

The idea that Earth's biological diversity is decreasing troubles many people, but what can we do to stop or even slow down the decline in biodiversity? Why should we be concerned? What actions are available and how practical are they? Biologists, governments, and ordinary citizens can all play a role in halting the decline.

The Role of Zoos in Preserving Biodiversity



Figure 1.65 The Calgary Zoo is known as one of the finest in the world. It opened in 1929 on St. George's Island. Since then, the zoo has grown, and now exhibits 1100 animals, including endangered species such as whooping cranes and Siberian tigers. The zoo is a major tourist attraction and has thousands of visitors every year.

Zoos are more than just a place to display plants and animals from around the world. The Calgary Zoo is an educational institution that runs school programs for elementary to high school students and is visited by students from across the province. The zoo is also a part of a worldwide network that is attempting to protect and preserve endangered animals. By exchanging animals between zoos, the network hopes to maintain the genetic diversity of these species. This genetic diversity is essential to species survival. In addition, the zoo initiates and supports research on biodiversity around the world.

To many people, zoos are the only visible evidence of our attempt to maintain biological diversity. The plants and animals are a concrete reminder of the world outside our own experience. Others see zoos as the perfect answer to the problem of declining biodiversity. They argue that saving a few samples of the world's different plants and animals is sufficient. Why should we slow progress and spend money to preserve the same species in the wilderness?

DidYouKnow?

Zoos began as private collections of exotic animals kept by the very rich. These collections were similar to collections of stamps, coins, or fine art. They were primarily for the enjoyment of the owner. The first public zoos were opened in the early 1800s in London, Vienna, and Paris. Today there are thousands of "zoos" around the world, and they range in size and quality from large, well-run and well-funded institutions to roadside attractions.



Pause & Reflect

Sometimes it is very difficult to recreate an animal's habitat in a zoo environment. In this situation, should the animal be kept in a zoo? What if its natural environment is dwindling? Would that alter your thinking? Debate both sides of the issue with a partner or a group. Record your arguments in your Science Log.

Assessing Breeding Potential

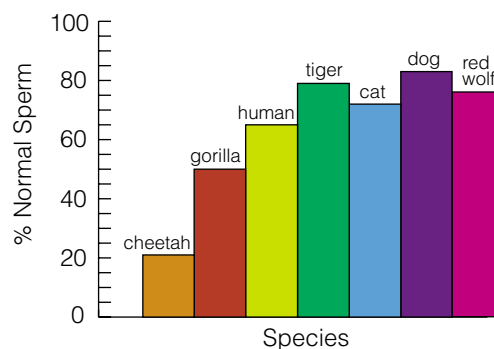
Think About It

Imagine you are assisting with a breeding program at the Calgary Zoo. The zoo already runs such a program with the Amur tiger, but is considering breeding cheetahs instead. Your job is to assess and recommend which of the two species will be the better candidate for the program by comparing sperm concentrations in each species.

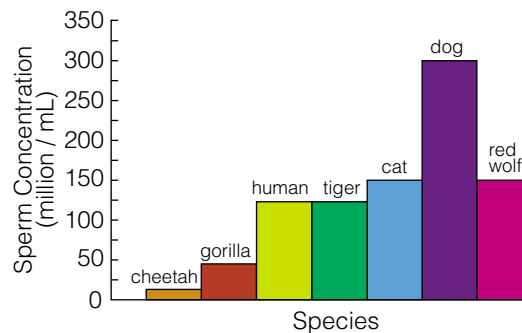


Data for Samples of Sperm Taken From Two Endangered Cats

Variable	Tiger (Tonghua)	Cheetah (Chuma)
percent sperm moving actively	95	75
percent normal sperm	80	28
sperm concentration (millions/mL)	125	5



Percent normal sperm in selected mammals



Normal sperm concentration in selected mammals

What to Do

- 1 Compare the percentage of actively moving sperm for each animal. Record which has the highest percentage. How might this influence successful fertilization?
- 2 Compare the percentage of normal sperm in each cat's sample to the percentage of normal sperm for the cat's species. Is either animal above or below the normal amounts?
- 3 Compare the sperm concentration for each cat to the normal sperm concentration for its species. Do both animals have enough sperm to fertilize an egg?



