Chapter 5 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 5.1 **Vanishing Species** National Science Education Standards UCP.1-3; A.1, A.2; C.4, C.5, C.6; E.1, E.2; F.1-6; G.1-3 (2 sessions, 1 block)	1. **Explain** biodiversity and its importance. 2. **Relate** various threats to the loss of biodiversity.	**MiniLab 5-1:** Measuring Species Diversity, p. 116 **Problem-Solving Lab 5-1,** p. 119 **Internet BioLab:** Researching Information on Exotic Pets, p. 130
Section 5.2 **Conservation of Biodiversity** National Science Education Standards UCP.1-3; A.1, A.2; C.4, C.5, C.6; E.1, E.2; F.2-6; G.1-3 (3 sessions, 1 block)	3. **Describe** strategies used in conservation biology. 4. **Relate** success in protecting an endangered species to the methods used to protect it.	**MiniLab 5-2**: Conservation of Soil, p. 126 **Art Connection:** Wildlife Photography of Art Wolfe, p. 132

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 130 Internet access, paper, pencil

MiniLabs

p. 116 paper, pencil, calculator (optional)
p. 126 beaker, plastic tray, graduated cylinder, water, lawn soil, lawn soil with grass

Alternative Lab

p. 122 self-sealing plastic bags (2), paper towels, small cups (2), labels, water, vinegar, small seeds (40)

Quick Demos

p. 121 cardboard, scissors, masking tape
p. 122 test tube (2), one-hole stopper, glass tube, distilled water, Alka-Seltzer tablet, pH paper
p. 129 *Ginko biloba* leaves

Key to Teaching Strategies

- L1 Level 1 activities should be appropriate for students with learning difficulties.
- L2 Level 2 activities should be within the ability range of all students.
- L3 Level 3 activities are designed for above-average students.
- ELL ELL activities should be within the ability range of English Language Learners.
- COOP LEARN Cooperative Learning activities are designed for small group work.
- P These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Biological Diversity and Conservation

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 5.1 **Vanishing Species**	**Reinforcement and Study Guide,** pp. 19-21 L2 **Concept Mapping,** p. 5 L3 ELL **Critical Thinking/Problem Solving,** p. 5 L3 **BioLab and MiniLab Worksheets,** pp. 21-22 L2 **Laboratory Manual,** pp. 31-34 L2 **Tech Prep Applications,** pp. 5-6 L2 **Content Mastery,** pp. 21-22, 24 L1	**Section Focus Transparency 10** L1 ELL **Reteaching Skills Transparencies 7a, 7b, 7c** L1 ELL
Section 5.2 **Conservation of Biodiversity**	**Reinforcement and Study Guide,** p. 22 L2 **BioLab and MiniLab Worksheets,** p. 23 L2 **Laboratory Manual,** pp. 35-38 L2 **Content Mastery,** pp. 21, 23-24 L1 **Tech Prep Applications,** pp. 7-8 L2	**Section Focus Transparency 11** L1 ELL

Assessment Resources

Chapter Assessment, pp. 25-30
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 5 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Products Available From National Geographic Society
To order the following products, call National Geographic Society at 1-800-368-2728:
CD-ROM
NGS PictureShow: Earth's Endangered Environments
Videodiscs
GTV: Planetary Manager
GTV: Biodiversity

Index to National Geographic Magazine
The following articles may be used for research relating to this chapter:
"Making Sense of the Millennium," by Joel L. Swerdlow, January 1998.
"Sanctuary: U. S. National Wildlife Refuges," by Douglas H. Chadwick, October 1996.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life
CD-ROM ELL
BioQuest: *Biodiversity Park*

The Infinite Voyage
Life in the Balance
Crisis in the Atmosphere
Secrets From a Frozen World

The Secret of Life Series
Gone Before You Know It: *The Biodiversity Crisis*

Chapter 5

Getting Started Demo

Hold up a picture of a scene in nature. Ask students to identify common organisms. Have them identify organisms that are few in number and then estimate the number of species in the photograph. Explain that this unit is about species, including how many species live in different areas of our planet and how we can protect species from extinction.

Theme Development

Homeostasis is a major theme of this chapter, which correlates increases in human populations with threats to biodiversity. Methods of reducing these threats are presented.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Resource Manager

Section Focus Transparency 10 and Master L1 ELL

Chapter 5

Biological Diversity and Conservation

What You'll Learn

- You will explain the importance of biological diversity.
- You will distinguish environmental changes that may result in the loss of species.
- You will describe the work of conservation biologists.

Why It's Important

When all the members of a species die, that species' place in the ecosystem is gone forever. Knowledge of biological diversity leads to strategies to protect the permanent loss of species from Earth.

Getting Started

Neighborhood Nature

Consider the different animals that live in your area. *Besides humans, what are the most common species in your neighborhood?*

interNET CONNECTION To find out more about biological diversity and conservation biology, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Earth may lose all of its giant pandas (above). Their loss of habitat, due to the encroachment of humans, has put them in peril. The passenger pigeon (inset), once so common it filled the skies of North America, was hunted to extinction.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Visual-Spatial Portfolio, pp. 118, 120, 121; Project, p. 119; Meeting Individual Needs, p. 126; Extension, p. 129

Interpersonal Biology Journal, p. 118; Meeting Individual Needs, p. 128

Linguistic Tying to Previous Knowledge, p. 118; Enrichment, p. 123; Extension, p. 124; Portfolio, p. 126; Biology Journal, p. 127

Logical-Mathematical Meeting Individual Needs, p. 116; Project, p. 117; Quick Demo, p. 121; Reinforcement, p. 123

Section

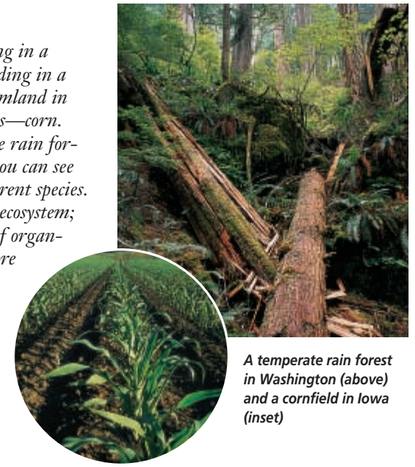
5.1 Vanishing Species

Section Preview

Objectives
Explain biodiversity and its importance.
Relate various threats to the loss of biodiversity

Vocabulary
biodiversity
extinction
threatened species
endangered species
habitat fragmentation
edge effect
habitat degradation
acid precipitation
ozone layer
exotic species

Imagine yourself standing in a cornfield and then standing in a rain forest. On this farmland in Iowa, one species dominates—corn. However, in this temperate rain forest in Washington State, you can see and hear hundreds of different species. The rain forest is a richer ecosystem; it is home to more species of organisms. The rain forest is more likely to survive disease, insects, and drought than the corn on the farmland.



A temperate rain forest in Washington (above) and a cornfield in Iowa (inset)

Biological Diversity

A rain forest has a greater amount of biological diversity, or biodiversity, than a cornfield. **Biodiversity** refers to the variety of life in an area. This area could be Mississippi, Mexico, the Sonoran Desert, or the entire planet Earth. The simplest and most common measure of biodiversity is the number of species that live in a certain area. For example, one acre of farmland may be dominated by only one species of plant; one acre of rain forest may contain 400 species of plants. The cornfield may contain two species of beetle, and the rain forest may have 5000 species of beetles.

Where is biodiversity found?

Areas around the world differ in biodiversity. A hectare of tropical rain forest in Amazonian Peru may have 300 tree species. Yet, one hectare of forest in the United States is more likely to have 30 tree species or less. Consider the number of species of mammals; Canada has 163 species, the United States has 367, and Mexico has 439. These examples illustrate that terrestrial biodiversity tends to increase as you move towards the equator. In fact, tropical regions contain two-thirds of all land species on Earth. The richest environments for biodiversity are all warm places: tropical rain forests,

Assessment Planner

Portfolio Assessment
Portfolio, TWE, pp. 118, 120, 121, 126
Problem-Solving Lab, TWE, p. 119
Assessment, TWE, pp. 124, 127, 129

Performance Assessment
MiniLab, SE, pp. 116, 126
Assessment, TWE, p. 123
Alternative Lab, TWE, pp. 122-123
Problem-Solving Lab, TWE, p. 128
BioLab, SE, pp. 130-131
BioLab, TWE, pp. 130-131

Knowledge Assessment
MiniLab, TWE, pp. 116, 126
Assessment, TWE, p. 121
Section Assessment, SE, pp. 124, 129
Chapter Assessment, SE, pp. 133-135

Skill Assessment
Alternative Lab, TWE, pp. 122-123

Prepare

Key Concepts

Students will explore the concept of biodiversity and factors that affect it. They will learn about human-created threats to biodiversity.

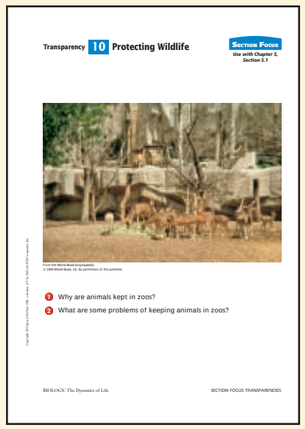
Planning

- Gather cardboard and tape for the first Quick Demo.
- Gather materials for the second Quick Demo.
- Purchase or gather plastic bags, paper towels, small cups, vinegar, and seeds for the Alternative Lab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 10** on the overhead projector and have the students answer the accompanying questions. L1 ELL



2 Teach

MiniLab 5-1

Purpose
Students will survey an area near school and calculate an index of diversity (I.D.).

Process Skills
apply concepts, collect data, compare and contrast, interpret data, observe and infer, organize data, predict, use numbers

Teaching Strategies
- Any plant type can be used. For example, the study could be conducted with flowering plants or cacti. Simply have students follow a marked path through any community and record their observations.
- If possible, locate and mark off an area that contains about 10 trees of different species. The trees do not have to be in a straight line but will have to be marked so they can be numbered in order of observation.
- If you wish, draw a map of the area to be visited and give copies to students. Include a birds-eye diagram of the trees and pre-number them.
- If a field trip is not possible, provide students with a map of trees labeled by species.

