TOPIC 2

Habitat and Lifestyle

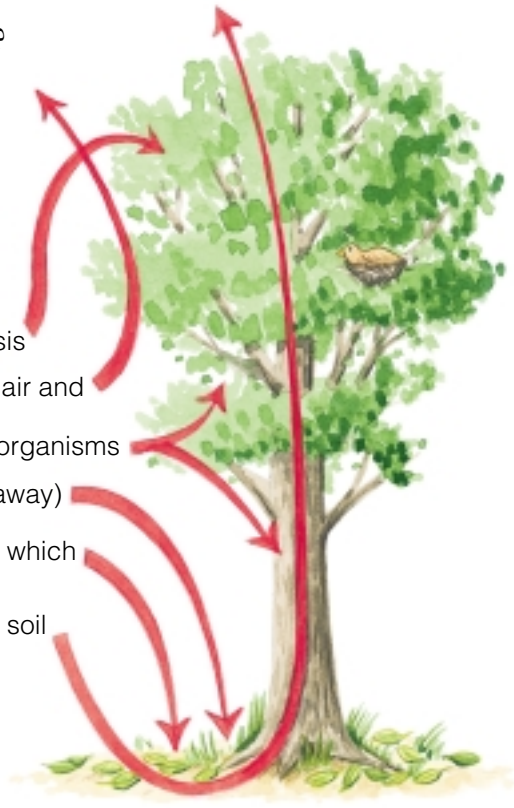
Everyone has special talents that make that person unique. What do you do better than anyone else in the class? Like people, some organisms do some things better than others. Variation in people and other organisms is more than just physical appearance. It can also be what an organism does well. For example, dandelions grow well in bright sunlight, while ferns grow well in the shade.

The Niche: What Makes an Organism Special?

Pause & Reflect

Describe the niches of three other organisms found in Alberta. Describe at least one plant and one animal. Write your answers in your Science Log.

As you have seen, adaptations allow an organism to play a specific role in its **environment**. Adaptations also help organisms to compete with each other for the needs of life. You may remember from earlier studies that an organism's niche includes two parts: where an organism lives (its habitat) and what it does. Look at the poplar tree in Figure 1.9. This poplar's habitat is a mountain forest just outside of Banff. But what does the poplar tree do? What is its role?



These various activities are what the poplar tree "does" and they make up its role in the ecosystem.

Figure 1.9 This poplar tree performs many functions, which, together with its habitat, make up its niche.

Variation and Competition

When resources such as food, water, or sunlight are plentiful, many species can share them. However, when any one of these resources becomes scarce, the organisms that depend on the resource must compete for it. **Competition** can occur between members of the same species or between different species.

Whenever two individuals compete, variations between the individuals may give one of them an advantage. Again, this is true of members of the same or different species. For example, if two species, such as mule deer and white-tailed deer, are competing for the same resource, one may have more favourable adaptations. Mule deer are able to tolerate cold winters much better than white-tailed deer. However, white-tailed deer thrive near agricultural lands. Depending on the surroundings, the members of one species may be faster or better able to avoid predators. This would allow the better-adapted deer species to reproduce and eventually "take over." In order for future generations to survive, the less successful species may have to change to a less desirable food source or move to another habitat.

DidYouKnow?

Hawaiian plants do not have thorns or toxins. Although pigs, goats, and deer have been introduced to the islands, there are no browsing mammals native to Hawaii. As a result, native plants did not evolve adaptations for protection from browsing mammals.

Figure 1.10 These deer must compete with each other and with other species for food and space.

Some species avoid competition with more dominant species by using a different food source or keeping different habits or behaviours. Cougar hunt large herbivores like deer, elk, or bighorn sheep, and are usually found in thick pine forests. Lynx can inhabit the same area as cougars, but tend to feed on snowshoe hare. Many owls avoid competing with hawks by hunting at night. As organisms change to avoid or reduce competition, they alter their niches. These subtle changes eventually increase the variation within or between species.

Think about what you would need to know about various species of trees and other plants in order to discuss the issue on pages 82–83. Is there an advantage to removing old trees? What effect might this action have on competition among other kinds of organisms on the area?

