Pause & Reflect

Clams, crabs, sea cucumbers, seaweeds, and over a dozen different kinds of sea stars live in intertidal areas (see Figure 1.17). Local people say, "When the tide is out, the table is set." In your notebook, explain what this expression might mean.

Section 1.2 Summary

Organisms and their interactions with the abiotic parts of their environment can be organized into different levels: individuals, populations, communities, and ecosystems.

- A population is a group of individuals of the same species that live together in one place at one time.
- A community is made up of all of the interacting populations that live in one area.
- An ecosystem is a community as well as the abiotic parts of the environment with which the populations in the community interact.
- All individuals need a habitat (a place to live). A habitat includes food, water, shelter, and a suitable amount of space for survival.
- A quadrat study is one way to sample an ecosystem. Ecologists can use sampling to learn about the relationships among organisms in a community or to monitor changes in a community over time.

Key Terms

population
habitat
community
sampling
quadrat

Check Your Understanding

1. (a) How would you use a quadrat to estimate population sizes?
   (b) Why is the result only an estimate, not an exact number?
2. What are the differences and similarities between populations and communities? Write your answers in a chart.
3. Why would it be useful to do at least two population studies of the same ecosystem, with a period of time between the two studies?
4. **Apply** Imagine that you are a biologist. The company for which you work predicts the effects of building large subdivisions or other building projects. There is a plan to build a new luxury resort on the shore of a large bay. Builders need to know how the project will affect the environment in a few particular ecosystems. Your job is to estimate the number of organisms in these ecosystems. Explain how you could sample
   (a) the numbers of different insects in a large tree
   (b) the numbers of different fish in the bay
   (c) the number of groundhogs in a local golf course
5. **Thinking Critically** A home aquarium contains water, an air pump, a light, algae, a goldfish, and algae-eating snails. What are the abiotic parts of this environment? Which parts of this environment would you consider to be a population? Which parts would you consider to be a community?

Section 1.3 Roles of Organisms in Ecosystems

Like all other members of human communities, you play several different roles in your daily life. At school, you are a student. You might also be a member of a sports team. Outside of school, you might be a volunteer at a food bank. Similarly, the organisms in a community of plants and animals play different roles. A **niche** [NEESH] is both the space where an organism lives and the role it plays within its ecosystem. To determine an organism's niche, you must look at what it eats, where it lives, and how it interacts with other organisms in its ecosystem.

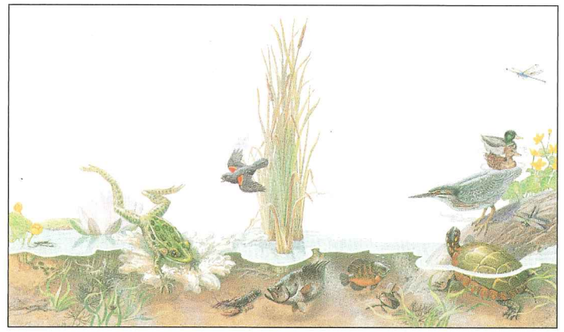


Figure 1.18
All these organisms have different roles, or niches, in this pond ecosystem.

Producers and Consumers

Plants are able to grow using energy from the Sun, carbon dioxide in the air, and water and nutrients in the soil. They fill the niche called producers. **Producers** are organisms that create their own food rather than eating other organisms to obtain food. The algae and water lilies in Figure 1.18 are producers. Producers make life possible for all other organisms on Earth.

Organisms that eat, or consume, food are called **consumers**. They cannot create their own food so they must eat producers or other consumers. All animals are consumers.

Types of Consumers

Consumers can be divided into three different groups: herbivores, carnivores, and omnivores. **Herbivores** are animals such as cows and herring that eat plants. **Carnivores** are animals that eat other consumers. Carnivores such as lynxes and dolphins eat meat. **Omnivores** are animals that eat both producers and consumers. Thus, they eat both plants and animals.

How are the niches of different organisms connected? How do they affect one another? Complete the next investigation to explore these questions.

READING Check

Are you a consumer or a producer? Explain your answer. Are you a carnivore, a herbivore, or an omnivore? Explain your answer.