Expected Results
Numbers below one (decimals) indicate a low index of diversity. Numbers over 1 show greater diversity. A typical city street may yield an I.D. of slightly over 1.

Analysis
1. A vacant lot might have a higher I.D. because many different species might be present in a small area. A grass lawn would have a much lower I.D., perhaps with only one species present.
2. A higher I.D. would indicate greater species diversity. Communities with a low I.D. may be prone to species extinction if environmental conditions change.

MiniLab 5-1 Using Numbers

Measuring Species Diversity
Index of diversity (I.D.) is a mathematical way of expressing the amount of biodiversity and species distribution in a community. Communities with many different species (a high index of diversity) will be able to withstand environmental changes better than communities with only a few species (a low index of diversity).

A tree-lined street

Procedure
1. Copy the data table below.
2. Walk a city block or an area designated by your teacher and record the number of *different species* of trees present (you don't have to know their names, just that they differ by species). Record this number in your data table.
3. Walk the block or area again. This time, make a list of the trees by assigning each a number as you walk by it. Place an X under Tree 1 on your list. If Tree 2 is the same species as Tree 1, mark an X below it. Continue to mark an X under the trees as long as the species is the same as the previous one. When a different species is observed, mark an O under that tree on your list. Continue to mark an O if the next tree is the same species as the previous. If the next tree is different, mark an X.
4. Record in your data table:
   a. the number of "runs." Runs are represented by a group of similar symbols in a row. Example—XXXXOOXO would be 4 runs (XXXX = 1 run, OO = 2 runs, X = 3, O = 4).
   b. the total number of trees counted.
5. Calculate the Index of Diversity (I.D.) using the formula in the data table.

Data Table
Number of species =
Number of runs =
Number of trees =
Index of diversity = $\frac{\text{Number of species} \times \text{number of runs}}{\text{Number of trees}}$ =

Analysis
1. Compare how your tree I.D. might compare with that of a vacant lot and with that of a grass lawn. Explain your answer.
2. If humans were concerned about biological diversity, would it be best to have a low or high I.D. for a particular environment? Explain your answer.

coral reefs, and large tropical lakes. Learn one way to measure species distribution in the *MiniLab* on this page.

The study of islands has led to additional understanding of factors that influence biodiversity. Large islands tend to have a higher biodiversity than smaller islands, as shown in ***Figure 5.1.*** These Caribbean islands are near each other; however, they differ in the number of species they each contain. For example, Redonda—a small island—has fewer species than Saba—a large island. Why do larger islands tend to have a greater biodiversity than smaller islands? The larger islands have more space and are more likely to have a greater variety of environments and ecosystems. In some cases, however, smaller islands can have a larger biodiversity than larger islands. Compare the huge island of Iceland to the much smaller island of Maui in ***Figure 5.2.*** Maui has more biodiversity because it is warmer and has

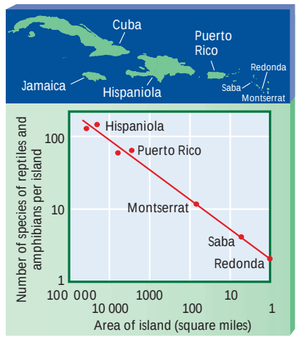


Figure 5.1
The relative number of species on an island can be predicted from the size of the island. For example, Puerto Rico is larger than Montserrat, and it has more species.

Figure 5.2
Although Iceland (left) is a bigger island than Maui (right), Maui has a greater biodiversity due to its warm climate and good soils. Nevertheless, all other things being equal, the larger the island the greater its biodiversity.

more nutrient-rich soil. However, if everything else is the same, the larger the island the greater the biodiversity it contains. These findings from island research have become important for managing and designing national parks and protected areas. Such areas have become "islands," not surrounded by oceans, but surrounded by human populations with buildings and roads.

Importance of Biodiversity

Compare a parking lot having nothing but asphalt to your favorite place in nature, perhaps a meadow, a forest, or a thriving lake. Which environment do you think is more pleasant? The presence of different forms of life makes our planet beautiful. You may go to the natural area to relax or to think. Artists get inspiration from these areas for songs, paintings, and literature. Looking at the beauty of one of Art Wolfe's photograph in the *Art Connection* can help you appreciate the beauty biodiversity gives our world. Beyond beauty, why is biodiversity important?

Importance to nature

Organisms are adapted to live together in communities. Although ecologists know of many complex relationships among organisms, many relationships are yet to be discovered. Scientists do know that if a species is lost from an ecosystem, the loss may have consequences for other living things. Other organisms suffer when an organism they feed upon is removed permanently from a food chain or food web. A population may soon exceed the area's carrying capacity if its predators are removed. If the symbiotic relationships among organisms are broken due to the loss of one of the dependent species, then the other species will soon be affected.

Life depends on life. Animals could not exist without green plants, many flowering plants could not exist without animals to pollinate them, and plants need decomposers to break dead or decaying material into nutrients they can use. A rain forest tree grows from nutrients in the soil released by decomposers. A sloth eats the leaves of this tree. Moss grows on the back of the sloth. Living things create niches for other living things.

Reinforcement
Ask students to recall the biomes they studied in Chapter 3. Which had the highest biological diversity? *tropical rain forest*

Chalkboard Activity
Write the terms *number of species* and *number of organisms* on the board. Ask students to explain the difference. Which is a better indicator of biological diversity? *number of species*

Enrichment
To establish how biodiversity helps meet our needs, have students list 20 things people use that come from 20 different plants or animals. L2

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
BioQuest: *Biodiversity Park*
Disc 3, 4

VIDEOTAPE
The Secret of Life
Gone Before You Know It: The Biodiversity Crisis

Resource Manager
BioLab and MiniLab Worksheets, p. 21 L2

Assessment

Knowledge Ask students why a city with one major industry may suffer if there is a downturn in that industry, whereas a city with a diverse industrial base will be better able to withstand an economic downturn. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC,** p. 17. L2

MEETING INDIVIDUAL NEEDS

Learning Disabled

Logical-Mathematical The simplest way of calculating biodiversity is to count the number of species in an area. Have students count the number of species in a fish tank to understand this concept. Caution them to count the number of species, not the number of fish. L1 ELL

Cultural Diversity

George Washington Carver

George Washington Carver (1865–1943) is best known for establishing crops such as cotton, peanuts, and sweet potatoes in the southern United States. He showed how reliance on one crop depletes the soil of nutrients. Have students research farming methods in different cultures and make models of them. L3

PROJECT

Comparing Diversity

Logical-Mathematical Have students rope off two different areas of the school grounds, each about 1 yard (1 m) square. Ask them to count all the species of plants or insects in or above each area. Then have them compare the numbers and suggest reasons for any differences in diversity. L2 ELL

Concept Development

Ask students to explain how the relationship between organisms and ecosystems is similar to the relationship between people and cities.

Tying to Previous Knowledge

Linguistic Have students describe ways that organisms depend upon other organisms. *food*, *symbiotic relationships*, *nutrient cycling* L2

Revealing Misconceptions

Students may not realize that many drugs begin as substances that have been isolated from living things. Point this out using Figure 5.3.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: Biodiversity
Importance of Diversity
Unit 1, Side 1, 2 min. 5 sec.

Resource Manager

Concept Mapping, p. 5
L3 ELL
Tech Prep Applications, p. 5
L2

Figure 5.3
Diverse living things provide many important medical drugs.

A Taxol, a strong anti-cancer drug, was first discovered in the Pacific yew.

B Rosy periwinkle is the source of drugs for Hodgkin's disease and leukemia.

C Willow bark was the original source of aspirin.

Biodiversity also brings stability to an ecosystem. A pest could destroy all the corn in a farmer's field, but it would be far more difficult for an insect or disease to destroy all individuals of a plant species in a rain forest. These plants would exist in many parts of the rain forest, making it more difficult for the insect or disease to spread. Although ecosystems are stronger due to their biodiversity, losing species may weaken them. One hypothesis suggests species in an ecosystem are similar to rivets holding an airplane together. A few rivets might break, and nothing will happen, but at some point enough rivets break and the airplane falls apart.

WORD Origin
Extinction
From the Latin words *ex*, meaning "out," and *stinguere*, meaning "to quench." A species becomes extinct when its last organisms die.

Importance to people

Humans depend on other organisms for their needs. Oxygen is supplied and carbon dioxide is removed from the air by diverse species of plants and algae living in a variety of ecosystems. Biodiversity gives people a diverse diet. Beef, chicken, tuna, shrimp, and pork are only a few of the meats and fish we eat. Think of all the plant products that people eat, from almonds to zucchini. When you consider all the foods eaten by all the people in the world, you realize that hundreds of species help nourish the human population. Biodiversity can help breeders make food crops grow better. For example, through cross-breeding with a wild plant, a food crop can be made pest-resistant or drought-tolerant. People also rely on the living world for materials used in clothes, furniture, and buildings.

Biodiversity can also be used to improve people's health. Living things supply the world pharmacy. Although drug companies may manufacture synthetic drugs, active compounds are usually first isolated from living things, such as shown in ***Figure 5.3***. The antibiotic penicillin came from the mold, *Penicillium*; the antimalarial drug quinine came from the bark of the cinchona tree. Preserving biodiversity ensures there will be a large supply of living things, some of which may provide future drugs. Maybe a cure for cancer or HIV is contained in the leaves of a small rain forest plant.

Loss of Biodiversity

Have you ever seen a flock of passenger pigeons? How about a woodland caribou, relic leopard frog, or Louisiana prairie vole? Unless you have seen a photograph or a stuffed museum specimen, your answer will be no. These animals are extinct. **Extinction** (ek STINGK shun) is the disappearance of a species when the last of its members dies. Since 1980, almost 40 species of plants and animals living in the United States have become extinct. Although extinction can occur as a result of natural processes, humans have been responsible for the extinction of many species. Is there a link between the land area a species can inhabit and extinction? Find out in the *Problem-Solving Lab*.