Warblers are small, active birds with sharp beaks adapted for capturing insects. Numerous species of warblers can be found in Alberta during the summer. They winter in the southern United States and in Central and South America. In the spruce forests of Canada five warbler species can co-exist in the same tree:

- Cape May warbler feeds on insects at the top and tips of the tree.
- Yellow-rumped warbler feeds on insects near the trunk's lower branches and on the ground.
- Black-throated green warbler feeds near the middle of the tree.
- Blackburnian warbler feeds from the outer tips from the middle to the top.
- Bay-breasted warbler feeds from the lower half of the tree away from the tips.

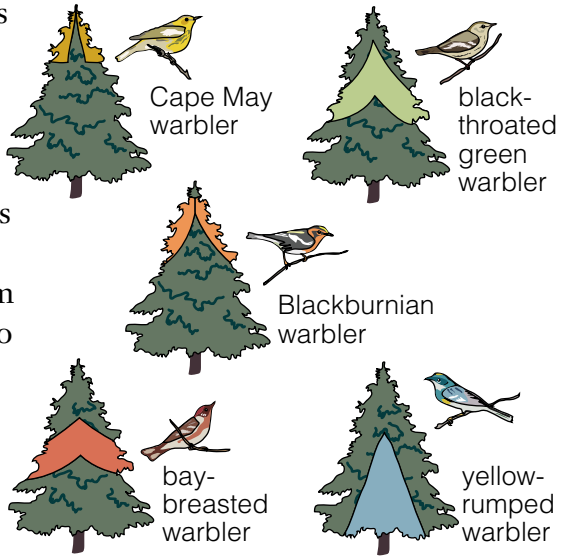


Figure 1.11 Which characteristics do all of the warblers share? How are these birds able to avoid competing with one another?

All of these birds live in the same tree, but do they share the same niche?

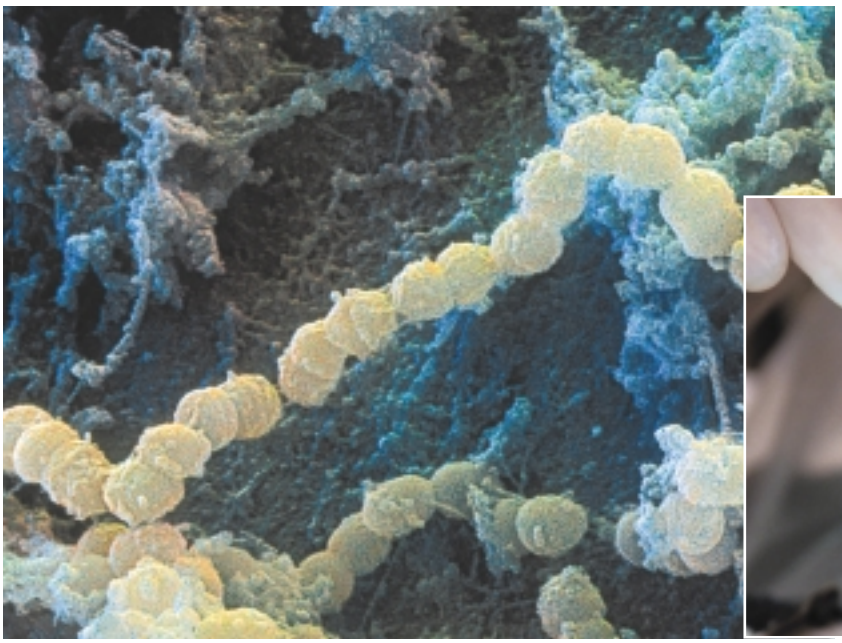
Animals are not the only organisms that have very specific niches. Did you know that countless numbers of micro-organisms inhabit the human body? You could say that each part of your body is its own ecosystem. Most of these micro-organisms are not harmful and the different species that inhabit the skin, the mouth, and the digestive tract are your constant companions.

Pause & Reflect

In your Science Log, create a scenario that would explain how the feeding habits of the different warblers developed.

Pause & Reflect

Explain why the diagram of the spruce tree does not show a completely accurate picture of the warblers' feeding patterns. How could you design an experiment to get a more accurate picture of what is happening? Write your thoughts in your Science Log.