THINK & LINK

INVESTIGATION 1-F

SKILLCHECK
- Predicting
- Inferring
- Modelling
- Communicating

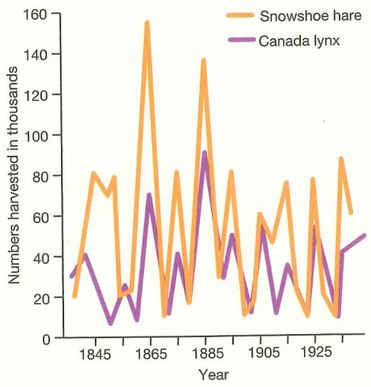
What Goes Up Must Come Down

Think About It

The niches of lynxes and showshoe hares are linked together. Lynxes feed mainly on showshoe hares. Snowshoe hares are herbivores. When there are plenty of plants for snowshoe hares to eat, more of them survive and reproduce. As a result, the lynxes, which feed on the snowshoe hares, will have more food as well. Therefore, more lynxes will survive and reproduce.

After several years, however, there may be so many lynxes killing snowshoe hares that the hare population starts to decline. Then the lynxes would not have enough food, and *their* numbers would decline. More plants would be able to grow because there are fewer snowshoe hares to eat them. As new generations of snowshoe hares are born, there will be plenty of food for them. Since there are fewer lynxes to hunt the hares, the hare population begins to increase. There is more food for the lynxes, so their numbers increase, too. Thus, the whole cycle, which lasts about ten years, will begin again.

The line graph below shows how the numbers of lynxes and hares that were harvested by trappers changed over a period of 90 years.



Skill POWER

For tips on writing a hypothesis, turn to SkillPower 6.

What to Do

Use the data in the graph to answer the following questions.

(a) In 1845, approximately how many lynxes and how many hares were harvested by trappers?
(b) How many lynxes and how many hares were harvested in 1855?
(c) In 1865, how did the two populations compare? What do you think led to this change in the numbers of the two populations?

Analyze

1. (a) How can prey control a predator's population?
   (b) How can predators control a prey's population?

2. Examine the following table. Notice that the human population in British Columbia rose steadily from the late 1800s. In what ways do you think the activities of humans might have affected the populations of lynxes and hares?

Year	Number of People
1870	36 247
1921	524 852
1961	1 629 082
2003	4 158 649

3. The graph ends at the year 1935.
   (a) Estimate the numbers of harvested lynxes and hares in 1940, based on the data in the graph.
   (b) Infer what might have happened to these populations by 1945.

5. The last few years that are shown on the graph are the first few years of the Great Depression (1929–1939) a time of mass unemployment. How might unemployment in these years have affected the populations of lynxes and hares?

Scavengers and Decomposers

READING Check

What is the main difference between a decomposer and a scavenger?

Have you ever wondered why you seldom see a dead animal in a natural environment? In every community, there are "clean-up squads" that get rid of garbage and sewage. In a biological community, the clean-up squads are consumers called scavengers and decomposers.

Scavengers are organisms that eat decaying plants and animals. The turkey vulture in Figure 1.19 feeds on decaying animal carcasses. The vulture's bald head is easy to keep clean. It uses its excellent sense of smell to find its next meal. The wolverine in Figure 1.20 is another important scavenger in British Columbia with an excellent sense of smell. Other scavengers include the larvae of houseflies, carrion beetles, crows, and some species of gulls.

Figure 1.19 Turkey vultures are found in southern British Columbia and on Vancouver Island. Vultures eat only dead animals.

Figure 1.20 Wolverines are scavengers. They also hunt animals, such as caribou, and eat plant roots and berries.

Have you ever seen food in your refrigerator become mouldy? If so, you have witnessed decomposers at work.

Decomposers break down (decompose) dead or waste materials, such as rotting wood, dead animals, or animal waste. Many bacteria and fungi, such as the bracket fungi in Figure 1.21, are decomposers. A decomposer does not bite and chew its meal. Instead, a decomposer releases a chemical onto the dead plant or animal that breaks down the tissue. Then the decomposer absorbs the nutrients into its own cells. These nutrients return to the environment when the decomposer dies.

Do different materials decompose as different rates? You will explore this question in the next investigation.

Figure 1.21 Fungi are important decomposers.