When the population of a species begins declining rapidly, the species is said to be a **threatened species.** African elephants, for example, are listed as a threatened species. In the early 1970s, the wild elephant population numbered about three million. Twenty years later, it numbered only about 700 000. Elephants have traditionally been hunted for their ivory tusks, which are used to make jewelry and ornamental carvings. Many countries have banned the importation and sale of ivory, and this has helped slow the decline of the elephant population. ***Figure 5.4*** shows some threatened animal species under protection in the United States.

Problem-Solving Lab 5-1 Interpreting Data

Does species extinction correlate with land area?
Species are at risk of extinction when their habitats are destroyed through human action. Is there a better chance for survival when the land area is large?

Analysis
A study of land mammals was conducted by a scientist to determine the effect of land area on species extinction. His research was confined to a group of South Pacific islands of Indonesia. The scientist's basis for determining the initial number of species present was based on research conducted by earlier scientists and from fossil evidence.

Table 5.1 Relationship of land area to extinctions

Island	Area in km^2	Initial number of species	Extinctions	Percent of loss
Borneo	751 709	153	30	20
Java	126 806	113	39	35
Bali	5 443	66	47	71

Thinking Critically
1. In general, how does land area correlate with loss of species?
2. What is the relationship between island size and the initial number of species?
3. Hypothesize why the study was conducted on only land mammals.

Figure 5.4
Several animal species in the United States are threatened.

A Sea otters *(Enhydra lutris* subspecies *nereis)* have been hunted for centuries for their fur.

B Wildlife experts classify loggerhead turtles *(Caretta caretta)*, as well as five other sea turtle species, as threatened.

Problem-Solving Lab 5-1

Purpose
Students will determine that reduced land area contributes to the extinction of species.

Process Skills
think critically, analyze information, compare and contrast, draw a conclusion, interpret data, predict, recognize cause and effect, use numbers

Teaching Strategies
- You may wish to ask students to locate these island areas on a map.
- Review the procedure for calculating percent. Allow students to use calculators.

Thinking Critically
1. There is a higher percent of species loss for smaller areas.
2. The larger the island, the more initial species it has.
3. Answers will vary, but students may mention that it's easier to trap and observe land mammals, and the initial data on species numbers may be more reliable.

Assessment

Portfolio Have students write a newspaper article describing some possible ways to reduce the number of extinctions of land mammal species on a small island such as Bali. Use the Performance Task Assessment List for Newspaper Article in **PASC,** p. 69. L2 P

Portfolio

Diagramming Dependence
Visual-Spatial Ask students to draw a realistic food web in which the removal of one organism could adversely affect at least five other organisms. L1 ELL P

BIOLOGY JOURNAL

An Alphabet of Biodiversity
Interpersonal Have students work in groups to create an alphabet of biodiversity. For letters *A* through *Z,* they will write one organism that people use and then describe its use, such as for food, shelter, or clothing. For example: Apple—food. L2 COOP LEARN

PROJECT

Finding Answers
Visual-Spatial Have students choose an extinct organism and research possible reasons for its extinction. Create a classroom bulletin board on extinction. L3

Revealing Misconceptions

While biologists suspect that humans have increased the rate of natural extinctions, help students realize that extinction is a natural process. Dinosaurs were extinct before people evolved. Extinction and evolution often go hand-in-hand.

Concept Development

Ask students to explain ways that people alter habitats. Try to identify whether the changes affect the biotic or abiotic factors of that habitat. For example, cutting trees can have biotic affects such as reducing the food supply for certain animals. It can also have abiotic effects, such as increasing the amount of sunlight that reaches an area.

Figure 5.5
In the United States, scientists have developed programs designed to save endangered species.

A **Urban growth has destroyed much of the California condor's habitat. To protect the species, the few remaining California condors *(Gymnogyps californianus)* were captured and placed in reserves.**

B **Florida manatees *(Trichechus manatus),* sometimes called "sea cows," are endangered due to loss of habitat and injury from barges and motorboats.**

A species is considered to be an **endangered species** when its numbers become so low that extinction is possible. In Africa, the black rhinoceros has become an endangered species. Poachers hunt and kill these animals for their horns. Rhinoceros horns are composed of fused hair rather than bone or ivory. In the Middle East, the horns are carved into handles for ceremonial daggers. In parts of Asia, some people believe powdered horn is an herbal medicine. ***Figure 5.5*** shows just two endangered species in the United States. Unfortunately, there are many more.

Threats to Biodiversity

Complex interactions among species make ecosystems unique and species are usually well adapted to their habitats. Changes to habitats can threaten organisms with extinction. As populations of people increase, the impact from their growth and development is altering the face of Earth and pushing many other species to the brink of extinction.

Habitat loss

The biggest threat to biodiversity is habitat loss. When a rain forest is made into a cattle pasture, a meadow made into a mall parking lot, or a swamp drained for housing, habitats are lost. With their habitats gone, the essentials of life are lost for species dependent upon these habitats, and species disappear. In tropical rain forests, the Earth's richest source of biodiversity, an area the size of Florida is cut or burned every year. Coral reefs, such as shown in ***Figure 5.6,*** are also very rich in biodiversity. Water and temperature changes can damage coral reefs. People remove large sections of coral reef for a variety of reasons. In some areas, coral is mined for building materials. Coral reef is often collected for souvenirs and aquarium decorations. Through habitat loss, as well as pollution and disease, many species that live in coral reefs are in danger of extinction.

Habitat fragmentation

As roads cut across wilderness areas, and as building projects expand into new areas, many habitats are

Figure 5.6
Coral reefs are rich in biodiversity. Removal of coral results in a loss of habitat for reef organisms.

becoming virtual islands. **Habitat fragmentation** is the separation of wilderness areas from other wilderness areas. Habitat fragmentation presents problems for many organisms. Recall how the study of islands revealed that the smaller the island, the fewer species it supports. Fragmented areas are like islands, and the smaller the fragment, the less biodiversity it will support.

Biotic issues

Habitat fragmentation, as shown in ***Figure 5.7,*** presents problems for organisms that need large areas to gather food. Large predators cannot obtain enough food if they are restricted to a small area. Some organisms, such as zebra and wildebeest, migrate with the seasons to ensure a constant grass supply. If their range is restricted, they will starve. Habitat fragmentation also makes it difficult for species to re-establish themselves in an area. Imagine a small fragment of forest where a species of salamander lives. A fast burning fire destroys the trees and all the salamanders. In nonfragmented land, when new trees grow, new salamanders would eventually move back into the land. However, in the fragmented land, there is no migratory route for the salamanders to reestablish their population.

Abiotic issues

Another problem with habitat fragmentation is that it can change the climate of the area. Consider a tropical rain forest. Recall that the area under the canopy is moist and shady. Now suppose loggers come in and cut everything down, except for a plot of land equal in size to a football field. The once shady, moist area is now exposed from the sides to sunlight and winds. The area dries out, and organisms that evolved in rain

Figure 5.7
Wildlife areas that become surrounded by human development result in habitat fragmentation.

Quick Demo

Logical-Mathematical Cut out a cardboard square to represent a national park. Put strips of masking tape along each edge to represent edge effect. Now cut the cardboard in half and tell students that a road has just divided the park. For each half of the park, put masking tape on the newly created edge. Ask students to explain why roads create more edge effects.

Enrichment

Have students find out how strip mining for coal differs from the more traditional deep-tunnel mining. Also ask them to research how companies attempt to restore mined land to a usable natural setting. L3

Assessment

Knowledge Ask students to explain which type of organisms tend to be most affected by habitat fragmentation. *large predators and organisms that migrate* L2

Portfolio

Observing Habitat Destruction

Visual-Spatial Have students record any direct evidence they observe of habitat destruction brought on by humans. Ask them to describe how the conditions they observe might be contributing to the reduction in numbers of some native plant or animal species. L2 P

Portfolio

Measuring Solid Waste Generation

Visual-Spatial Have students prepare a table to illustrate the solid waste generated by their families per day, week, month, year, and decade. Use 1.8 kg of waste per person per day. Week = 12.6 kg; month = 54 kg; year = 657 kg; decade = 6570 kg. L2 P

Quick Demo

Determine the pH of a test tube of distilled water using pH paper. Add an Alka-Seltzer tablet to the water. Place a stopper that has a plastic tube extending into the test tube. Allow the gas generated in the tube (carbon dioxide) to bubble through another tube of distilled water. Check the pH of the tube that received the gas. Explain that this shows water and carbon dioxide joining to form carbonic acid.

Revealing Misconceptions

Students may think that tap water has a pH of 7, but tap water is usually slightly acidic. Illustrate this point by using pH paper to test the tap water in your area. Explain that the pH of tap water can be affected by chlorine or other additives used in water purification and by contaminants in the pipes.

Resource Manager

Laboratory Manual, pp. 31-38 L2
Critical Thinking/Problem Solving, p. 5 L3
Reteaching Skills Transparencies 7a-7c and Masters L1 ELL

Figure 5.8
Acid precipitation and acid fog are believed to be major contributors of this damage to trees in Mount Mitchell, North Carolina.

forest conditions can no longer survive at the edges. The different conditions along the boundaries of an ecosystem are called an **edge effect.**

Habitat degradation

Another threat to biodiversity is **habitat degradation,** the damage to a habitat by pollution. Three types of pollution are air, water, and land pollution. Air pollution can have negative effects on living organisms, such as causing breathing problems and irritating membranes in the eyes and nose. Although pollutants can enter the atmosphere in many ways—including volcanic eruptions and forest fires—the burning of fossil fuels is the greatest source of air pollution.