The sperm on the left is normal. The abnormal sperm shown on the right is smaller and has a crooked flagellum. Animals with normal sperm are more likely to reproduce and to have healthy offspring.

Analyze

1. Write a report recommending which animal is likely to be more successful in the breeding program. Use the results of your analysis to support your conclusion.
2. Based on your investigation, what conclusions can you draw about the relative ability of each cat to reproduce?

Preserving the Biodiversity of Plants

Seed banks are established to gather and store seeds from plants that are threatened with extinction. In some cases seed banks are run by companies that sell a wide variety of plants to gardeners and farmers. Such companies cater to individuals who want to grow something unusual or who live in specialized environments. Other seed banks are run by governments or universities for research purposes.

One of the largest seed collections is in the Royal Botanic Gardens in London, England. The goal is to gather samples of 10% of the world's seed-bearing plants. The seeds are stored at -20°C , and a few seeds of each sample are germinated every ten years. It is estimated the samples will last a couple of centuries.

By collecting seeds, researchers are able to preserve the genetic diversity of many plant species. This diversity may be a useful resource in the future. Some tree planters have another method of maintaining genetic diversity in the wild. Instead of replanting areas with trees grown from seed stocks, they use seeds that have been collected straight from the forest floor.



Figure 1.66 Seed banks are one way of preserving the biological diversity of plants. However, many scientists would also like to preserve plant biodiversity as it exists in natural ecosystems.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus9

How would you design a good quality zoo? Evaluate your sources of information based on whether or not the site is up to date, is believable, and the extent to which its claims are supported by data. Write a short (one-page) report outlining your findings and opinion. To begin your search you can visit the web site of the Calgary Zoo. Go to the web site above, and click on **Web Links** to find out where to go next.

Pause & Reflect

Suppose scientists have identified ten species of falcon. Five of these species are endangered and face extinction. Three of the five endangered falcon species are close genetic cousins of a falcon that is not endangered. Which of the endangered falcons should we protect? All of them? Or only the two genetically distinct falcons? Write your thoughts in your Science Log.





Figure 1.67 It is illegal to hunt leopards and cheetahs and sell their skins. Even so, some people will pay a high price for these products.



Figure 1.68 This rhinoceros is being protected from poachers by guards.

A Global Effort

The preservation of biological diversity depends on both local efforts and global co-operation. The Eastern Slopes Grizzly Bear Project is a Canadian-based study to learn how human activities affect grizzlies in and around Banff National Park. Knowledge gained from the study is being applied locally in conservation efforts. However, because of the demand for grizzly bear products outside of Canada, international co-operation is needed to conserve the grizzly bear.

Global treaties have been drawn up to protect endangered plants and animals. The 1975 Convention on International Trade of Endangered Species (CITES) is aimed at preventing endangered plants, animals, or parts of these organisms from being imported or exported. This law makes it illegal to buy or sell endangered animals such as rare birds, reptiles, or amphibians. It also makes it illegal to buy or sell animal parts such as rhino horns or elephant tusks, which are used to make jewellery, sculptures, or folk remedies. Five hundred species are identified for protection by CITES. In addition, one hundred and eighty countries have signed the 1992 Convention on Biodiversity and have agreed to set up protected areas for threatened and endangered species.

The job of saving biodiversity is not just up to our governments.

Groups such as the Canadian Wildlife Federation and Canadian Nature Federation educate the public and bring issues about biodiversity to our governments' attention. Some groups support conservation efforts financially or through active participation. Science can teach us about biodiversity, and maybe even how to preserve it. What we decide to do with this knowledge is up to us.



Some people believe that the gall bladders of grizzly bears contain special properties. The organs are used in certain folk remedies. There are people who are willing to pay poachers large amounts of money to illegally hunt grizzlies for their gall bladders.

INTERNET CONNECT

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What can you as an individual do to preserve Earth's biodiversity? One possibility would be to join a group that supports conservation. Research the activities of one such group and write a newspaper article presenting what you find out. You may use a computer to create graphics for your article and to design the layout. To begin your search, go to the web site above, and click on **Web Links** to find out where to go next.



