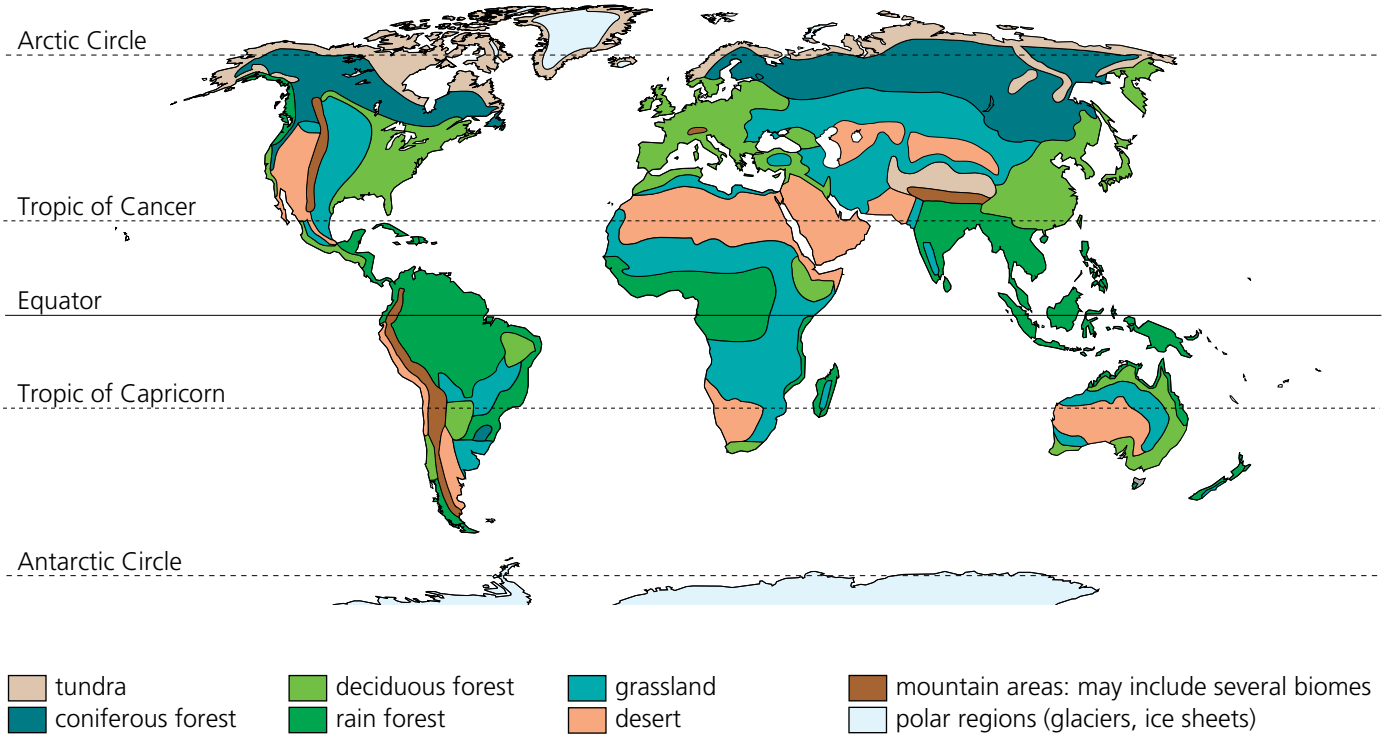


Figure 3
This map shows the major biomes of the world. Each biome is named after the most common type of vegetation that is found there.

Biomes are still very large, so scientists often study smaller ecosystems within each biome. All these ecosystems overlap. They are connected to each other and to the ecosystems in the oceans.

Together, the world's oceans form one vast ecosystem (**Figure 4**) that is connected to the ecosystems on land. Just as there are ecosystems within ecosystems on land, there are many ecosystems within the vast ecosystem of the oceans. For example, smaller ocean ecosystems along the coasts are very different from ecosystems in the open ocean. Ecosystems near the surface of the ocean are very different from ecosystems in the deep.

Figure 4
This is a photo from space. Notice that the oceans cover almost three-quarters of Earth's surface.