Acid precipitation—rain, snow, sleet, and fog with low pH values—is responsible for the deterioration of forests and lakes. Sulfur dioxide from coal-burning factories and nitrogen oxides from automobile exhausts combine with water vapor in the air to form acidic droplets of water vapor. When the acidic droplets of water fall from the sky as precipitation, the moisture leaches calcium, potassium, and other valuable nutrients from the soil. This loss of nutrients can lead to the death of trees. Acid precipitation also damages plant tissues and interferes with plant growth. Many trees in the forests of the United States are dying because of acid rain and fog, as shown in ***Figure 5.8.*** Acid precipitation also has severe effects on lake ecosystems. Acid precipitation falling into a lake, or entering it as runoff from streams, causes the pH of the lake water to fall below normal. The excess acidity can cause the death of plants, animals, and other organisms.

The atmosphere contains a sort of sunscreen—known as the **ozone layer**—that helps to protect living organisms on Earth's surface from receiving damaging or lethal doses of ultraviolet radiation. The chemical formula for ozone is O_3, meaning it contains three oxygen atoms. Chlorofluorocarbons, or CFCs, are synthetic chemicals that break down the ozone layer. CFCs are used as coolants in refrigerators and air conditioners, and in the production of polystyrene. Some scientists have hypothesized that the loss of the ozone layer, and the resulting increased ultraviolet radiation, may partially explain why more frogs and toads are born with deformities, and why many amphibian populations are declining.

Water pollution

Water pollution degrades aquatic habitats in streams, rivers, lakes, and oceans. A variety of pollutants can affect aquatic life. Excess fertilizers and animal wastes from farms are often carried by rain into streams and lakes. The sudden availability of nutrients causes algal blooms, the excessive growth of algae, such as the one shown in ***Figure 5.9.*** As the algae die, they sink and decay, removing needed oxygen from the water. Silt from eroded soils can also enter water and clog the gills of fishes. In coral reefs, silt can cover the coral and prevent sufficient light from reaching the photosynthetic organisms within the coral polyps. Detergents, heavy metals, and industrial chemicals in runoff can cause sickness and death in aquatic organisms. Abandoned drift nets in oceans can entangle and kill dolphins, whales, and other sea life.

Land pollution

How much garbage does your family produce every day? Trash, or solid waste, is made up of the cans, bottles, paper, plastic, metals, dirt, and spoiled food that people throw away every day. The average American produces about 1.8 kg of solid waste daily. That's a total of about 657 kg of waste per person per year. Does it ever decompose? Although some of it might, most of our trash becomes part of the billions of tons of solid waste that are buried in landfills all over the world. As you might expect, these landfills destroy wildlife habitats by taking up space and polluting the immediate area.

The use of pesticides and other chemicals can also lead to habitat degradation. For many years, DDT was commonly sprayed on crops to control insects and sprayed on water to kill mosquito larvae. Birds that fed on insects, fish, and other small animals exposed to DDT were observed to have high levels of DDT in their bodies. The DDT was passed on to the predators that ate these birds. Because of the DDT in their bodies, some species of predators, such as the American bald eagle and the peregrine falcon, tended to lay eggs with very thin shells that cracked easily,

Figure 5.9
Cattle manure contains nitrogen and other nutrients that make it valuable as a plant fertilizer. But too much of a good thing can cause pollution problems.

A **The cattle on this feed lot produce more waste than the decomposers in the soil can handle. If the waste is not contained, it can be washed into nearby streams by rainfall.**

B **The large amounts of nitrogen in runoff from a feed lot stimulate the rapid growth of algae in waterways downstream. This lush growth of algae consumes all or most of the oxygen in the water, making it impossible for insects, fishes, and other animals to survive.**

Reinforcement

Logical-Mathematical Have students prepare a circle graph showing the percentage by weight of urban solid waste. Provide these data: paper/cardboard 41%; yard waste 18%; food waste 9%; metal 9%; glass 8%; plastic 7%; wood 3%; rubber/leather 3%; cloth 1%; and other 1%. L2

Enrichment

Linguistic Rachel Carson's book *Silent Spring* was important in creating awareness of problems resulting from the use of DDT. Have students read all or part of this book and/or research Carson's life. L3

Assessment

Performance Assessment in the Biology Classroom, p. 55, *Finding Out Why a Pond Is Dying.* Have students carry out this activity to determine how pollutants affect pond ecosystems. L2

3 Assess

Check for Understanding

Ask students to explain how the following could lead to a loss of species.

a. habitat loss
b. habitat fragmentation
c. acid rain
d. introduction of exotics

Alternative Lab

Acids and Seed Germination

Purpose

Students will observe the effect of acid precipitation on seed germination.

Materials

self-sealing plastic bags, paper toweling, small cups, labels, water, vinegar, small seeds

Procedure

Give the following directions to students.

1. Place 20 seeds in a small, labeled cup of water and 20 seeds in a small, labeled cup of vinegar. **CAUTION:** ***Wear goggles while handling and pouring vinegar. Wash your hands after working with seeds.***
2. Allow the seeds to remain in the liquids overnight.
3. The next day, remove seeds from the water. Wrap the seeds in a paper towel. Moisten the towel with water and slide it into a self-sealing plastic bag. Label the bag with your name, date, and the word *water*.
4. Repeat step 3 for the seeds in vinegar. Moisten the towel with vinegar and label the bag with your name, date, and the word *vinegar*.
5. Prepare a data table to record your observations. Record the number of seeds that germinate during the next four days. Germinating seeds show a root growing from the seed.

Expected Results

Seeds soaked in water will germinate, but most of those soaked in vinegar will not.

Analysis

1. Compare the number of germinated seeds after four days. How do the water-soaked and vinegar-soaked seeds compare? *There is less germination of the vinegar-soaked seeds.*
2. Vinegar is an acid. Explain how acid precipitation might affect seed germination. *Acid precipitation could delay or prevent seed germination.*

Assessment

Skill Design an experiment that determines the tolerance limit for mustard seed germination in vinegar. Conduct the experiment if time permits. Use the Performance Task Assessment List for Designing an Experiment in **PASC,** p. 23. L2

Reteach

Have students explain the relationship between the words in each of the following pairs. L1

a. island size—biodiversity
b. threatened species—endangered species
c. exotic species—native species
d. algae blooms—fertilizers

Extension

Linguistic The introduction of exotic species can also cause problems for people. Ask students to research the introduction of an exotic species and prepare a five-minute presentation to share what they learn. L3

Assessment

Portfolio Have students provide a written definition of biodiversity and reasons why we should protect it. L1

4 Close

Activity

Have students name conditions or practices that increase problems associated with pollution and endangered species.

Resource Manager

Content Mastery, p. 22 L1
Reinforcement and Study Guide, pp. 19-21 L2

Figure 5.10
Exotic species can cause many problems when introduced into new ecosystems.

A **Kudzu was introduced into the U.S. from Russia and Japan as an ornamental and to reduce soil erosion. It grows and reproduces rapidly, smothering areas of native plants.**

B **Zebra mussels were introduced into the Great Lakes from the ballast of ships. These fast-growing mussels filter food from the water, blocking many food chains.**

killing the chicks inside. The populations of these species showed sharp declines. These observations led to the banning of DDT, and helped more people become aware of conservation biology issues.

Introduction of exotics

People, either on purpose or by accident, sometimes introduce a new species into an ecosystem. This can cause problems for the native species. When people brought goats to Santa Catalina Island, located off the coast of California, 48 native species of plants soon disappeared from the local environment. Building the Erie canal in the nineteenth century made it possible for the sea lamprey to swim into the Great Lakes. The sea lamprey resembles an eel, with a round clamp for a mouth. It swims up to a fish, clamps onto its body, and sucks the fluids out of the fish using its sharp teeth and tongue. The lamprey has totally eliminated certain fish species from some lakes. **Exotic species,** such as the goat and the lamprey, are organisms that are not native to a particular area. Other examples of exotic species are shown in ***Figure 5.10.*** When exotic species are introduced into an area, these species can grow at an exponential rate due to a lack of competitors and a lack of predators. They may take over niches of native species, and can eventually replace the native species completely.

Section Assessment

Understanding Main Ideas

1. What are two causes for a species to become threatened or endangered?
2. How does acid precipitation kill trees?
3. What is an edge effect?
4. How do exotic species affect populations of native species?

Thinking Critically

5. Suggest reasons why warm tropical areas have more biodiversity than cooler areas.

Skill Review

6. **Designing an Experiment** Thinning of the ozone layer allows increased ultraviolet radiation from the sun to penetrate Earth's atmosphere. Your hypothesis is that increased ultraviolet radiation results in higher mortality rates for frogs. Design an experiment to test your hypothesis. Remember to set up a control group. For more help, refer to *Practicing Scientific Methods* in the **Skill Handbook.**

Section Assessment

1. Answers may include habitat loss, degradation, or fragmentation; introduction of exotic species; or excessive hunting or collecting.
2. by destroying their leaves or needles through acid fog and precipitation or by changing the soil pH, which causes leaching of nutrients
3. different conditions along the boundaries of a natural area
4. The exotics can out-compete the native species for food or shelter. Or the exotic species may eat a native species.
5. Possible reasons: They have longer growing seasons, greater biomass, and a longer time since their last ice age.
6. The control and experimental groups of frogs should both include adequate numbers. The experimental group will be exposed to a greater amount of ultraviolet radiation. Mortality rates of the groups will be compared.

Section

5.2 Conservation of Biodiversity

SECTION PREVIEW

Objectives
Describe strategies used in conservation biology.
Relate success in protecting an endangered species to the methods used to protect it.

Vocabulary
conservation biology
sustainable use
habitat corridors
reintroduction programs
captivity

The loss of species from Earth is a permanent tragedy. Fortunately, people are working to protect species from extinction. One strategy is to bring organisms back into areas where they once lived, as is being done in Yellowstone National Park with gray wolves. Organisms are endangered for a variety of reasons, and perhaps through a variety of strategies, these organisms can be protected.

The gray wolf

Strategies of Conservation Biology

Conservation biology is a new field that studies methods and implements plans to protect biodiversity. Effective conservation strategies are based on principles of ecology. These strategies include natural resource conservation and species conservation. Learn about soil conservation in the *MiniLab* on the next page.

Many species are in danger due to the actions of humans, so working with people is an important part of conservation biology. Conservation biologists not only focus on ecology, but also seek to understand law, politics, sociology, and economics to find effective strategies for conserving Earth's biodiversity.