Protected Areas of the World

Protected areas are preserves, refuges, and national parks set up to protect wildlife and habitat. In Alberta we have national parks, provincial parks, wilderness areas, and forest reserves. Each of these offers different levels of protection for habitat and wildlife. Hunting, logging, mining, and drilling for oil and gas are allowed in some areas but not in others. Protected areas around the world follow the same pattern. Since various uses are permitted in different areas, it can be difficult to assess the effectiveness of protecting these spaces.

Procedure

Use a bar graph to illustrate the data (percentage of protected area).

What Did You Find Out? Analyzing and Interpreting

1. What conclusions can you draw from the data? Is there a better way to display the results?
2. The data summarized in the table do not include areas of less than 10 km². Does this affect your comparison of the amount of protected area in different countries?
3. What other information would you need to accurately compare the percentage of protected areas between countries? What

Find Out ACTIVITY

Country	Area of country (km ²)	Area protected (km ²)	% Land protected
North America			
Canada	9 922 385	825 455	8.32
United States	9 372 614	1 042 380	11.12
Mexico	1 972 545	97 287	4.93
South America			
Brazil	8 511 965	321 898	3.78
Costa Rica	50 900	6 386	12.50
Peru	1 285 215	41 762	3.25
Argentina	2 777 815	43 731	1.57
Europe			
France	543 965	56 015	10.30
Germany	356 840	91 957	25.77
United Kingdom	244 880	51 280	20.94
Africa			
Libya	1 759 540	1 730	.10
Sudan	2 505 815	938 250	37.44
Zaire	2 345 410	99 166	4.23
Asia			
China	9 597 000	580 666	6.05
India	3 166 830	143 507	4.53
Mongolia	1 565 000	61 678	3.94

would you need to know to make this comparison meaningful?

4. Why is it more difficult to create protected areas in some countries than in others?



Computer CONNECT

Enter the data from the table into a spreadsheet. Use the application to draw a computer graph.

Canada's National Parks

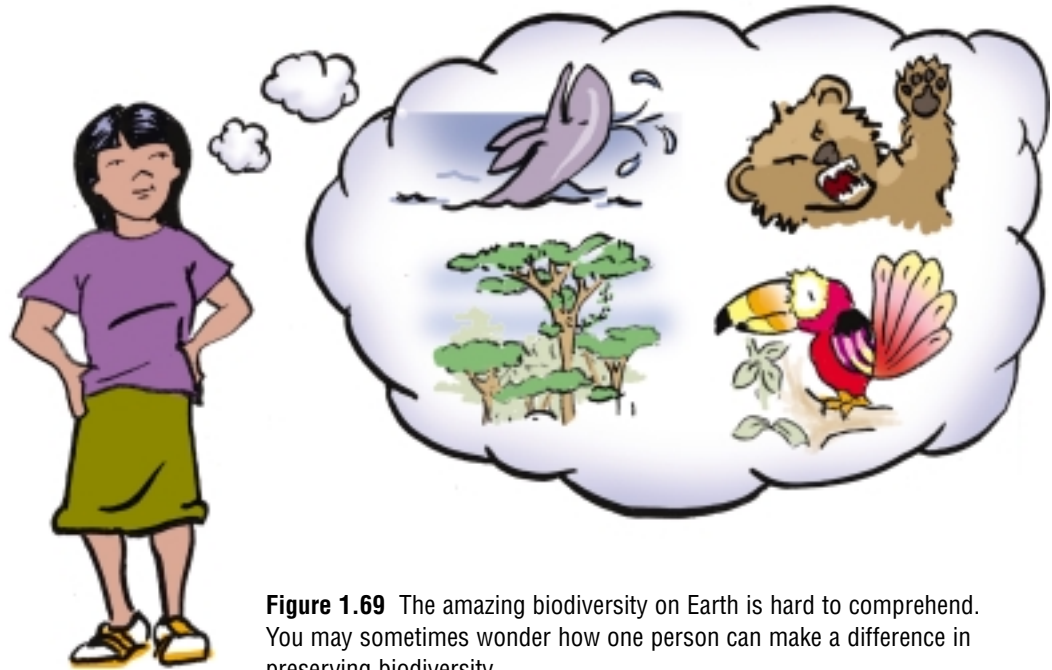


Figure 1.69 The amazing biodiversity on Earth is hard to comprehend. You may sometimes wonder how one person can make a difference in preserving biodiversity.