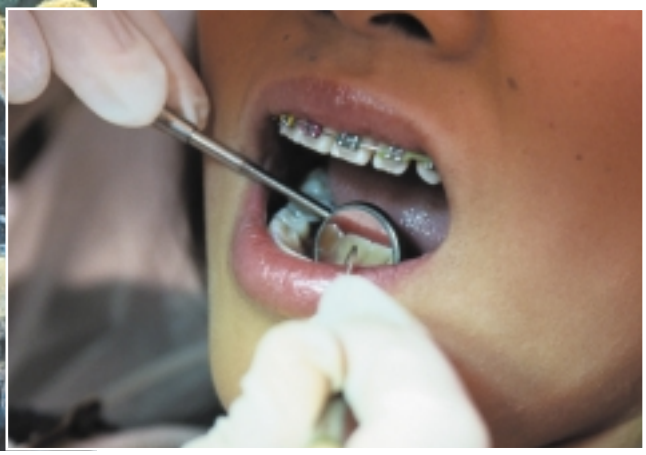


Figure 1.12
The bacterium *Streptococcus mutans* is a major component of dental plaque. Regular brushing is required to prevent plaque from building up and causing cavities.

Find Out ACTIVITY

Bird Watching

Alberta is home to many birds, such as the robin, sparrow, magpie, chickadee, and duck, which are common in neighbourhood backyards or parks.

Materials

binoculars (optional)
tape recorder (optional)
notebook
pens

Procedure Initiating and Planning, Communication and Teamwork, Performing and Recording

1. With a group, choose two or three birds in your neighbourhood to observe. Devise a procedure for making and recording observations.
2. Make your observations of the birds, keeping the following questions in mind:
   (a) In what location do the birds live? (For example, one bird may live next to a pond in the local park.)
   (b) Where do the birds make their nests?
   (c) What do the birds eat?
   (d) Do other birds or animals live in the same area as the birds you are studying? Which ones?

What Did You Find Out? Analyzing and Interpreting

1. How were your answers similar to or different from your classmates' answers?
2. Based on your observations, describe the niches of your study birds. Compare and contrast their niches.
3. How would your observations be different if you had done this activity at another time of year?

The Broad Niche

If you have had the chance to travel around northern Canada and observe the wildlife, you may have noticed two things. First, there are not as many different species of plants and animals as there are in other regions. Second, there are very large populations of the species that you do find. There are vast herds of caribou and millions of arctic hare. Even large carnivores like wolves and polar bears are found not only in northern Canada but also all around the northern regions of the globe. These same species of wolf *(Canis lupus)* and polar bear *(Ursus maritimus)* are found in Russia and northern Europe. In contrast, if you travel through the rainforests of Central and South America, you may see hundreds or thousands of different species, but each population is very small. It is quite possible that you could walk through the jungle and not see the same kind of bird twice in one day.

Why do Canadian ecosystems lack diversity but support high numbers of the species that live here? The animals that live here year-round must be able to withstand daily and seasonal changes in temperature.

Figure 1.13 Wolves need large areas of land to live. Wolves currently travel between Canada and the United States along a wildlife corridor, a natural route used by animals, in the Rocky Mountain region.

Figure 1.14 Like the caribou, polar bear, and wolf, the arctic hare is a generalist, and is adapted to living in cold winters and mild summers.

They also must be able to eat a variety of plants or other animals as seasons and conditions change. There are exceptions, but in general, organisms that survive here must have a **broad niche**. They must have adaptations that allow them to survive in the heat of the summer and the freezing cold of the winter. These Canadian species are **generalists** that are able to spread over large areas.

Diversity in the Tropics: The Dangers of a Narrow Niche

In the tropics, temperatures and food supplies are relatively stable. In these regions, most organisms are **specialists**, which means they have adaptations that make them very efficient at surviving in their own environments. Plants and animals tend to have very **narrow niches** with adaptations directed toward competing for one dependable food source, one type of soil, or one level of light. This **specialization** allows many different species to inhabit a single area, but it prevents any one species from spreading over a large area. The result is that the tropics have an incredible diversity of species, but their populations tend to remain low.

A specialist is well suited to one particular environment. This has been described as "the trap of specialization." As the species competes with others, the more useful adaptations it acquires and the more successful it becomes. However, many of the adaptations that make a species successful in one environment may prevent it from being able to inhabit other environments. For example, the lion-tailed macaque of India is specialized for life in the forest canopy. This monkey is not suited for life on the ground. As the forests are cut down the lion-tailed macaque has nowhere else to live.

Figure 1.15 The tropical rain forests of the world are areas of rich biological diversity. Many parts of these forests have never been explored by scientists and likely contain many undiscovered species.

Figure 1.16 Not all specialists live in the tropics. The prairie white-fringed orchid is an endangered specialist. If populations of the hawkmoths that pollinate this flower decrease, what will happen to the orchid?