Legal protections of species

In response to concern about extinction, President Nixon signed the U.S. Endangered Species Act into law in 1973. This law made it illegal to harm any species on the endangered or threatened species lists. Further, the law made it illegal for federal agencies to fund any project that would harm organisms on these lists. Harm includes changing an ecosystem where endangered or threatened species live. This law has been partially responsible for recoveries in the populations of the American bald eagle, the American alligator, and the brown pelican. Other countries have enacted similar laws. International agreements also protect endangered or threatened species. For example, the Convention on

NATIONAL GEOGRAPHIC

VIDEODISC
GTV: Planetary Manager
Side 2: *Tidy World*

VIDEODISC
STV: Biodiversity
Preserving Diversity (in its entirety)
Unit 2, Side 1, 12 min. 10 sec.

Prepare

Key Concepts

Students will learn how conservation biology strategies are used to prevent the loss of species. Throughout the section, students will learn success stories in conservation biology.

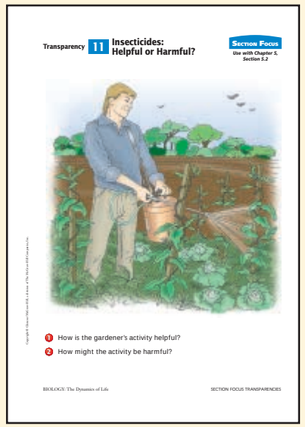
Planning

- Gather soil, trays, beakers, and water for the MiniLab.
- Gather ginkgo leaves for the Quick Demo.
- Arrange access to the Internet for the BioLab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 11** on the overhead projector and have the students answer the accompanying questions. L1 ELL



Resource Manager

Section Focus Transparency 11 and Master L1 ELL

2 Teach

MiniLab 5-2

Purpose
Students will determine that soil erosion is reduced on land areas with vegetation compared with land areas with no vegetation.

Process Skills
compare and contrast, draw a conclusion, interpret data, measure in SI, recognize cause and effect, formulate a model

Safety Precautions
Have students wear a lab apron and safety goggles.

Teaching Strategies
- Obtain soil with grass growing in it from a lawn area (with permission) or purchase sod from a garden store.
- Try to keep the volume of soil equal in both trays. Water should be poured slowly.
- Review the use of a graduated cylinder for reading volumes. Remind students to allow the soil to settle after they pour it into the cylinder.
- You may wish to conduct this activity as a demonstration.

Expected Results
There will be less measured soil erosion when vegetation is present than when soil is bare.

Analysis
1. water and soil draining into the dish
2. to reduce soil erosion

Assessment
Knowledge Pull a small plant from the ground and have students examine the root system and the soil clinging to it. Have them explain how roots reduce soil erosion. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC,** p. 17. L1

MiniLab 5-2 Experimenting

Conservation of Soil Soil is an important natural resource and should be conserved. How does one conserve soil? As a start, we should be aware of factors that promote or speed up its unnecessary loss or erosion.

Procedure

1 Copy the data table below.

Data Table

Source of sample	Volume of original water	Volume of collected water	Volume of eroded soil
Bare soil			
Soil with grass			

2 Measure 200 mL of water in a beaker.
3 Fill a plastic tray with soil as shown in the diagram.
4 Pour the water onto the soil, tilting the tray and placing a dish underneath the end of it as indicated in the diagram.
5 Wait several minutes for all water and soil to drain into the dish.
6 Pour the soil and water from the dish into a graduated cylinder. Wait several minutes for the soil and water to settle. Measure the volume of soil and water that washed or eroded into the dish. Record these values in your data table.
7 Repeat steps 2-6, only this time place a section of soil in which grass is growing onto the tray. **CAUTION:** ***Always wash your hands with soap and water after working with soil.***

Analysis
1. What part of the experiment simulated soil erosion?
2. Based on this experiment, explain why farmers usually plant unused fields with some type of crop cover.

International Trade in Endangered Species (CITES) has established lists of species for which international trade is prohibited or controlled. This agreement has been endorsed by more than 120 countries.

Preserving habitats

Another conservation biology approach focuses on protecting whole communities and whole ecosystems as the best way to conserve species. An effective way to do this is by creating nature preserves. The United States established its first national park—Yellowstone National Park—in 1872. You might look at Yellowstone, ***Figure 5.11,*** and think of bear, elk, bison, and moose; however, the park was created to preserve the unique geology of the area, not its biodiversity. Back in 1872, bear, bison, moose, and elk were widely distributed across the United States as far east as Pennsylvania. As the human population in America expanded, large parks such as Yellowstone preserved habitats and prevented the extinction of many species.

Establishing parks and other protected areas can be an effective way to preserve an ecosystem and the communities of species that live there. Yet, only 6 percent of Earth's land surface is protected in this way. Although this is only a small fraction of our planet's land, these areas contain a large amount of biodiversity. For example, in Zaire, Africa, only 3.9 percent of the land is protected, but 89 percent of Zaire's bird species are found there. Because the biggest threat to biodiversity is habitat loss, preserving land is an effective means of preserving species.

Saying an area is protected does not automatically make all species safe. Parks and protected areas often hire people, such as rangers, to manage the parks and ensure the protection of organisms. In some areas, access by people is restricted. In other lands, people can harvest food or obtain materials but this use is managed. The philosophy of **sustainable use** strives to let people use the resources of wilderness areas in ways that will not damage the ecosystem. For example, in some tropical rain forests in the Amazon, people harvest Brazil nuts, as shown in ***Figure 5.12,*** to eat and to sell. This practice gives people the opportunity to earn a living, and it helps them appreciate the value of preserving the area. When local people benefit from a natural area, through jobs or resources, they are more likely to cooperate with the area's preservation. For this reason, the preferred choice of people hired to protect natural areas are local people.

If a conservation group had enough money to buy 1000 acres of forest to set aside for protection, what would be their best strategy? Should they buy one big 1000-acre plot or ten 100-acre plots? Recall the research concerning number of species on islands of different sizes. In general, larger islands have more species than smaller islands. Therefore, to best protect the biodiversity of an area, the conservation group should generally buy one large plot of land. However, if the ten plots protected a variety of ecosystems, they may be a better choice for conserving biodiversity. Each decision needs to be made on a case-by-case basis. There are general guidelines, however. It is usually better to buy land that is connected to other protected areas so bigger "islands" are created. It is also a good idea to connect protected areas with corridors. **Habitat corridors** are natural strips that allow the migration of organisms from one area to another. Corridors can help overcome some of the problems of habitat fragmentation.

Figure 5.11
Yellowstone National Park was the first national park in the United States. It is home to a wide variety of life.

Figure 5.12
Allowing sustainable use of wildlife areas provides additional motivation for local people to protect these areas. The sale of Brazil nuts, sustainably harvested from rain forests in the Amazon, provides income for people living in and near rain forests.

Concept Development
Point out that sustainable use often leads to conflicts. Some people want access to more of a resource, while others may think that too much of a resource is being used. Ask students if they think deer hunting should be allowed. If yes, should there be limits on how many deer are shot? How will these limits be established? Will everybody be happy with these limits?

Assessment
Portfolio Explain how setting up a park in a community might protect the habitat of local animals. How might a new park threaten an existing habitat?

GLENCOE TECHNOLOGY

VIDEODISC
The Infinite Voyage
Secrets from a Frozen World, Global Awareness: Preserving the Environment (Ch. 9) 4 min.

The Infinite Voyage
Life in the Balance, Biodiversity: Battling Extinction in the Costa Rican Dry Forest (Ch. 7)
11 min. 30 sec.

Resource Manager
BioLab and MiniLab Worksheets, p. 23 L2

MEETING INDIVIDUAL NEEDS

Hearing Impaired
Visual-Spatial Photocopy a map of a country and a map of the same region that shows protected areas. Give both maps to students. Have them color in the protected areas on the unmarked map. Ask them to estimate what percent of the country's land is protected. L2 ELL

Portfolio

Preserving Natural Habitats
Linguistic Have students research a national park. Ask them to record in their portfolios the date it was established, its location, and common plants and animals in the park. L3 P

BIOLOGY JOURNAL

Organized Conservation
Linguistic Have students research a conservation group such as The Nature Conservancy or The World Wildlife Fund. Ask them to describe how the group is protecting biodiversity. L2

TECHPREP

Use of Natural Areas
Have students find out how natural areas in their region are identified and protected. Who maintains them? What skills and equipment are required to maintain them? L2

Problem-Solving Lab 5-2

Purpose

Students will explore opinions regarding the preservation of certain endangered species.

Process Skills

think critically, analyze information, communicate, draw a conclusion, recognize cause and effect

Teaching Strategies

- You may wish to have teams of volunteers debate the issues explained in this lab.
- Remind students to show respect for others' opinions.

Thinking Critically

1. No. Ranchers may think that any wolf they see is threatening their livestock and kill it.
2. Yes. The native wolves probably evolved from the reintroduced species and might look similar to them.
3. They are killing ranchers' livestock.

Assessment

Performance Have volunteers give persuasive speeches to convince "decision-makers" to continue reintroducing wolves or to end the program. Use the Performance Assessment List for Investigating an Issue Controversy in **PASC,** p. 65. L2

Revealing Misconceptions

Students may not realize that reintroduction is successful only when the problems affecting the reintroduced species have been corrected. For example, if urban sprawl led to the disappearance of jaguars, reintroduced jaguars would probably still not have enough land to meet their needs.

Problem-Solving Lab 5-2 Thinking Critically

Is everyone pleased with conservation efforts? There have been many attempts to breed wild animals or move wildlife from one area to another. The goal is to preserve wildlife species if they appear to be in danger of extinction. These programs may result from the Endangered Species Act. How do groups with opposing interests or opinions view these programs?