DidYouKnow?

Some small farms in Mexico and South America grow coffee plants under a canopy of shade trees. This practice provides a habitat for migratory birds, including many that summer in Canada!

INTERNET CONNECT

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One approach that is being used to protect endangered species is a sponsorship program. Schools, families, individuals, or companies give contributions to help an individual animal in the wild. To learn about a wolf sponsorship program in Alberta, go to the web site above, and click on **Web Links** to find out where to go next. Evaluate the strengths and weaknesses of the sponsorship program. Present your ideas in a 5 min talk to a group of students.

DidYouKnow?

Busy highways cut through some of Canada's parklands. To give grizzlies and other wildlife a safe way across the highway, wildlife overpasses have been constructed in some parts of Alberta.

TOPIC 8 Review

1. How can zoos contribute to preserving biodiversity? How do zoos sometimes contribute to decreasing biodiversity?
2. Name five things you could do — without spending money — to help preserve biological diversity.
3. How important is international co-operation in preserving biological diversity?
4. How would you respond to someone who suggested that saving a plant species was not as important as saving an animal species?

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

Key Terms

domestic animal

natural selection

seed bank

artificial selection

extirpation

global treaties

selective breeding

bioindicator species

protected areas

Reviewing Key Terms

1. How are new breeds of domestic animals developed? (6)
2. Which species are closely monitored to assess human impacts on ecosystems? (7)
3. How can governments ensure wildlife habitats are preserved? (8)
4. What can be done to preserve the genetic diversity of plants? (8)



Understanding Key Concepts

5. Darwin noted that organisms produce more offspring than can survive. How is this important in understanding how natural selection occurs? (6)
6. What accounts for Earth's biodiversity? (6)
7. New discoveries of large animals are extremely rare. Does this mean scientists have a complete catalogue of all of Earth's species? Explain. (7)
8. Why did the process of artificial selection lead Darwin to understand natural selection? Compare and contrast artificial and natural selection. (6)
9. There have been five major declines in Earth's biodiversity in the past. Why should we be concerned that biodiversity is once again declining? (7)
10. Is the "sixth extinction" inevitable? Why or why not? (7, 8)
11. Does natural selection result in variation, or does variation cause natural selection? Explain. (6)
12. Forty or 50 years ago one of the main tourist attractions in Banff was the town dump. Why? What problems did this create? (7)
13. Through natural selection, organisms can adapt to changing environments. Why would changes we make to the environment threaten biodiversity? (6, 7)
14. In the rain forests of Borneo, there is a swimming ant that lives inside the carnivorous pitcher plant. The ant promotes proper digestion for the pitcher plant by removing larger prey insects. How might the pitcher plant be affected should the swimming ant go extinct? How might the loss of the pitcher plant affect the survival of the swimming ant? What do your answers suggest about the consequences of decreasing biodiversity? (7, 8)
15. How can zoos preserve the genetic diversity of certain species? (8)
16. Which areas of the world are the most at risk of losing biodiversity? Why? (7)



an

Expert



John Acorn

Award-winning scientist and television host John Acorn explores Alberta's biodiversity close up. He has written many books and articles about many types of animals and was the host for two nature television programs, *Acorn, the Nature Nut* and the bird-watching show *Twits and Pishers*. These shows allowed him to travel the continent and study the creatures living on it. They also allowed him to communicate with a general audience about his loves — ecology and biodiversity. Acorn's studies of insects led him to discover a new species of beetle, which is being named in his honour.

Q Is Alberta an ecologically diverse place?

A We have a lot of variety in the sorts of habitats we have in Alberta, with everything from the alpine zone of the mountains right down to the hot badlands in Dinosaur Provincial Park. My guess — and everyone has a different guess — is that we have around 20 000 species of invertebrate creatures living in Alberta. When you get to a number that big, it doesn't matter if another place has more — it's still diverse!