CONDUCT AN

INVESTIGATION 1-G

SKILLCHECK
- Hypothesizing
- Controlling Variables
- Interpreting Data
- Modelling

Don't Waste It!

Imagine cooking dinner at your home. You may peel potatoes, chop lettuce, and crack an egg. Each of these actions leaves you with waste material to throw away. Kitchen "waste" does not need to be garbage, however. Under the right conditions, it can be composted. When waste is composted, it is broken down so the nutrients can be released. The composted material can then be recycled, for example, as fertilizer in your garden. What kinds of materials break down well? What kinds of materials never break down at all? This investigation will allow you to explore the process of composting.

Question

What kinds of materials decompose, and how long does decomposition take?

Skill POWER

For tips on how to write a hypothesis, turn to SkillPower 6.

Safety Precautions

Apparatus

4 identical large plastic pots with drainage holes (1 per test material)

saucers to go under pots

pieces of window screen or similar material

magnifying glass

Materials

small stones

labels for pots

garden soil (not sterilized)

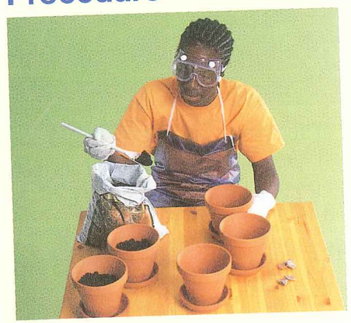
water

approximately 250 mL of some or all of the test materials in List A and List B

List A: banana peels, cabbage leaves, grass clippings, orange peels, coffee grounds, potato peels, carrot peels, egg shells

List B: aluminium foil, small pieces of plastic, shredded wax paper, shredded paper

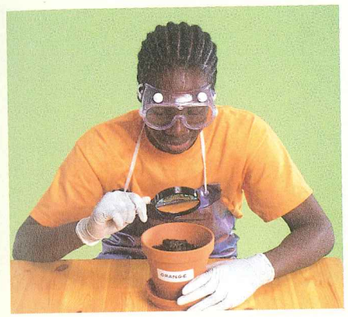
Procedure



1. Before starting this investigation, formulate a **hypothesis** about the kinds of materials that can decompose. Choose four materials to test: two from List A and two from List B. Based on your hypothesis, **predict** what will happen to each of the materials you are going to test.

2. Set each pot on a saucer.
   (a) Put a few small stones over the drainage holes in each pot.
   (b) Add garden soil to each pot until the pot is about half full.

3. Put one test material in each pot. Label the pot to show what material is in it.
   (a) Cover the materials in the pots with equal amounts of soil.
   (b) Estimate the amount of water that you can add to each pot so that a little water will come out the bottom of the pot into the saucer. Add that amount of water to each pot. If no water drains out of the bottom of the pots, add small but equal amounts of water to each pot until some water drains out of the bottom of the pots.
   (c) Cover the open top of each pot with a piece of window screen.
   (d) Put the pots in a permanent location for a few weeks. Moisten the soil every few days. Be sure to add the same amount of water to each pot.



4. After a week, remove the uppermost layer of soil. Check that the soil underneath is moist. **Observe** the amount of decomposition. If possible, use a magnifying glass. **Record** your observations. Replace the soil, and continue the process until you can see a difference in the condition of the test materials.

5. Clean up your work area as your teacher directs. Wash your hands thoroughly after completing each part of this investigation.

Skill POWER

For tips on designing an investigation, turn to SkillPower 6.

Analyze

1. Which test materials decomposed rapidly? Why do you think these test materials decompose rapidly?
2. Which test materials decomposed slowly? Why do you think these test materials decompose slowly?
3. Which materials did not decompose over the course of the investigation? Why do you think these materials not decompose?
4. Did your observations support your hypothesis? Explain.

Conclude and Apply

5. Considering the health of the environment, what should be done to recycle or dispose of the materials you listed in questions 2 and 3? Name several steps your community could take to ensure that wastes are disposed of properly.
6. What factors might speed up the decomposition of the materials you listed in question 2?