A gray wolf

Analysis

Case 1: In March 1998, the U.S. Fish and Wildlife Service reintroduced 11 captive-bred Mexican gray wolves *(Canus lupus baileyi)* into parts of Arizona. They had been extinct from the area for 20 years. By law, ranchers are not allowed to kill native wolves. However, reintroduced wolves received special legal status under the Endangered Species Act and can be killed by ranchers only if they threaten livestock.

Case 2: Gray wolves *(Canus lupus)* had been extirpated from Yellowstone National Park since 1926. In 1995, the first group of gray wolves was captured in Canada and introduced to Yellowstone National Park, nearly 30 years after being listed as endangered in the lower 48 states. Despite a program to compensate ranchers for livestock losses to wolves, legal pressure was mounted to have the wolves removed as a threat to livestock. In December 1997, a United States district court ruled that the wolves should be removed from the park. However, a nonprofit group called Defenders of Wildlife has appealed the decision and the fate of the wolves remains with the courts.

Thinking Critically

1. Should supporters of the Endangered Species Act be pleased with the special legal status in Case 1? Explain.
2. In Case 1, ranchers pointed out that they cannot tell reintroduced species from native wolves. Is their concern justified? Explain your answer.
3. In Case 2, what is the main reason for the opposition against wolves in the park? Explain your answer.

Reintroduction programs

The year is 1992 in Wyoming. A wildlife manager carries a cage with a black-footed ferret, as shown in ***Figure 5.13***. She opens the cage door, and the ferret cautiously steps out onto the land. Black-footed ferrets used to live here, but the population declined steadily. Farmers had poisoned prairie dog colonies, thinking that the prairie dogs were competing with their livestock for food. Prairie dogs are one of the ferret's main foods. Black-footed ferret survivors were captured and bred. Some of the ferrets that were released back to the land survived to reproduce. **Reintroduction programs,** such as this one, release organisms into an area where their species once lived. Form your own opinions about these programs by reading the *Problem-Solving Lab.* The factors that lead to the decline of the organisms must be removed if the reintroduction is to be a success. For example, the prairie dog population must be healthy for the ferrets to survive.

The most successful reintroductions occur when organisms are taken from an area and transported to a new suitable habitat. The brown pelican was once common along the shores of the Gulf of Mexico. DDT caused this bird's eggs to break, and the brown pelican completely disappeared from these areas. After DDT was banned, 50 birds were taken from Florida and put on Grand Terre Island in Louisiana. The population grew and spread, and today over 7000 brown pelicans live in the area.

Figure 5.13
A black-footed ferret is reintroduced into its native habitat in Wyoming. The caregiver wears a mask to reduce the chances she will transmit a human disease to the ferret.

Sometimes all the organisms in wild areas are gone, and the only members of the species are in zoos. An organism that is held by people is said to be in **captivity.** The ginkgo tree, ***Figure 5.14,*** is an example of a species surviving extinction because it was kept by people. The ginkgo is an ancient tree; all similar species became extinct long ago. However, Chinese monks planted the ginkgo tree around their temples. By keeping these trees in "captivity," they prevented the tree from becoming extinct. Ginkgos now add beauty to modern cities. The ginkgo shows that not only can a species be protected, but that a protected species may be useful to people.

The best place to keep plants is in their natural ecosystems in the wild. If they must be kept in captivity, an economical way to do this is to store their seeds. Seeds can be cooled and stored for long periods of time. By establishing seed banks for threatened and endangered plants, these species can be reintroduced if they become extinct.

Figure 5.14
The ginkgo tree would probably be extinct if not for the care given to it by Chinese monks. It is a beautiful tree that survives pollution well, making it a good tree for urban landscapes.

Reintroductions of captive animals is more difficult than for plants. Keeping animals in captivity, with enough space, adequate care, and proper food, is expensive. Animals kept in captivity may lose the necessary behaviors to survive and reproduce in the wild. Despite the difficulties involved, some species held in captivity, such as the Arabian oryx and the California condor, have been successfully reintroduced to their native habitats after becoming extinct in the wild.

Section Assessment

Understanding Main Ideas

1. Contrast the fields of conservation biology and ecology.
2. Describe the U.S. Endangered Species Act. When did it become law, and how does it help protect or preserve endangered species?
3. What are the difficulties with reintroduction programs using captive-born animals?
4. Choose one species that you have read about, either here or in your library, and explain how conservation strategies lead to its recovery.

Thinking Critically

5. Why is it necessary for a conservation biologist to understand economics?

Skill Review

6. **Recognizing Cause and Effect** For a wildlife area near you, what would be one use of the area that fits into the philosophy of sustainable use? What is one use that would damage the ecosystem? For more help, refer to *Thinking Critically* in the **Skill Handbook.**

Meeting Individual Needs

Learning Disabled

Interpersonal Organize students into groups and have each group draw a large protected area and a system of several small protected areas. Then have the groups explain the advantages and disadvantages of each. L1

Resource Manager

Content Mastery, pp. 21, 23-24 L1
Reinforcement and Study Guide, p. 22 L2
Tech Prep Applications, p. 7 L2

Quick Demo

Ginkgo leaves are distinctive. Bring in a few leaves so students can identify the tree.

3 Assess

Check for Understanding

Have students explain which conservation biology strategy they feel is the most important and why.

Reteach

Have students list the three conservation biology strategies in this section. For each strategy, they should describe one organism that was helped. L2

Extension

Visual-Spatial Have students create endangered species posters. Each poster should have a picture, a description of the organism's niche, and what could be done to help the organism. L2 ELL

Assessment

Portfolio Have students write a letter to a local newspaper expressing their views about preserving endangered species. L2

4 Close

Discussion

Hold a class discussion about ways that individuals can help conserve biodiversity. Discuss programs and projects that can be undertaken by groups and communities to meet the same goal.

Section Assessment

1. Conservation biology focuses on protecting biodiversity. Ecology is the study of interactions in nature.
2. This 1973 law made it illegal to harm organisms on the threatened or endangered species lists.
3. Captive-born animals are expensive to raise and may lose their wild behaviors.
4. Students might describe the California condor being helped by reintroduction programs or elephants being helped by bans on selling ivory.
5. Wildlife areas are often destroyed for economic reasons, so providing economic reasons for their preservation is an important conservation strategy.
6. Hunting and nut collecting are examples of sustainable use. Damage could include building a mall or cutting trees for lumber.

INTERNET BioLab

Time Allotment

If conducted at home, the activity will require a 15-minute orientation in class. If computers with Internet access are used in class, the activity will take one to two periods.

Process Skills

acquire information, collect data, compare and contrast, draw a conclusion, think critically, define operationally

Preparation

Alternative Materials

- Use current magazines if Internet access is not available.
- Arrange for a guest lecturer, such as a veterinarian. Ask the speaker to discuss the issue and provide specific information for students to record in their data tables.

Analyze and Conclude

1. *Domesticated* means bred for an extended period of time in captivity.
2. Answers will depend on the information students located.

Resource Manager

BioLab and MiniLab Worksheets, p. 25 L2

INTERNET BioLab

Researching Information on Exotic Pets

What would it be like to own a pet like a snake or a ferret? Sound glamorous? Maybe it's a lot of hard work for the owner and maybe it's not so fair to the pet. Use the Internet as a research tool to locate information on exotic pets. Consider any animal as exotic if it is not commonly domesticated and is not native to your area.

A rhesus monkey

Preparation

Problem

How can you use the Internet to gather information on keeping an exotic animal as a pet?

Objectives

In this BioLab, you will:

- **Select** one animal that is considered an exotic pet.
- **Use the Internet** to collect and compare information from other students.
- **Conclude** if the animal you have chosen would or would not make a good pet.

Materials

access to the Internet

Scarlet macaw

Procedure

1. Copy the data table and use it as a guide for the information to be researched.
2. Pick an exotic pet from the following list of choices: hedgehog, snake, ferret, large cat such as tiger or panther, monkey, ape, iguana, tropical bird.
3. Go to the Glencoe Science Web Site **to find links** that will provide you with information for this BioLab. Note: You are not limited to the pet suggestions provided. If a different organism appeals to you, research it instead.
4. Record your findings in the data table.

A hedgehog

Data Table

Category	Response
Exotic pet choice	
Scientific name	
Natural habitat (where found in nature)	
Adult size	
Dietary needs	
Special health problems	
Source of medical care, if needed	
Safety issues for humans	
Size of cage area needed	
Special environmental needs	
Social needs	
Cost of purchase	
Cost of maintaining (monthly estimate)	
Care issues (high/low maintenance)	
Additional information	
Additional sources	

A ferret

Iguanas

Analyze and Conclude

1. **Defining Operationally** What is meant by the term *domesticated?*
2. **Using the Internet** Look at the findings posted by other students. Which of the animals researched would make the best pet? Which would not be a wise choice? Why?
3. **Interpreting Data** What do you consider the most important information gained from your research that:
   a. supports keeping your exotic pet choice?
   b. does not support keeping your exotic pet choice?
4. **Thinking Critically** What positive contribution might be made to the cause of conservation when keeping an exotic pet? Explain.
5. **Thinking Critically** How can keeping exotic pets be a negative influence on conservation biology efforts?
6. **Analyzing Information** What are some reasons why zoos rather than individuals are better able to handle exotic animals?

Sharing Your Data

internet CONNECTION Find this BioLab on the Glencoe Science Web Site at **www.glencoe.com/sec/science.** Post your findings in the data table provided for this activity. Use additional data from other students on the Internet to answer the questions for this BioLab.

INTERNET BioLab

3. a. Answers may include that exotic pets are interesting, have a good market for resale, attract attention, and are challenging to raise.
   b. Answers may include that these animals are expensive and difficult to feed and care for, including finding veterinarian services.
4. Answers may include that keeping these pets allows for possible breeding, thus helping to save an endangered species.
5. Students may note that buying these pets endangers species even more by encouraging black-market trade.
6. Zoos can better meet the animals' needs for food, shelter, and medical care.