Q What areas do you study?

A I'm interested in looking at what sorts of animals live here (and by animals I primarily mean insects, but I've worked with birds, reptiles, and amphibians, too), what sorts of habitats they require to survive, and where they came from at the end of the last ice age. I'm interested in how their status is changing or has changed over time.

Q What do you hope to accomplish with your books on species in Alberta?

A My book on the tiger beetles is a detailed treatment of the 19 species of tiger beetles that we have here. That's a good example of what needs to be done for all our species — to know exactly what their ranges are, something about their life histories and their habitats. It's one thing to say there are X-number of species. It's another to know each species in detail. Then you're really digging in!

Q What are your latest projects?

A I'm working on damsel flies right now (the book should be out within a year). I'm also working on ladybugs, larger moths, and dragonflies. I have a long-standing interest in butterflies in Alberta. We have more butterfly counts in Alberta than any other state or province in North America. People from interested kids getting out with their parents to professional entomologists are out surveying our butterflies each year and keeping track of the about 160 species of butterfly.

Q Can anyone explore biodiversity?

A Anyone can make important discoveries. When I was in junior high, I found a colony of rare ground beetles that had previously been known in North America only from one specimen in Fort McMurray, and all the rest of these beetles were known from deep in Siberia. For me, that was really exciting because professional entomologists were coming to me for advice on how to find and study this rare beetle. Even as a junior high student, I was able to make a completely new discovery. There is a role for professionally trained biologists with huge grants, but here is also a role for amateurs, from school kids up, to get out there and monitor and explore biodiversity. It just takes time, effort, and a passion for the world around you.

Q What are some threats to biodiversity in Alberta?

A The main threats are loss of habitat and introduced species. An introduced ladybug species arrived from the United States and it quickly became the most common species. As a result, some of the species that used to be common are now rare. I've been trying to reconfirm the existence of all the species we knew about before the seven-spot ladybug arrived. We've relocated most of them in smaller numbers, but there are others we haven't found yet.

Also, many of the rare tiger beetle's important habitats in Alberta's prairie sand dunes are being covered up by plant growth. To farmers, dunes are just waste fields, but to many organisms, eroded landscapes such as sand dunes are essential habitats. We're finding that tiger beetles, rare reptiles and amphibians such as the hog-nosed snake, the great plains toad, and the Ord's kangaroo rat require these sand areas as well. There is a lot of biodiversity that's reliant on particular habitats.

Q Do people associate biodiversity with Alberta?

A Not always. You hear "biodiversity" and you immediately think of the tropics and the concerns about the Amazon rain forest. It's true that there is more biodiversity in the tropics and that it is in greater danger than it is here. That doesn't mean we should forget about what we have right in front of us. In Alberta, we know enough to know the province's biodiversity is very complex, but we don't know enough to even come close to understanding it.

EXPLORING Further

John Acorn has made a career out of observing and examining creatures he finds more or less in his own back yard. Reread the Ask an Expert feature, and choose one of the organisms he discusses. With a partner, do some research and prepare an

illustrated report about the organism. You may wish to gather your class's reports and prepare them as a book for display in your classroom. You may also wish to make your reports available by e-mail to other classes.

An Issue to Analyze

A PUBLIC FORUM

To Burn or Not to Burn



Think About It

The provincial government maintains a vast and expensive network of people and machinery to detect and fight forest fires. The government fights fires to prevent damage to public and private property and to protect lives. Commercial forests, sections of the forest that the government leases to companies, are also protected from fires. The trees are used for lumber, paper, or other wood products. Commercial forests provide income for the government and jobs for many people. There is another problem with forest fires — they create air pollution, and the larger the fires, the more pollution they produce.

However, recent evidence suggests that fire prevention programs may have been too successful. You may remember that forest fires play an important role in secondary succession. Research in the Kananaskis Valley suggests that, prior to human intervention, any one area of forest was burnt by naturally occurring fires every 50–75 years. These

fires were relatively small and ran out of fuel quickly. The fires opened up space for grasses, bush, and poplar trees. These plants provided food for a variety of animals, such as deer.