Extend Your Skills

7. Design an investigation to determine what effects, if any, temperature has on the rate of decomposition. Have your teacher approve your procedure before you carry out your investigation.
8. Design an investigation to test what effect, if any, using sterilized soil (such as potting soil) has on the rate of decomposition. Have your teacher approve your procedure before you carry out your investigation.
9. Find out about red wrigglers. What are they? What are their habitat requirements? How can they be used to help recycle waste? With your teacher's permission, obtain some red wrigglers to observe and use in your classroom.

Off the Wall

There are more individual organisms in a decaying log than there are people on Earth!

Living Relationships

Imagine having a back full of barnacles, each the size of a small orange! Grey whales that travel along the British Columbia coast (like the one in Figure 1.22) know how this feels. The barnacles are a species that attaches only to whales. The barnacle gets a free ride, dining on small animals as it cruises along with the whale. The relationship between barnacles and grey whales is an example of symbiosis. **Symbiosis** is a biological relationship in which two species live closely together in a relationship that lasts over time. The two species are said to have a **symbiotic** relationship. There are three main types of symbiotic relationships: parasitism, mutualism, and commensalism.

Figure 1.22 Grey whales can be covered with clusters of barnacles.

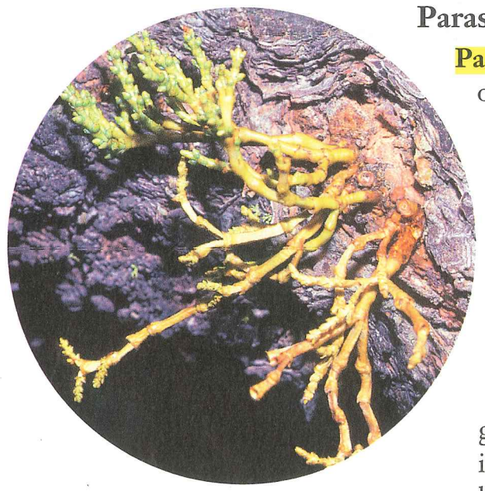


Figure 1.23 Mistletoe is a parasitic plant. It grows on trees such as hemlock, pine, juniper, and fir in British Columbia.

Parasitism

Parasitism is a symbiotic relationship between organisms, in which one partner benefits and the other partner is harmed. The partner that benefits from the relationship is the **parasite**. The partner that is harmed is called the **host**. The whale lice grow on the backs of grey whales, amongst the barnacles. They feed on the grey whale's skin and any damaged tissue. Lice are external parasites which hide in the hair, fur, and feathers of many animals.

The mistletoe in Figure 1.23 is a tiny, yellow-green leafless plant. It grows as a parasite on trees in British Columbia. The roots of the mistletoe burrow into the branch and rob the host tree of sugar, water, and other nutrients.

Some parasites, such as tapeworms, live inside an organism. The tapeworm in Figure 1.24, for example, can live in the small intestine of a human. It may grow as long as 10 m! Tapeworms benefit by absorbing the nutrients from the hosts' food. The hosts are harmed because they do not get the nutrients from the food they eat.

Figure 1.24 Tapeworms are parasites that live inside other animals' intestines.

Figure 1.25 The bacteria, the protozoa, and the termite all benefit from the relationship called mutualism.

Mutualism

Mutualism [MYOO-choo-al-is-uhm] is a relationship between two different organisms, in which each partner benefits from the relationship. The termites in Figure 1.25, for example, are decomposers of wood. They are incapable of breaking down the wood on their own, however. A termite has a mutualistic relationship with bacteria and protozoa that live in its digestive tract. The bacteria and protozoa digest the wood. The termite lives on the waste products of the bacteria and protozoa.

Figure 1.26 The relationship between scale worms and organisms such as sea stars, limpets, worms, and other marine animals is called commensalism.

Commensalism

Commensalism is a symbiotic relationship between organisms, in which one partner benefits and the other partner does not appear to lose or gain from the relationship. The relationship between the barnacles and the grey whale is an example of commensalism. The barnacles gain a habitat (the whale's back) and access to food, but the whale does not appear to be harmed. Similarly, a scale worm (like the one in Figure 1.26) lives on the surface of a sea star, inside the tube of a marine tubeworm, or in a small marine animal called a limpet. The scale worm gets a free ride and "free" food, but it does not harm its host.