Land and ocean ecosystems overlap. The Khutzeymateen estuary is a lush, green place where the Khutzeymateen River runs into the Pacific Ocean (**Figure 5**). Here, the mixing of salt water and fresh water creates a unique ecosystem for many different types of plants and animals.

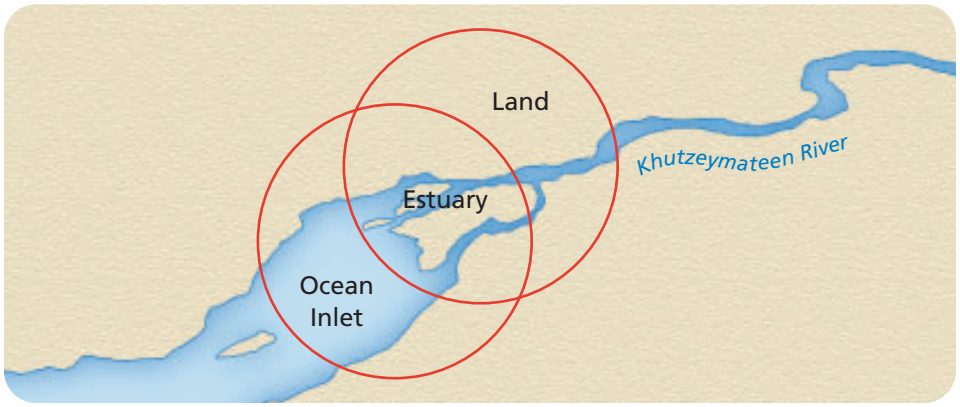


Figure 5
A Venn diagram can be used to show how ocean and land ecosystems overlap.

Land and ocean ecosystems are linked where they meet. They are also linked over great distances through the movement of animals and the flow of water. For example, western grebes (**Figure 6**) spend their winters on the coastal waters of British Columbia, yet fly back to large interior lakes each spring to reproduce and rear their young.

Figure 6
An interior lake with western grebes

In many parts of British Columbia, salmon link ocean and land ecosystems. Salmon that hatch in inland rivers spend their adult lives in the open ocean. Then they swim hundreds of kilometres, back to the rivers where they hatched, to spawn. Even if you live far inland, rivers and streams that flow through or near your community connect you to the ocean.

Dividing the biosphere into smaller and smaller ecosystems helps us study them in more detail. It is important, however, to remember that all of Earth's ecosystems are connected and affect one another.

CHECK YOUR UNDERSTANDING

1. The Khutzeymateen Valley and a koi pond are both examples of ecosystems. How are they different? How are they the same?
2. List three small ecosystems that you might find within the larger ecosystem of your schoolyard.
3. In what biome do you live? What type of vegetation is this biome named after?
4. Use a nested circle diagram to show how your schoolyard ecosystem is part of the biosphere. Compare your diagram with your classmates' diagrams. Do all the diagrams have the same number of circles? Explain how there can be several different correct diagrams.

LEARNING TIP

For help in how to use a nested circle diagram to show parts within a whole, see "Using Graphic Organizers" in the Skills Handbook.

The Needs of Living Things 1.4

Organisms must have their basic needs (such as food, water, and suitable living conditions) met in order to survive. If an ecosystem does not supply an organism with its basic needs, the organism will not be found in this ecosystem. Think of what you need to survive. Plants and animals need these things too. Like you, if they have the right combination of all of these things, they will probably thrive.

Survival Needs

The survival needs of plants and animals include the following:

- *Sunlight:* Plants need sunlight in order to produce food. As well, sunlight provides heat for both plants and animals.
- *Food:* Plants can produce their own food using sunlight, but animals must eat plants or other animals to get their food.
- *Air:* Animals need oxygen from the air. Plants need carbon dioxide from the air to make food with the help of sunlight.
- *Water:* The bodies of both plants and animals are mostly water. In fact, you can think of living things as sacs of water. Water has many important functions in the bodies of living things.
- *Shelter:* Some animals find natural shelter in their environment. Others, like beavers and wasps, build shelters using materials from their environment.

LEARNING TIP

Make connections to your prior knowledge. What do you already know about survival needs from previous grades? Is there any new information here?