Now many national and provincial parks face a problem. Fire suppression over the last 50 years has created forests that no longer support the natural food chains they once did. Also, as trees in these forests die, they become fuel for larger, hotter, and more devastating fires.

How Can Science Help?

In this class activity you will be asked to decide if fires should be allowed to burn in government-controlled forests. What would you need to know in order to thoroughly examine this issue from different angles and come to a wise decision? In your group, write down some questions that you think should be answered. You might want to know if any endangered species live in old growth forests in Canada. What species would benefit

from forest fires? As you record your questions, suggest ways that scientists could collect data in order to find out the answers. For instance, scientists may need to monitor animal populations in a specific area. The information that you gather will help you during a public forum with your class to discuss and vote on the forest fire issue.

Plan and Act

- 1 As a class, brainstorm some possible solutions to the forest fire problem. For example, some possible solutions might be:
 - Continue to use controlled fires to open up parts of the forest.
 - Allow loggers to clear-cut sections of the forest to mimic forest fires.
 - Prevent forest fires and allow old growth forest ecosystems to develop.
- 2 Like most social and environmental issues, this issue is complex. Some of the factors that should be considered are:
 - *ecological*: concern for the environment
 - *economic*: concern for profit and economic security
 - *scientific*: interest in knowledge for its own sake and possible applications
 - *moral and ethical*: concern for what is “right” and “wrong”
 - *technological*: understanding of what is possible/not possible
 - *aesthetic*: concern for beauty
 - *emotional*: concern for feelings and emotions
 - *historical*: interest in learning from the past

Your teacher will assign one of the above factors to your group of two or three students. Your group should find background information on this aspect of the forest fire issue by reading newspaper and magazine articles, watching or listening to local news, or doing research in the library or on the Internet. As a group, consider the possible solutions to the forest fire dilemma. The group should then prepare a 5 min oral presentation on why the factor you have researched is important. You should explain which alternative to the problem your group

would choose, taking into account the factor you are discussing. Be sure to present the advantages and disadvantages of this solution.

- 3 Each group will present its position at the forum. Your teacher will chair the event. After the oral presentations, the class will vote on one solution to deal with the forest fire issue. If the class is split between opposing views, the students who agree with each other should come up with a short description of their views. One student from each side should write the description on the chalkboard.

Analyze

1. How do the possible solutions to the forest fire issue affect the biodiversity of the parks?
2. Do you agree with the class’s decision on how to deal with the forest fire issue? Explain why or why not.
3. How did your understanding of science and biological diversity help you to make a decision on the issue at hand?
4. What were some of the challenges of working in a group and as a class? What were some of the advantages of working together?

Extension

5. Write a brief letter stating your views and reasoning on the forest fire issue. Send your letter to a suitable government representative (federal or provincial).



1 Review

Unit at a Glance

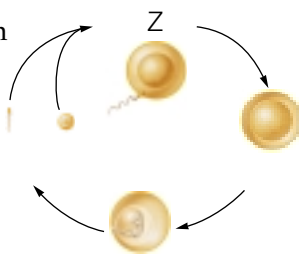
- All groups of living things show variation. There are variations between species and within species.
- Biological diversity is the number and variety of organisms in an area.
- Organisms show a wide variety of structural and behavioural adaptations.
- Competition within or between species may force groups of organisms to adopt different niches.
- Generalists can survive through the changing seasons of northern climates and spread over large areas. Specialist are well adapted to specific environments and narrow niches.
- Traits that are passed on from one generation to the next are said to be inherited or heritable.
- Clones, or copies of one parent organism, are produced by asexual reproduction. Types of asexual reproduction include binary fission, asexual spores, budding, and, in plants, vegetative growth.
- In sexual reproduction, the genetic information from two parents is inherited. In plants and animals, a sperm fertilizes an egg to form a zygote.
- Some organisms, such as the mould, *Rhizopus*, can reproduce both sexually and asexually.
- Flowers are the reproductive structures of angiosperms. Angiosperms also reproduce vegetatively from the roots or special root, leaf, or stem structures.
- Inherited characteristics that show a limited number of variations, such as tongue-rolling, show discrete variation. Characteristics with a range of possibilities, such as human heights, show continuous variation.
- Some inherited characteristics are dominant to other, recessive traits.
- Not all characteristics are inherited: The environment can influence a person's characteristics. Mutagens alter the genetic information itself.
- DNA is the genetic material and controls the function of cells. Chromosomes, which are found in the nucleus, are made up of coiled strands of DNA. A section of DNA that codes for a specific protein and function is called a gene.
- Sexual reproduction increases variation within a species. Each zygote has a random combination of chromosomes from both parents.
- Transgenic animals and genetically modified crops are important in medicine and food production.
- People have used artificial selection to develop many varieties of domestic animals. Selective breeding is also used to develop new plant varieties.
- Natural selection results in species that are well adapted to specific locales or niches.
- Although Earth has great biological diversity, the current rate of extinction is about one species per day, and possibly many more. As a result, Earth's biological diversity is declining.
- Zoos and seed banks are two ways in which people try to maintain biological diversity. Protected areas and global treaties have also been set up to protect endangered plants and animals.