READING Check

A fish called a topsmelt feeds on whale lice and flakes of old skin on a grey whale's back. What kind of relationship does a topsmelt have with a grey whale? Explain your answer.

Section 1.3 Summary

A niche is where an organism lives and what role it plays within its ecosystem.

- Plants are producers and animals are consumers.
- A consumer can be a herbivore, a carnivore, or an omnivore.
- Scavengers are consumers that eat dead organisms.
- Decomposers are consumers that break down dead organisms.

Symbiosis is a relationship between two species that live in close association over time. The three main types of symbiosis are:

- parasitism (one partner benefits and the other is harmed)
- mutualism (both partners benefit)
- commensalism (one partner benefits and the other does not lose or gain from the relationship)

How can huge humpback whales survive by eating some of the smallest organisms in the ocean? What happens when fire devastates an ecosystem? These are some of the topics you will examine in the next chapter.

Key Terms

niche
producers
consumers
herbivores
carnivores
omnivores
scavengers
decomposers
symbiosis
symbiotic
parasitism
parasite
host
mutualism
commensalism

Check Your Understanding

1. Define and give an example for each term.
   symbiosis mutualism omnivore
   producer parasite
2. What are the effects of predators on a community? What are the effects of parasites? How are the effects of predators and parasites similar or different?
3. Define symbiosis. Give one example of symbiosis from this chapter and one example from your own experience.
4. Classify each organism as a producer, a herbivore, an omnivore, or a carnivore.
   cow grass human green alga
   deer rabbit wolf oak tree
5. **Apply** Hagfish live in the Pacific Ocean. They look something like an eel with a large, sucking mouth. Hagfish enter the mouth of a dead animal then eat it from the inside out. What niche is filled by hagfish?
6. **Thinking Critically** Choose and observe an ecosystem in your neighbourhood. For example, you could observe a park, a pond, or a dead tree. What are the biotic and abiotic parts of this ecosystem? What niche does each organism occupy in this ecosystem?

CHAPTER at a glance

Now that you have completed this chapter, try to do the following. If you cannot, go back to the sections indicated in brackets.

(a) Make a chart that lists the needs of living things. (1.1)

(b) Explain the difference between an ecosystem and a biome. Describe the biome(s) in British Columbia.

(c) What are the key differences between a community and an ecosystem? Give examples of a community and of an ecosystem to help explain the differences. (1.2)

(d) Explain the relationships among individuals, populations, and communities. (1.2)

(e) Give examples of different areas that could be sampled. Explain why sampling is necessary. (1.2)

(f) What is the niche of each of the organisms shown here?

(g) Explain the difference between scavengers and decomposers. What roles do decomposers play in everyday life? (1.3)

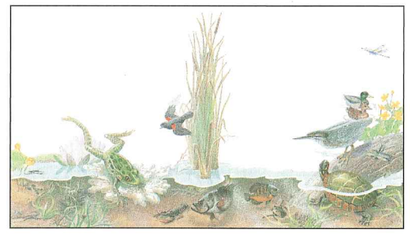
(h) Explain why termites cannot function alone as decomposers. (1.3)

(i) Describe one way in which you used a model to explain science ideas in this chapter. (1.1, 1.2, 1.3)

Prepare Your Own Summary

Summarize this chapter by doing one of the following. Use a graphic organizer (such as a concept map), produce a poster, or write a summary to include the key chapter ideas. Here are a few ideas to use as a guide:

- Create a series of pictures to illustrate levels of organization that ecologists use to communicate their observations. Write two or three sentences to explain each of your pictures.
- Identify the producers and consumers in this picture. Do some research to determine whether each animal is a herbivore, a carnivore, or an omnivore.
- Do some research to learn a few ways in which early Aboriginal peoples in



British Columbia used the resources in their environment.

- Choose key scientific terms from this chapter. Create a crossword puzzle to review their meanings.
- Create a poster to represent an organism that lives in British Columbia. Describe the biotic and abiotic parts of the organism's environment.