Pause & Reflect

Plants and animals that have specialized niches in wetlands are put at risk when wetlands are drained. Research Alberta wetlands to learn about some of the species that live there. You can use the library or the Internet for your research, or you can contact an expert with a wildlife conservation group. How would you advise the local government about any plans to build houses over a wetland area? Record your findings in your Science Log.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus9

What happens if a new species is introduced into a food web? To begin your research for this activity, go to the web site above, and click on Web Links to find out where to go next. Present your findings in a short talk to your class.

Introducing . . .

Generalists can live almost anywhere. Their adaptations allow them to survive in a variety of environments and live on a variety of different food sources. When introduced into a new area where there are too few predators or competing organisms, generalists spread rapidly. As you may recall, an introduced generalist can sometimes take over, forcing out species that are specialized for life in local ecosystems.

Procedure Performing and Recording

Research an example of an introduced species, find out if it was introduced intentionally or accidentally, and detail its effect on local species and ecosystems.

Find Out ACTIVITY

What Did You Find Out? Analyzing and Interpreting

1. How have populations of local species changed since the arrival of the introduced species?
2. What niche does the introduced species now occupy?
3. Should we limit the spread of the introduced species? If so, what steps are being taken to control the further spread of this species?
4. Make a list of all of the species introduced to Canada that you and your classmates have researched. Enter the names of these species into a data base that other people can search.

Dependencies Between Species

Living things have struggled to survive for millions of years. Few, if any, have done so alone. You may think that an elk needs only water to drink and plants to eat. In fact, the elk would not be able to digest its food without the help of communities of micro-organisms that live in the elk's rumen, a specialized stomach. In turn, the elk provides the micro-organisms with a place to live. This kind of close partnership is common in natural communities.

Many plants depend on mycorrhizae, specialized fungi, to help absorb water and minerals from the soil. The fungi attach to the roots of the plants, which increases the surface area of the roots. The mycorrhizae also protect the plants from some diseases. The fungus benefits by being able to draw nutrients from the plants. You may recognize that this is a **symbiotic** relationship in which two organisms live in direct contact. It is also an example of mutualism, because the relationship benefits both species.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus9

Many micro-organisms play important roles in the environment. To find out more about them, go to the web site above, and click on Web Links to find out where to go next. Record the names of three or more beneficial micro-organisms. Write a short paragraph explaining the importance of each.

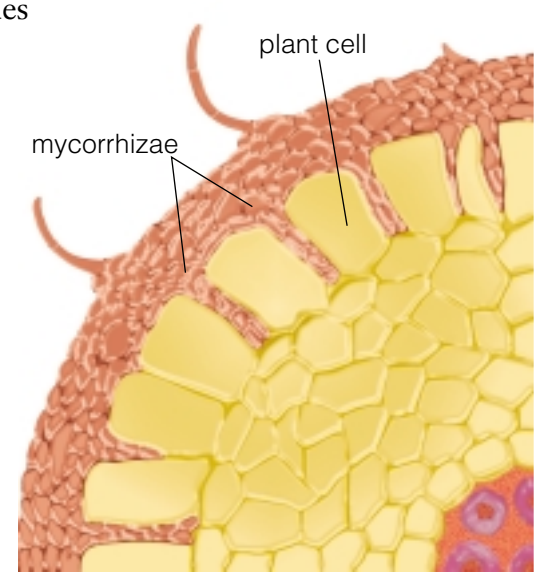


Figure 1.17 The ability of plants and mycorrhizae to live in symbiosis is an adaptation — but with a difference. In each case the adaptation was made in close harmony with the other species. Both partners in the relationship developed compatible adaptations at the same time. Here, the fungus is shown as it infects a plant root.

INQUIRY

INVESTIGATION 1-C

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

Clover and Soil Bacteria

Clover, peas, beans, and other plants called legumes have symbiotic relationships with certain soil bacteria. These bacteria, known as rhizobia, are able to live in the plant roots, where they remove nitrogen from the air and change it into nitrogen compounds the plant can use.

Hypothesis

Formulate a hypothesis about the importance of rhizobia to clover plants and their role in soil communities.

Safety Precautions

- Be careful when cutting nodules from roots.

Apparatus

small shovel
scissors
eye dropper
microscope
slide
cover slip

Materials

methylene blue dye

Procedure

1. Clover is found in most lawns and fields. Find patches of clover in your schoolyard or local park.
2. Dig up two or three clover plants, taking care to keep the roots intact.