The physical space where a certain species lives is called its **habitat.** A species of plant or animal can only live in a habitat where its survival needs are met. Although most species need the same basic things, the amount and type they need may be very different. Different ecosystems provide different amounts of sunlight and water and different types of shelter. For example, the Khutzeymateen Valley ecosystem gets about 304 cm of rainfall and has about 1400 h of sunlight per year. The antelope brush ecosystem, in the south Okanagan, gets about 34 cm of rainfall and has about 2000 h of sunlight per year (**Figure 1**).

Figure 1
Many plants and animals that thrive in the rain forest ecosystem of the Khutzeymateen Valley could not survive in the antelope brush ecosystem of the south Okanagan because their survival needs would not be met.

LEARNING TIP

Before reading the next four pages, "walk" through them and note the subheadings. Make a list of the limiting factors you expect to learn about.

Limiting Factors in the Non-Living Environment

All organisms have basic survival needs. If one of these needs is not met in an ecosystem, then the organism will not be able to live there. Any part of the non-living environment that determines whether or not an organism can survive is called a limiting factor. Limiting factors include physical barriers, sunlight, water, temperature, and soil.

Physical Barriers

Often an organism is not found in a particular ecosystem simply because it is unable to get to the ecosystem. Oceans, rivers, mountain ranges, and other landforms can block a plant or animal from moving to another suitable area. These landforms are called physical barriers.

Gwaii Haanas [G-why Hah-nas], the group of islands at the south end of Haida Gwaii [HY-duh G-why], has 39 plant and animal species that are not found anywhere else in the world. One of these species is the Haida Gwaii black bear, the largest black bear in North America (**Figure 2**). Many of the organisms in Gwaii Haanas would be able to live in similar habitats on the mainland, but it is too far for seeds to travel or animals to swim.

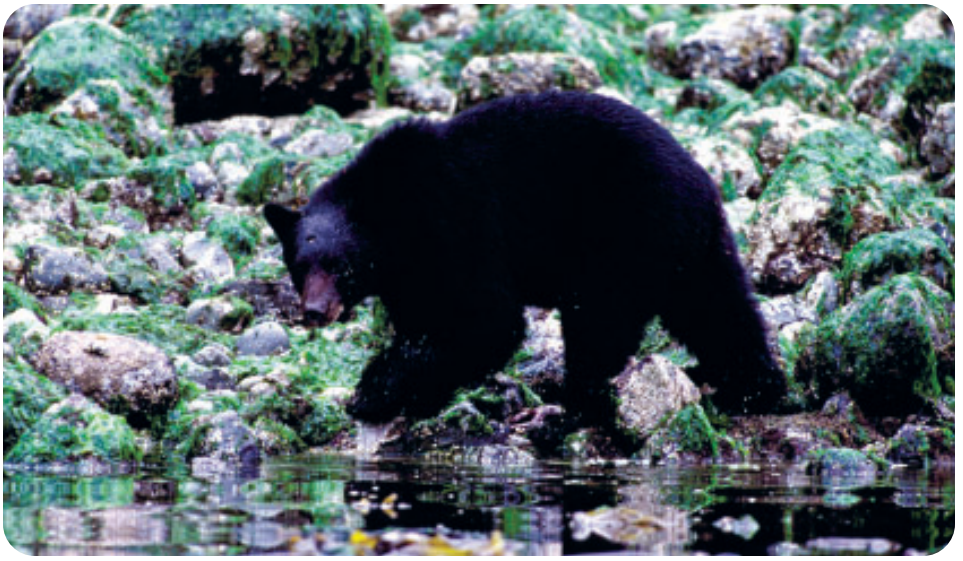


Figure 2
The Haida Gwaii black bear is only found in Gwaii Haanas because the stretch of water between the islands and the mainland is a physical barrier.

Sunlight

The amount of sunlight in an area can determine whether or not an organism can live there. Some plants grow better in bright sunlight. Other plants grow better in shade. For example, dandelions grow better in sunny places, but skunk cabbages grow better in shade.

In water ecosystems, sunlight can only shine down to a certain depth. Organisms that use sunlight to produce food can only exist in areas close to the surface, which have enough sunlight (**Figure 3**).

Figure 3
Kelp requires sunlight to produce food.