CHAPTER

1 Review

Key Terms

abiotic
climate
biotic
species
ecology
ecologist
ecosystem
biome
ecoprovinces
biogeoclimatic zones
population
habitat
community
sampling
quadrat
niche
producers
consumers
herbivores
carnivores
omnivores
scavengers
decomposers
symbiosis
symbiotic
parasitism
parasite
host
mutualism
commensalism

Reviewing Key Terms

If you need to review, the section numbers show you where these terms were introduced.

1. For each of the following, what is the *difference* between the two terms?
   (a) biotic and abiotic (1.1)
   (b) community and population (1.2)
   (c) ecologist and ecosystem (1.1)
   (d) mutualism and parasitism (1.3)

2. Complete the following table in your notebook. If possible, give examples of organisms that are not described or listed in this chapter. (1.2)

Type of organism	Examples of organism
producer	1. 2.
consumer: herbivore	1. 2.
consumer: carnivore	1. 2.
scavenger	1. 2.
decomposer	1. 2.
parasite	1. 2.
omnivore	1. 2.

3. Define the term "niche." List five different niches in an ecosystem. Give examples of each niche in your list. (1.3)

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

A	B
(a) long-lasting relationship between two organisms	• adaptation (1.1)
(b) all the interacting living and non-living parts in an area	• ecologist (1.1)
(c) relationship between two organisms, in which one organism benefits and the other organism is harmed	• symbiosis (1.3)
(d) scientist who studies interactions within an environment	• parasitism (1.3)
(e) a characteristic that helps an organism survive in its environment	• ecosystem (1.1)

Understanding Key Ideas

Section numbers are provided if you need to review.

5. Why are quadrats useful for carrying out studies on an ecosystem? (1.2)

6. What are some differences and similarities between communities and ecosystems? (1.2)

7. What are the main parts of an ecosystem? Give examples of each part. (1.2)

8. If you found hawks, field mice, and corn in the same ecosystem, what niche would each organism fill? Explain your answer. (1.3)

9. Why is the study of ecology best done outside a classroom or laboratory? Explain your answer. (1.2)

10. Why are Aboriginal peoples often considered to be the first ecologists in Canada? Explain your answer. (1.1)

11. **(a)** Why are scavengers and decomposers important in an ecosystem?
    (b) How do scavengers and decomposers differ? (1.3)

12. Choose an organism. Explain how it is affected by the abiotic parts of its environment. (1.1)

Developing Skills

13. Think of an ecosystem, and observe it (if possible). Make a chart, a poster, or another representation to show abiotic-biotic interactions in the ecosystem.

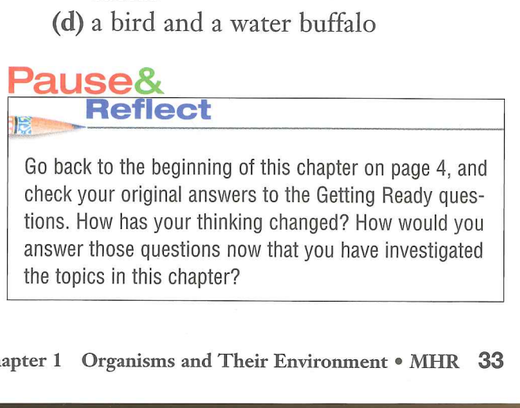
14. Make a graphic organizer showing what you have learned about Canada's four major biomes.

15. How would you create a scientific model of an ecosystem? What would you include in your model? Why?

Problem Solving

16. Do you have a fish, a hamster, or another living creature in your classroom, school, or home? What are some of its adapatations? (For example, what kind of teeth does it have? What kind of feet does it have? Can it run quickly? Is it active during the day or during the night?) After observing the animal, what do you think its original (wild) habitat was?

17. Choose at least four pairs of living organisms in the figure below. What are the interactions between each pair? What niche does each organism fill?



18. What are some examples of relationships that are similar to mutualism in a human community?

Critical Thinking

19. Think about each of the following pairs of organisms, and name the type of symbiotic relationship the partners might have. What are the gains or losses for each partner?
    (a) a flowering plant and a bee
    (b) a dog and a flea
    (c) a nectar-eating bat and a flowering cactus
    (d) a bird and a water buffalo

Pause & Reflect

Go back to the beginning of this chapter on page 4, and check your original answers to the Getting Ready questions. How has your thinking changed? How would you answer those questions now that you have investigated the topics in this chapter?