Assessment

Performance Ask volunteers to debate this issue. One group should support the keeping of exotic pets, and the other group should be opposed to the idea. Use the Performance Task Assessment List for Investigating an Issue Controversy in **PASC,** p. 65. L2

Sharing Your Data

internet CONNECTION To navigate to the Internet BioLabs, choose the *Biology: The Dynamics of Life* icon at the Glencoe Science Web Site. Click on the student icon, then the BioLabs icon. Have students determine whether capture, breeding, and release programs have been successful for certain species of endangered animals. L2

Procedure

Teaching Strategies

- Students with home computers and access to the Internet should be encouraged to complete this activity at home. Students lacking access to computers can gain the information needed through articles in current periodicals.
- If necessary, review how to research a topic.

Troubleshooting

Students may need to be directed to narrow their searches or ignore certain web sites.

Data and Conclusions

Student data and conclusions will differ, depending on the animals they researched, the web sites they visited, and other references they used.

Art Connection

Purpose

Students will learn about a renowned photographer and his unique way of "preserving" nature —in photographs.

Teaching Strategies

- Obtain some of Wolfe's books from a library and encourage the class to study the photographs. Have students each choose a favorite photograph and explain their choice. Challenge students to classify several photographs with respect to Wolfe's goals while he is on location.
- Have students search the web to find a current list of endangered species. Have them identify which of Wolfe's subjects are endangered.

Connection to Biology

Wildlife photographs capture interesting phenomena of nature as well as document what might not exist in the future.

Art Connection

Wildlife Photography of Art Wolfe

Art Wolfe received a degree in fine arts from the University of Washington where he was trained as a painter. He applied his knowledge of art and painting to become one of the world's best wildlife photographers. With more than 1 million images to his credit, Wolfe's photographs of Earth and its inhabitants capture the best nature has to offer.

Although he has captured many an awesome landscape on film, photographer Art Wolfe is probably most well-known for his images of wildlife. These include just about every organism from A to Z. Wolfe, for example, has traveled to Antarctica to photograph playful Adélie penguins as they waddle across the ice sheet. Journeys to the northern hemisphere brought Wolfe into contact with brown bears, mule deer, and wolves. Treks to Africa have allowed the photographer to capture the intricate patterns and symmetry of zebras, both alone and in herds.

Capturing the moment Wolfe generally has four goals in mind when out on a shoot. One of the goals is to get as close as possible to his subject. This, according to the artist, allows him to freeze the instant of contact between himself and his subject. Another of Wolfe's goals is to try to capture an animal in its natural surroundings. Says Wolfe of one of his images of a black bear, " . . . habitat is as important as the animal." Wolfe's third goal—to capture patterns in nature—is perhaps fueled by his knowledge of art and his admiration of the German artist, Martin Escher. A photograph of a herd of zebras taken from above the herd exemplifies this particular goal. His last goal while out on a shoot is to try to capture an animal's behavior. Among Wolfe's photographs illustrating this goal are brown bears sparring in a cold Alaskan river, a Northern gannet meticulously constructing its nest, a snowy owl chick practicing a fierce stare, and mule deer foraging in a grassy field somewhere in Montana.

Snowy owl chick

Preserving nature for posterity Wolfe's work has been seen by wide audiences. His photographs help people appreciate the natural world and want to protect it. In 1998, the North American Nature Photography Association awarded Wolfe its prestigious Outstanding Photographer of the Year Award. That year, Wolfe also received the first Rachel Carson Award presented by the National Audubon Society for his work in calling attention to animals and habitats that are in danger of disappearing forever.

Connection to Biology

Why is it important for wildlife to be photographed by Art Wolfe and others?

internet CONNECTION To find out more about endangered species, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Internet Address Book

internet CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Chapter 5 Assessment

Summary

Section 5.1 Vanishing Species

Main Ideas

- Biodiversity refers to the variety of life in an area.
- The most common measure of biodiversity is the number of species in an area.
- Extinctions occur when the last members of species die.
- Human actions have resulted in habitat loss, fragmentation, and degradation that has accelerated the rate of extinctions.

Vocabulary

acid precipitation (p. 122)
biodiversity (p. 115)
edge effect (p. 122)
endangered species (p. 120)
exotic species (p. 124)
extinction (p. 119)
habitat degradation (p. 122)
habitat fragmentation (p. 121)
ozone layer (p. 122)
threatened species (p. 119)

Section 5.2 Conservation of Biodiversity

Main Ideas

- Conservation biology is the study and implementation of methods to preserve Earth's biodiversity.
- Legal protection of species and habitat preservation have provided effective strategies in conservation biology.
- Larger protected areas generally have greater biodiversity than smaller protected areas.
- Animal reintroduction programs have been more successful when the reintroduced organisms come from the wild rather than from captivity.

Vocabulary

captivity (p. 129)
conservation biology (p. 125)
habitat corridors (p. 127)
reintroduction programs (p. 128)
sustainable use (p. 126)

Understanding Main Ideas

1. In a study, aquatic ecologists counted the number of species in equal volumes of water. Where would you expect them to find the smallest number of species?
   a. Lake Victoria, a very large tropical lake in East Africa
   b. the Great Barrier Reef, a coral reef off the coast of Australia
   c. Lake Champlain, a large lake between New York and Vermont
   d. coral reefs in the Red Sea, between Israel and Egypt
2. The water hyacinth is from South America. People brought it to the waterways of Florida where it is growing out of control, killing native water plants, and blocking the waterways. The water hyacinth is a(n) _____ species.
   a. threatened **c.** exotic
   b. extinct **d.** endangered
3. A protected wildlife area allows local hunters to shoot deer when their population rises above a certain level. This is an example of _____.
   a. habitat degradation **c.** habitat loss
   b. habitat fragmentation **d.** sustainable use

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 5: *Biological Diversity and Conservation*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 25-30
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 5 quiz

Chapter 5 Assessment

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site.
www.glencoe.com/sec/science

THE PRINCETON REVIEW ***All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.***

Understanding Main Ideas

1. c
2. c
3. d

4. b
5. d
6. d
7. c
8. b
9. b
10. c
11. conservation biology
12. sustainable use
13. biodiversity, species
14. degradation
15. reintroduction
16. exotic species
17. habitat corridor
18. crack
19. threatened, endangered
20. Reintroduction programs

Chapter 5 Assessment

4. If a researcher found that a higher incidence of eye damage in kangaroos was due to increased ultraviolet radiation hitting the Earth, which pollutant would most likely be suspected as the cause?
   a. sulfur dioxide **c.** ozone
   b. chloroflourocarbons **d.** nitrogen dioxide
5. The California condor was extinct in the wild. Later they were bred in captivity and released in their old habitat. This is an example of:
   a. corridors
   b. sustainable use
   c. an exotic species
   d. a reintroduction program
6. The federally funded project of building a telescope in Arizona was stopped because an endangered species was found on the land. This probably occurred due to:
   a. the Convention on International Trade in Endangered Species
   b. reintroduction programs
   c. habitat fragmentation
   d. the U.S. Endangered Species Act
7. Two species of animals, Prezwalski's horse and Pere David's deer, no longer exist in the wild; they exist only in zoos. These species:
   a. would be classified as a threatened species
   b. are making a comeback
   c. exist only in captivity
   d. are extinct

THE PRINCETON REVIEW — TEST-TAKING TIP

Stumbling Is Not Falling

Every once in a while you'll hit a question that will completely throw you. It happens. You read the question eight times over, and you still can't understand it. Eliminate, guess, and then move on.

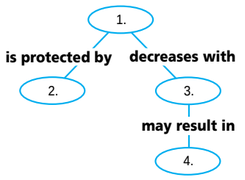
8. A national park has four ways to have roads cross the park. Which method would produce the least habitat fragmentation?
   a. 
   b. 
   c. 
   d. 
9. DDT was effective in killing insects. However, which organism was endangered most by its use?
   a. passenger pigeon **c.** elephant
   b. American bald eagle **d.** sea lamprey
10. The biggest threat to global biodiversity is:
    a. habitat degradation **c.** habitat loss
    b. habitat fragmentation **d.** exotic species
11. A branch of biology that seeks to preserve the world's biodiversity is _____ _____.
12. Allowing people to remove resources from a protected area as long as damage is not done to the ecosystem is an example of the philosophy of _____ _____.
13. The variety of life in an area is its _____. The number of _____ in the area usually provides a measure of this.
14. Water pollution is an example of habitat _____.
15. If Venus fly trap plants were planted in their native habitat, this could be part of a(n) _____ program.
16. Rats came to Hawaii on European boats; their populations grew very quickly. The rats are an example of a(n) _____ _____.
17. In Costa Rica, a thin strip of land links two protected wildlife areas. This is an example of a(n) _____ _____.
18. The insecticide DDT caused the American bald eagle and peregrine falcon eggs to _____, killing the chicks.
19. When a population of organisms falls drastically, that species may become a(n) _____ species. If its population falls almost to the point of extinction it is said to be a(n) _____ species.
20. _____ _____ release organisms into an area where the species was once found.

Applying Main Ideas

21. Why is habitat loss such a big threat to biodiversity?
22. How do habitat corridors help overcome some problems with habitat fragmentation?
23. Would building a road across a wilderness area, without building on the land, help preserve wild habitats? Explain your answer.

Thinking Critically

24. **Recognizing Cause and Effect** Using the idea of carrying capacity, design a plan for sustainable use of trout in a midwestern lake by fishers.
25. **Forming a Hypothesis** Suggest reasons why large carnivores have a greater chance of becoming extinct than other organisms. Provide examples.
26. **Concept Mapping** Complete the concept map by using the following vocabulary terms: biodiversity, conservation biology, habitat degradation, extinctions.

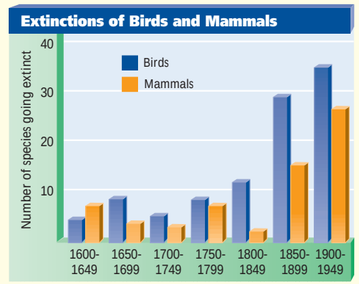


CD-ROM

For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

Making and Using Graphs The graph below shows extinction rates for birds and mammals since 1600.



Use the graph to answer the following questions.