Many of the reptiles that live in British Columbia, such as snakes and turtles, bask in the sunlight to raise their body temperatures (**Figure 4**). Reptiles that live in hot climates seek the shade to escape the heat.

Figure 4
A western painted turtle basks in the sunlight to warm itself.

Water

All organisms need water. How much water they need, when they need it, and what type of water they need (fresh or salty) varies, however. The availability and type of water in an ecosystem determines what organisms can live there.

Some plants and animals need to absorb or drink water every day. Other plants and animals can exist for a long time without water. Some animals live on land but need water to reproduce (**Figure 5**).

Figure 5
This Pacific Treefrog lives on land but returns to a pond to breed.

Most plants and animals need either salt water or fresh water. A few organisms, such as salmon, live in fresh water for one part of their life cycle and salt water for the other part. Some organisms, such as the Nootka rose and shooting star (**Figure 6**), may be found in estuaries where salt water and fresh water mix.

Figure 6
This shooting star can grow in very salty soils.

Temperature

Temperature can limit the survival of an organism, if the temperature is too hot or too cold for an extended period of time. In British Columbia, the temperature is usually the coldest in the north or on mountaintops. As you travel north or up mountains, you find a tree line (**Figure 7**). Above the tree line, the temperature is too cold for trees to grow.

Figure 7
Temperature is a limiting factor for the growth of trees.

Even short-term changes in temperature can affect survival. For example, the upper limit of water temperature for successful hatching of salmon eggs is 20°C.

Soil

In nature, soil gets its nutrients from the decomposition of plants and animals. The soil of the Khutzeymateen Valley has large amounts of broken-down plant material in it. Therefore, it holds water like a sponge. The soil in the antelope brush ecosystem contains very little plant material, so water runs through it very quickly. Plants need different types of soil. For example, Indian hellebore grows well in rich, moist soil, but sagebrush requires thin, dry soil (**Figure 8**).

Figure 8
Indian hellebore (left) and sagebrush (right) require different types of soil to grow well.

TRY THIS: IDENTIFY THE BEST LIVING CONDITIONS

Skills Focus: inferring, classifying

The plant tags in **Figure 9** describe the best living conditions for the different plants. You can infer the limiting factors for the plants from their tags.

Design a "best living conditions" tag for an organism. The organism could be you, a pet, or a plant or animal from the ecosystem in which you live.

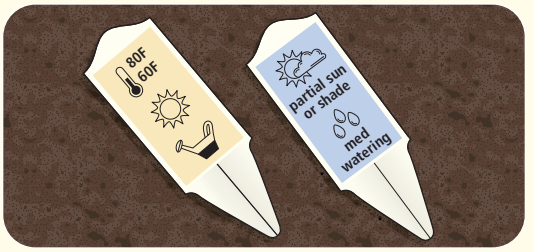


Figure 9

CHECK YOUR UNDERSTANDING

1. List the survival needs of all living things.
2. A gardener places a plant in a garden where there is a suitable amount of space and water, and suitable soil and temperature. The plant soon dies, however, because it is in the shade. What is the limiting factor for the success of this plant?
3. Logging companies are no longer allowed to remove trees that shade salmon streams. What limiting factor would exist for salmon if the trees were removed?

1.5 Design Your Own Experiment

SKILLS MENU

● Questioning	● Observing
● Predicting	● Measuring
● Hypothesizing	○ Classifying
● Designing Experiments	● Inferring
● Controlling Variables	● Interpreting Data
○ Creating Models	● Communicating

Factors That Limit Yeast Growth

Did you know that yeast is a living thing (**Figure 1**)? It feeds, reproduces, and even excretes waste. Yeast lives in a moist, sugar-rich environment. In order to grow, it requires food in the form of a sugar. What are the limiting factors for yeast? Can it grow in any conditions? Does it grow better in certain conditions? Design an experiment to answer your own question about the growth of yeast.