3. In the lab, gently rinse the roots to remove any soil.
4. **Examine** the roots to find any bumps or nodules (see figure at top right).
5. Cut out one or two of the nodules and place them on a microscope slide. Add one or two drops of methylene blue dye. Put on a cover slip and press gently on the cover slip to crush the nodules.
7. **Observe** the nodules on the highest magnification available.

Analyze

1. Where did you find the clover?
2. Could you see the bacteria from the crushed nodule?
3. Why is it difficult to see the bacteria?

Conclude and Apply

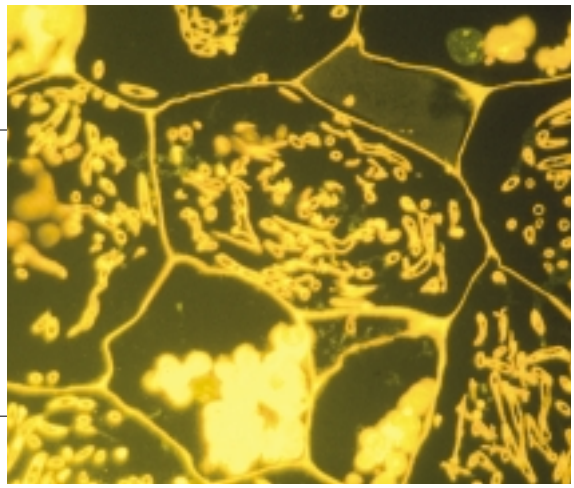
4. What evidence did you observe in the field that indicates the bacteria are adding nitrogen to the soil?
5. Why do farmers sometimes alternate clover with other crops?
6. Can legume plants grow without living in symbiosis with rhizobia? Explain your answer.

Extend Your Knowledge

7. Repeat the experiment with pea plants or bean plants. Choose plants from fertilized and unfertilized soils. Which plants have nodules? Explain your findings.

Cool Tools

Without special stains, many microscopic structures would be almost impossible to see, even using a microscope. As mycorrhizal fungi surround and enter roots, the roots themselves change shape. Shown here are the roots of an orchid seedling colonized by a mycorrhizal fungus. In order to see mycorrhizae, biologists used a fluorescent stain. A blue light was then shone on the stained specimen. When seen through a microscope, the mycorrhizal fungi showed up in fluorescent colours.



Life in the Extreme

Would you expect to find life at 110 °C? In a salt lake? In the desert sand? In fact, there are organisms adapted to living in all of these extreme environments. The Antarctic springtail, for example, is adapted to the extreme cold. This tiny arthropod produces a type of antifreeze in its tissues, which allows it to survive temperatures as low as -35 °C. Snow algae, which can be found on snowfields around the globe, have cell membranes that are adapted to cold temperatures. Being photosynthetic, the snow algae make their food using the energy of sunlight. However, high in the mountains, sunlight can be very intense. Some snow algae produce reddish pigments that protect against the Sun's damaging rays.

Many organisms have adaptations that defy our current understanding of life. Scientists who are curious about the possibility of life on other, less hospitable planets hope to learn from these strange, earthly species.

DidYouKnow?

Specialized bacteria called archaebacteria make their home in the boiling waters of geysers in Yellowstone National Park, in the United States. The study of heat-loving bacteria led to the discovery of an important heat-stable product used in scientific research.

Figure 1.18 Have you ever seen pink snow? Snow alga is a red alga that is well adapted to living in cold climates. It can be found living on the surfaces of snowfields and glaciers.