Understanding Key Concepts

1. How do we recognize biological diversity? What are some different forms of biological diversity?
2. Describe the function of DNA.
3. Describe a situation in which an area with a high diversity index is healthier than an area with a low diversity index.
4. (a) Describe how an organism reproduces by budding.
(b) State one advantage of this type of reproduction.



5. Give an example of a generalist that lives in Canada. Explain why this species is able to have a broad niche.
6. Give an example of a behavioural adaptation and an example of a structural adaptation. How is each adaptation suited for a specific niche?
7. (a) Explain and give examples of how plants can reproduce from roots, stems, and leaves.
(b) Why are plants produced by these methods considered identical to the parent plant?
8. Give an example of a dominant trait that is uncommon in certain human populations.
9. Redraw this figure in your notebook. Label the cells and structures in the diagram. What happens after cell z is formed?
10. What must each mushroom spore contain in order for it to produce a new mushroom?
11. Describe three human traits that show continuous variation.
12. (a) What are some examples of observations that led Darwin to propose the theory of natural selection?
(b) What are the four statements that describe natural selection?
13. Why do some environments, such as the tropics, support such great biological diversity?
14. What are the dangers of having a narrow niche?
15. Describe five ways in which individuals and groups of people can help preserve biological diversity.
16. Give one reason why the conversion of tropical forests into farmland has generally been unsuccessful.



17. List four human impacts on biological diversity. How have people affected Earth's biological diversity?
18. (a) Redraw this diagram in your notebook and label the structures shown.
(b) Explain how, when, and where the pollen tube forms.
(c) What is the purpose of the pollen tube?



Developing Key Skills

19. "Sexual reproduction is more effective than asexual reproduction, and it is only a matter of time before all living organisms reproduce that way exclusively." In teams, prepare arguments either for or against this statement. Support each argument with a quote or an example. Each team will present its argument in a class debate.
20. Suggest an experiment to measure the biological diversity in a pond. Why would this information be important to know?
21. Make a Venn diagram (two overlapping circles) showing the relationship between selective breeding and genetic engineering. In the overlapping area of the circles, write the things that the two have in common. In the areas that do not overlap, write the things that are different.
22. How could you measure the diversity index of flowers in a meadow? What precautions would you take to preserve the flowers you are studying? Would it be important to include a study of the insects in the meadow as well? Why or why not?
23. Fern leaves grow from tightly coiled, tender spirals called *fiddleheads*. Although fiddleheads have been collected as a vegetable delicacy for ages, they are mildly toxic. How would this feature help a fern survive? How could you test your hypothesis?