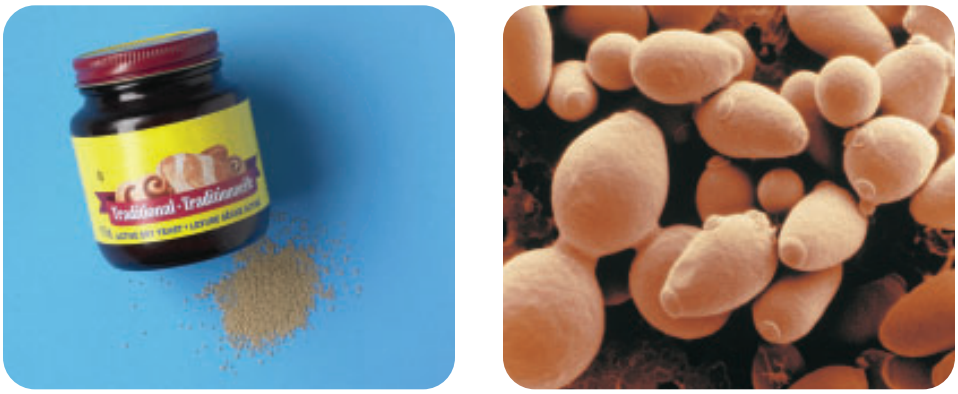


Figure 1
Baker's yeast grows and reproduces in the right conditions.

Question

Write a question you would like answered about factors that affect the growth of yeast. Think carefully about what you want to find out in your experiment. What do you want to know about yeast growth and limiting factors?

LEARNING TIP

For help with writing a hypothesis, controlling variables, or writing up your experiment, see "Hypothesizing," "Controlling Variables," and "Writing a Lab Report" in the Skills Handbook.

Hypothesis

Write a hypothesis based on your question. Your hypothesis should be a cause and effect statement that you can test. It should be a sentence in the form "If … then …."

Materials

Make a point-form list of all the materials you will need to complete your experiment. Be sure to include exact sizes and quantities.

Procedure

- Design a procedure for your experiment. In your design, include
  - descriptions of the independent, dependent, and controlled variables
  - a step-by-step description of the procedure
  - a list of safety precautions
- Be sure to include at least two controlled variables (variables that you will control during the experiment). Remember that you need to design a fair test.
- Submit your procedure, including any safety precautions, and a diagram of how you will set up the equipment to your teacher for approval. Your diagram should be at least a half page in size.

Data and Observations

Design a data table and record your observations.

Analysis

Look at your observation table. Why do you think you observed what you did? Do you think your experiment was affected by a variable that you did not control? If so, what might this variable have been?

Conclusion

Write a conclusion that explains the results of your experiment. Your conclusion should refer back to your hypothesis. Was your hypothesis correct, partly correct, or incorrect? Explain how you arrived at your conclusion.

Applications

What other questions could you ask about limiting factors for the growth of yeast?

LEARNING TIP

You might graph your results in order to find a pattern. For help in graphing data, see "Using Graphic Organizers" in the Skills Handbook.

CHECK YOUR UNDERSTANDING

1. Explain what conducting a fair test means. List two things in this experiment that contributed to it being a fair test.
2. Describe one thing that someone might do to make this an unfair test.

1.6 The Interactions of Living Things in Ecosystems

You have learned that the number of plants or animals in a population can be limited by factors in the non-living environment, such as sunlight and water. You have also learned that plants and animals interact with other living things. These interactions can place limits on population growth as well.

Competition

When you run a race or play a baseball game, you are competing. You are hoping to be more successful than your competitors. Other animals and plants also compete, often for life or death. Competition in ecosystems occurs when an organism tries to get what it needs to survive, but other organisms need and try to get the same things (**Figure 1**). For example, plants that grow close together all try to get water, sunlight, and nutrients from the same small area. They may all be small and thin, until some die and make more water, sunlight, and nutrients available for the remaining plants (**Figure 2**).

Figure 1
Which animals are competing for the salmon in this carving by Fred Davis (Haida)?

Figure 2
Which plants are winning this competition?

A competition can leave you feeling tired and weak. Plants and animals are also weakened by competition. It is easier for a disease to affect a weakened organism.

The competition for the resources in an ecosystem limits the sizes of populations. For example, grizzly bears compete with other grizzly bears for food and places to live. Each grizzly bear requires a very large area for gathering food. Even the huge Khutzeymateen Valley can only support about 50 grizzly bears.