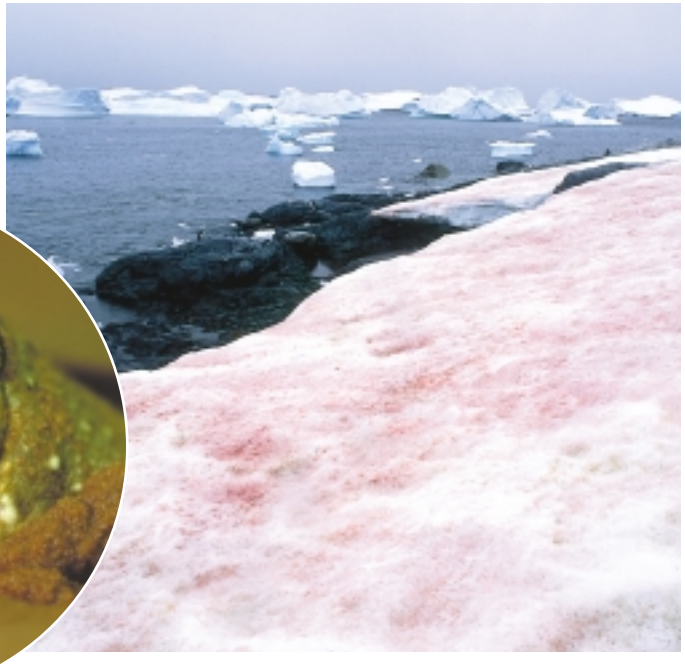


Figure 1.19 The desert spadefoot frog has its niche in the harsh conditions of the Australian desert. This frog can remain inactive for years while buried in the desert sand awaiting rain.

Across Canada

Lemmings do not intentionally jump off cliffs to drown in the sea, as some people may think. Mass movements of these near-sighted little rodents may result in their accidental drowning, however. University of British Columbia ecologist Dr. Deborah Wilson went to Nunavut in Canada's Far North to study lemmings. As part of her study, she looked at their population peaks and crashes, which have led to the cliff-jumping myth.

"Lemming numbers fluctuate quite regularly," Deborah explains, "with peaks in the population every three years. We place small radio transmitters on individual lemmings and follow their movements. This helps us learn whether they become food for predators or whether some other factor is responsible for the steep declines in numbers. Predators (such as arctic foxes and ermine) are responsible for most lemming deaths, but that's not the whole story. Lemmings reproduce at a lower rate when they are very abundant. Whether their lower reproduction is a response to the population density or to a shortage of food or space to live in is not known."

One great thing about working in the North, Deborah reports, "was getting to know the Inuit who lived near our remote field station. Some helped with our field study, and we were able to learn about their culture and the difficulties they face living in an arctic environment."

Deborah started her working life as a computer programmer, but later realized that she would rather be an ecologist. This meant more years of study, but it was worthwhile. "Keep striving to do what you love," she advises students. "It took me a long time to be able to work in the field of ecology, where my real interest lies. It is much less lucrative than working in business, but that doesn't matter to me at all."

TOPIC 2 Review

1. What two things make up an organism's niche?

2. **(a)** Both red squirrels and grey squirrels live in Alberta, although the grey squirrel was introduced from eastern Canada. Both feed on seeds, nuts, flowers, fruit, insects, and birds' eggs. Do these squirrels have to compete for resources? What are some ways they could avoid competing for resources?

   (b) Would you classify red squirrels and grey squirrels as specialists or generalists? Explain.

3. Describe two examples of symbiotic relationships found in nature. In each example, how do the adaptations of one organism depend on the other's?

Off the Wall

No one knows for sure how they got there, but the bright green parrots of New York City aren't leaving anytime soon. Flocks of the birds make New York their home, where they build nests on high-voltage power poles. The parrots are also called feral parakeets because they are probably descended from pet birds that escaped. It is hard to say if these parrots are generalists or just very lucky specialists!

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

Key Terms

variation
biological diversity
species
speciation
structural adaptation
behavioural adaptation
diversity index
environment
competition
broad niche
generalist
specialist
narrow niche
specialization
symbiotic association

Reviewing Key Terms

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

A	B
• a struggle for resources between organisms of the same or different species	• diversity index (1)
• a species with a very narrow niche	• generalists (2)
• the word that describes both the role and the habitat of an organism	• behavioural adaptations (1)
• the many differences between individuals of the same or different species	• competition (2)
• a mathematical expression of the different kinds of organisms in an area	• symbiotic (2)
• a direct or close association between two different species	• variation (1)
• the habits of a species that have been developed over time	• niche (2)
• populations of these organisms tend to be high, although there is not usually very much diversity in the kinds of these organisms	• specialist (2)

Understanding Key Concepts

2. Examine the photograph of the eagle. What structural and behavioural adaptations does it have that enable it to obtain food?

3. How could you go about measuring the biological diversity in a tropical area? What would you expect to find? (1) What has happened over time to produce this level of diversity? (2)

4. What are the advantages of a broad niche? When can these advantages turn out to be disadvantages for different species? (2)

5. Define the term "species" using your own words. Are all organisms that look alike the same species? Are all organisms that look different from separate species? Explain your answer. (1)

6. If an area of tropical rainforest were cleared to make room for a farm, how might the local wildlife be affected? Would the consequences be worse for specialists or generalists? Explain. (2)