Problem Solving/Applying

24. Genetic fingerprints can be used to find out if two or more animals in a population are closely related. Explain why biologists might want to compare the genetic fingerprints between captive cheetahs in a zoo. How could biologists use the information to preserve the cheetah as a species?
25. There are fewer than 400 whooping cranes in the world. These large birds breed in the wetlands of northern Alberta and winter in the southern United States. Propose an action to help preserve this endangered species.
26. Blueberry farmers rely on bees to pollinate blueberry flowers. Wild bees are also important in natural ecosystems. Describe one possible role of wild bees and how human actions may affect wild bee populations.
27. Propose a theory that explains why bacteria, protists, fungi, and some invertebrates tend to reproduce asexually, while most vertebrates never reproduce this way. How could you test your theory?
31. Some invertebrates, such as crabs, have the ability to regrow body parts that have been lost through injury. What cell part do you think scientists study to learn more about the process of regeneration in these animals?
32. How does the story of antibiotic resistance illustrate the importance of variation?
33. Herbicide-resistant plants are usually selected to resist specific herbicides. Why would it be an advantage for a company to produce both the genetically modified seed and the herbicide?
34. A mutation that results in faster growth of a plant could be advantageous. Explain why.
35. One of the stated objectives of zoos and wildlife preserves is the protection of endangered species. However, many people believe that keeping animals in captivity is wrong. List arguments for:
 - (a) allowing animals to become extinct in their natural habitats and
 - (b) saving them in the basically unnatural habitat of zoos and preserves.

Critical Thinking

28. If candy colour were a genetic trait, would Smarties® show continuous or discrete variation?
29. (a) Suggest some reasons why mating does not ensure successful reproduction.
(b) What is the function of fertilization? Suggest some reasons why fertilization alone does not ensure successful reproduction.
30. Biologists would like to preserve corridors connecting wildlife, such as grizzly bears, in Canada and the United States. Why are these corridors important for the long-term survival of these animals?
36. How does the environment affect the artificial selection of farm animals such as goats? Did the environment play a role in the natural selection of mountain goats?
37. The coelacanth is an ancient marine fish. For many years, people mistakenly thought the coelacanth was extinct. The unexplored depths of the oceans probably contain many other species of plants, animals, and bacteria that have never been discovered.
 - (a) Light does not penetrate to the greatest depths of the sea. Describe some possible adaptations that would be useful for life at the bottom of the ocean.

- (b) Give some reasons why it would be important to learn about biological diversity in the oceans.
- (c) Why do you think some people are encouraged by the story of the coelacanth?
38. The populations of some shark species are declining. Sharks are killed not only because they are seen as dangerous predators. Sharks are also hunted for food and for their cartilage, which is used in certain medicines. However, sharks have an important role as scavengers in the oceans. Speculate what might happen if large sharks became extinct. Write down the advantages and disadvantages of preserving sharks.
39. Mosquito eggs hatch only when there is enough moisture. Explain how this adaptation affects mosquito populations from year to year.
40. The carnivorous sundew has underdeveloped roots and is covered by sticky secretions. Charles Darwin once wrote: "I care more about the origin of the sundew than the origin of all the species in the world." What are some adaptations of the sundew that may have attracted Darwin's interest? What makes these adaptations different from many other plants?
41. Purple loosestrife has caused extensive damage in Alberta since its introduction. However, this plant has some natural enemies. Do you think it would be a good idea to introduce new species that are predators or pests of purple loosestrife? Why or why not?
42. Atlantic salmon are sometimes raised off the coast of British Columbia. Large numbers of these fish have escaped, and a few have been found in rivers in British Columbia, which are the natural habitat of Pacific salmon. Why are some people concerned about the escape of farmed Atlantic salmon into Pacific waters?
43. Many monarch butterflies summer in Canada and winter in Mexico. The loss of their wintering grounds is a major threat. How else do you think people might impact populations of monarch butterflies?
44. Why are there so many insect species relative to other animal species?
45. Scientists are investigating the possibility of growing animals from unfertilized eggs. What term describes the offspring in relation to the mother in this situation? Scientists may be able to use this technique with human eggs in the future. What would be the pros and cons of using this technique with human eggs?



sundew

Pause & Reflect

1. Identify a specific issue raised by this unit. Explain why it is important to you. What knowledge would be important to have in order to resolve this issue?
2. Now that you have completed this unit, review your answers to the Focussing Questions on page 4. Would you now answer differently? Based on what you have learned from Unit 1, write new answers to these questions in your Science Log.