Predator–Prey Interactions

An animal that hunts another living thing for food is called a **predator.** The organism that is being hunted is called the **prey.** A lynx (the predator) eating a snowshoe hare (the prey) is an example of a predator–prey relationship (**Figure 3**).

Figure 3
A lynx (the predator) is chasing a snowshoe hare (its prey).

A population of predators cannot increase unless there is enough prey. At the same time, the predators tend to keep the population of prey from increasing. As a result, there is usually a balance between predators and prey in an ecosystem. This balance is more like a teeter-totter than a level beam, with more prey or more predators at different times.

Case Study: The Search for an Explanation

The population of snowshoe hares in the Yukon Territory and other parts of northern Canada rises and falls in a cycle that is about 10 years long. Some Aboriginal peoples have known about this cycle for thousands of years. The hare were a major food source for the Aboriginal peoples. When the population of hares was at its lowest, they often went hungry.

Fur traders for the Hudson Bay Company also noticed this cycle. They bought the pelts of both the hare and one of its predators, the lynx. In 1925, a scientist graphed the Hudson Bay Company data (**Figure 4**). The graph showed that the lynx population also cycles in a pattern. The lynx pattern follows the hare pattern by about a year.

LEARNING TIP

Look at each axis of the graph and the legend. What do they tell you about what the graph shows? Check your understanding by explaining the graph to someone else.

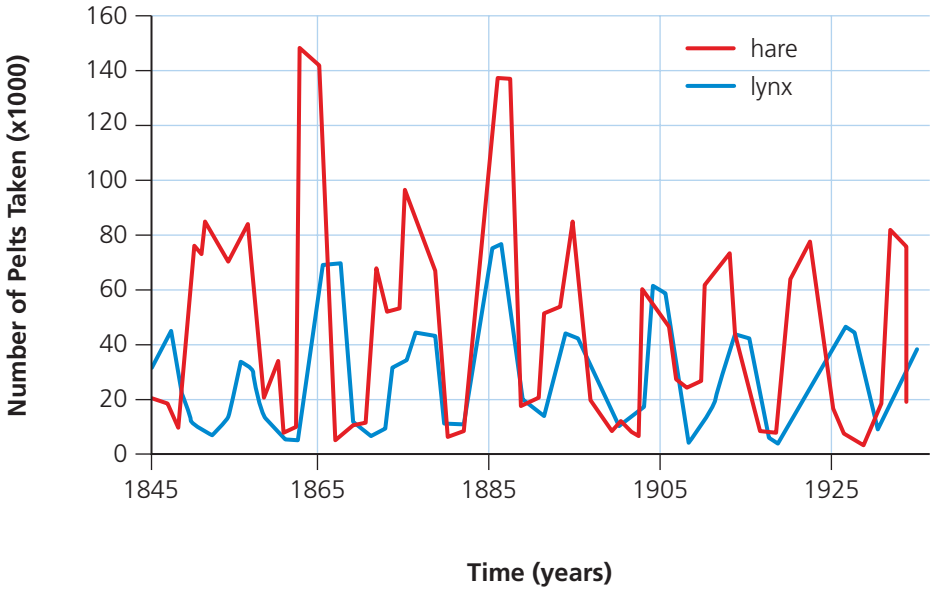


Figure 4

The size of the hare (prey) population is the main factor that controls the size of the lynx (predator) population.

At first, scientists thought that they had found a simple cause-and-effect relationship. If there were many snowshoe hares, then the lynx population would increase. When there were more lynx killing and eating hares, the hare population would decrease. As the hare population decreased, there was less food for the lynx and their population would also decrease. With fewer lynx killing hares, the hare population would increase again, and so on.

Scientists still think that the size of the hare population is the main factor that controls the lynx population. Although lynx eat other animals, such as grouse, they depend mainly on hares for food.

Scientists no longer think, however, that the lynx population is the main factor that controls the hare population. Snowshoe hare populations cycle even in areas where there are no lynx. This may be due to the fact that hares have several other predators, including wolves, owls, and humans.

Some scientists thought that perhaps the hares run out of food when their numbers are high. To find out, they fenced areas of plants to keep the hares out. To their surprise, they found little difference between the number of plants in the fenced areas and the number of plants in the unfenced areas where the hares were feeding. When scientists looked at the plants, however, they found that the plants nibbled by hares had produced substances that made them less tasty. The hares were not running out of food. The food was there, but the hares could not eat it. The scientists had discovered another cycle. As the number of hares increases, the number of plants that produce the unappetizing substances also increases. This decreases the number of hares, which, in turn, decreases the number of plants that produce the unappetizing substances.

Today, scientists are still testing hypotheses to explain the hare population cycle. They still cannot fully explain the causes of the cycle. This is because all living things in an ecosystem are interconnected.

LEARNING TIP

If you find this explanation difficult, read more slowly at the beginning until you feel you understand the content.

CHECK YOUR UNDERSTANDING

1. How can competition affect the success of a plant or animal population?
2. Why do gardeners sometimes thin out rows of vegetable plants while the plants are still small?
3. Aboriginal peoples did not blame the lynx when the hare population declined. What might these Aboriginal peoples have known that the Hudson Bay Company fur traders did not?
4. Explain why a pet cat might have more effect than a wild predator on a population of birds.

1 Chapter Review

Ecosystems support life.

Key Idea: **Ecosystems are made up of living and non-living things.**

plants animals temperature Sun soil water

Living Factors Non-Living Factors

Vocabulary

organisms p. 6

micro-organisms p. 6

Key Idea: **Groups of living things interact within ecosystems.**

Vocabulary

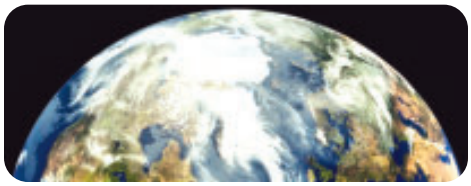
species p. 6

population p. 6

community p. 6

ecosystem p. 7

Key Idea: **All the ecosystems on Earth are interconnected.**



Vocabulary

biosphere p. 12

biomes p. 12

Key Idea: **Limiting factors determine which species' needs will be met in an ecosystem.**

- Temperature
- Food
- Sunlight
- Shelter
- Water

Vocabulary

habitat p. 15

Key Idea: **Living things interact in different ways.**

Competition

Predator-Prey relationship

Vocabulary

predator p. 23

prey p. 23

Review Key Ideas and Vocabulary

When answering the questions, remember to use vocabulary from the chapter.

1. Make a two-column table with the headings "Living" and "Non-Living." Think about your local ecosystem. In your table, list as many living and non-living parts of your local ecosystem as possible.
2. Humans are a species. They are also a population in your local ecosystem. What are some other populations that form communities with humans in your local ecosystem?
3. A pond lies untouched by humans in a remote part of the province. Your local garden centre has a demonstration pond to show people how to create a water garden. How are these two ponds similar? How are they different?
4. Describe two ways in which your local land ecosystem is linked to the Pacific Ocean.
5. Infer two factors that might limit the size of a population of small plants growing on a forest floor.
6. Give an example of a predator-prey relationship from your local ecosystem. Is there another predator that competes for the same prey? If so, what is it?

Use What You've Learned

7. Go for a walk near your home or school and find a small ecosystem. Sketch the ecosystem, or take a photo of it. Make a presentation to your class, in which you describe the living and non-living parts of the ecosystem. Compare ecosystems with your classmates.
8. Identify a predator in your local ecosystem. Find out all the organisms it uses as prey. Is it prey for any other organisms? Use print or electronic sources of information, or ask knowledgeable people in your community.

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9. Make a display about the ecosystem where you live. Your display could include
   - photographs of the landscape
   - samples, sketches, or models of typical plants and animals
   - samples of soils and rocks
   - graphs, models, or newspaper articles that describe the climate
   - newspaper articles or Aboriginal stories about how the environment affects the people who live in the ecosystem

Think Critically

10. Do you compete with any of the organisms in your environment? If so, how?
11. Are you a predator? Explain.
12. Do you think that the environment affects humans less, more, or about the same as it affects other organisms?
13. Humans can live in more types of environments than any other species. Explain why.

Reflect on Your Learning

14. Make a list of new things that you have noticed or learned about your local ecosystem.
15. List two questions that you still have about ecosystems. Glance through the rest of the unit. Do you think your questions will be answered in the topics that are covered? If not, where can you go to find the answers?