1. In what interval were there more extinctions for mammals than for birds?
   a. 1600–1649 **c.** 1750–1799
   b. 1650–1699 **d.** 1850–1859
2. In what interval were there the most mammal extinctions?
   a. 1600–1649 **c.** 1850–1999
   b. 1650–1699 **d.** 1900–1949
3. Approximately how many birds became extinct in the interval 1650–1699?
   a. 7 **c.** 15
   b. 10 **d.** 20
4. Approximately how many birds became extinct during the interval from 1600–1949?
   a. 37 **c.** 115
   b. 70 **d.** 300
5. **Predicting** How many species of birds and how many species of mammals do you predict became extinct in the years 1959–1999?

Chapter 5 Assessment

Applying Main Ideas

21. Loss of habitat results in less area in which organisms can try to meet their needs. As habitats shrink, they support fewer species.
22. They allow the movement of organisms between areas so they can better meet their needs.
23. No, because the road would cause an edge effect and divide the area into two smaller areas.

Thinking Critically

24. Any plan that limits the catching of trout is acceptable. Plans include allowing harvesting of a limited number of trout, of certain size trout, or only in certain seasons.
25. Reasonable hypotheses include that carnivores need a greater range to obtain their prey since they are at a higher trophic level, that they depend on the healthy existence of a larger number of organisms, and that their large size makes them more likely to be killed by people.
26. 1. Biodiversity; 2. Conservation biology; 3. Habitat degradation; 4. Extinctions

Assessing Knowledge & Skills

1. a
2. d
3. b
4. c
5. Students might predict an increase over the 1900-1949 numbers, perhaps 45-50 species of birds and 40-45 species of mammals.

National Science Education Standards
UCP.I, UCP.3, UCP.4, C.3, C.4, C.5, C.6, F.2, F.4, F.5

Prepare

Purpose

This BioDigest can be used as an overview for ecology. If time is limited, you may wish to use this unit summary in place of the chapters in the Ecology unit.

Key Concepts

Students learn about abiotic and biotic factors in ecosystems. They are introduced to trophic levels, population growth, succession, and biodiversity.

1 Focus

Bellringer

Before presenting the lesson, write the term *food chain* on the chalkboard. Then write these terms with connecting arrows: *rose* ⇒ *aphid* ⇒ *ladybug*. Ask students what they think the arrows show. *how one organism consumes or depends on another; the movement of matter and energy*

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *World Biomes*
Disc 1
Video: *Symbiosis*
Disc 1

For a **preview** of the ecology unit, study this BioDigest before you read the chapters. After you have studied the ecology chapters, you can use the BioDigest to **review** the unit.

Ecology

An organism's environment is the source for all its needs and all its threats. Living things depend on their environments for food, water, and shelter. Yet, environments may contain things that can injure or kill organisms, such as diseases or predators. Ecology is the study of organisms in their environments.

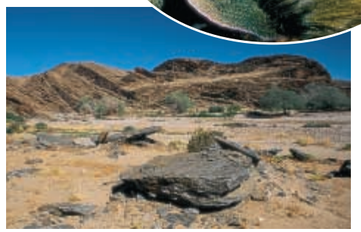
This coral reef's survival strategies include methods of obtaining needs and avoiding dangers.

Ecosystems

The relationships among living things and how the nonliving environment affects life are the key aspects of ecology. An ecosystem is composed of all the interactions among organisms and their environment that occur within a defined space.

Abiotic Influences

Around the world there are many types of biomes, such as rain forests and grasslands. The nonliving parts of the environment, called abiotic factors, influence life. For example, temperature and precipitation influence the type of life in a terrestrial biome.



Hot temperatures and little precipitation are abiotic factors in this desert biome.

FOCUS ON ADAPTATIONS

Bees pollinate flowers, and in return bees obtain nectar.

Symbiosis

Relationships formed between organisms are important biotic factors in an environment. Adaptations, which can be physical structures or behaviors, enable organisms to profit from relationships. In symbiosis, the close relationship between two species, at least one species profits. There are three categories of symbiosis that depend on whether the other species profits, suffers, or is unaffected by the relationship.

Cling fish hide in the spines of a sea urchin.

Mutualism In mutualism, both species benefit from their relationship. For example, bees have a mutualistic relationship with flowers. As the bee eats nectar from the flower, pollen becomes attached to the bee. The bee moves to another flower, and some of the pollen from the first flower pollinates the second flower. The bee gets food, and the flower is able to reproduce.

Commensalism In commensalism, one species benefits, while the other species is neither helped nor hurt. A cling fish hiding in the spines of a sea urchin is commensalism. The cling fish hides in the spines of the sea urchin to hide from predators because the sea urchin's sting deters many organisms. The cling fish benefits from the relationship, but the sea urchin is not harmed.

Parasitism Another form of symbiosis is parasitism, which exists when a smaller parasite gets its nutrition from a larger host. The relationship benefits the parasite, and is harmful to the host. Examples of parasitism include mistletoe on a tree and a tapeworm in the intestines of a human.

A tree is parasitized by mistletoe.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Kinesthetic Meeting Individual Needs, p. 138; Biology Journal, p. 140

Visual-Spatial Quick Demo, p. 137; Tech Prep, p. 139;

Interpersonal Reinforcement, p. 137

Linguistic Portfolio, p. 138; Concept Development, p. 139; Project, p. 140

In photosynthesis, plants use nonliving materials, including water, carbon dioxide, and light energy, to produce nutrients.

The water cycle, featuring evaporation from lakes and oceans, condensation to produce clouds, and precipitation, provides an understanding of how water flows through an ecosystem. Nitrogen and carbon also cycle through ecosystems. In the carbon cycle, plants produce nutrients from carbon dioxide in the atmosphere. When these nutrients are broken down for energy, carbon dioxide returns to the atmosphere.

Biotic Factors

The ways organisms affect each other are called biotic factors. Within a population of one species, parents nurture their young, and organisms compete for food or mates. Within a community of species, organisms compete for needs, predators kill prey, and diseases spread.

Food for Life

One of the most important ecological characteristics of organisms is how they meet their nutritional needs. Unlike animals that must eat other organisms to obtain their energy, plants usually make their own food using the energy from the sun.

Autotrophs and Heterotrophs

Organisms that make their own food, such as plants and algae, are called autotrophs. Organisms that cannot make their food must consume other organisms. These organisms are called heterotrophs. Heterotrophs that consume only plants are called herbivores. Heterotrophs that consume only animals are called carnivores. Omnivores consume both plants and animals.

Energy Flow

Life on Earth depends on energy from the sun. Plants use this light energy to make food. Animals eat plants or other animals for food.

The path the nutrients and energy take can be shown in a food chain such as:

rose ➔ aphid ➔ lady bug

This shows that the aphid eats the rose and obtains its nutrients and energy. The ladybug eats the aphid and obtains its nutrients and energy. This food chain is a simple representation. Feeding relationships are often more complex and are represented with a food web.

Assessment Planner

Portfolio Assessment
Portfolio, TWE, p. 138
Performance Assessment
Assessment, TWE, p. 140
Knowledge Assessment
BioDigest Assessment, SE, p. 141
Skill Assessment
Assessment, TWE, p. 137

2 Teach

Reinforcement

Interpersonal Organize students into pairs. See how many pairs can list five autotrophs, five herbivores, five carnivores, and five omnivores. L2

Quick Demo

Visual-Spatial Bring in and display a lichen. Explain that this is an example of the symbiotic relationship called mutualism. A species of fungus and alga work together to form the lichen and allow it to survive on dry, barren rocks.

Assessment

Skill Have students make a diagram showing the flow of water in an ecosystem. L2

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Symbiosis (Ch. 5)
Disc 1, Side 1, 37 sec.

CD-ROM
Biology: The Dynamics of Life
BioQuest: *Antarctic Food Web*
Disc 1

Assessment

Knowledge Ask students to explain why there are more herbivores than there are carnivores. L2

Enrichment

Ask students to describe characteristics of effective predators. Then ask them to describe effective prey. You might point out that one interesting difference in mammals is that predators, such as cheetahs, have eyes on the front of their heads, while prey, such as antelopes, tend to have eyes on the sides of their heads.

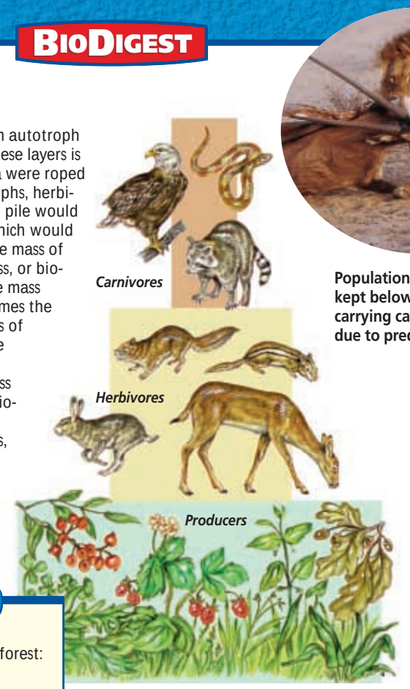
GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Pyramid of Energy*
Disc 1

Trophic Levels

Nutrients and energy move from autotroph to herbivore to carnivore. Each of these layers is called a trophic level. If a forest area were roped off and three piles created—autotrophs, herbivores, and carnivores, the autotroph pile would be larger than the herbivore pile, which would be larger than the carnivore pile. The mass of the piles indicates the biological mass, or biomass, of the three trophic levels. The mass of autotrophs is usually about ten times the mass of the herbivores, and the mass of the herbivores is about ten times the mass of the carnivores.

In a stable ecosystem, the biomass of plants must be greater than the biomass of herbivores. If the herbivores were more abundant then the plants, all the plants would be consumed and the herbivores would die. Likewise, if carnivores outnumbered herbivores, there would not be enough food for the carnivores.



Biomass of a 100m x 100m square section of deciduous forest.

Populations may be kept below their carrying capacity due to predation.

VITAL STATISTICS

Vital Statistics
Energy in a 100 x 100 m section of forest:
Producers—24,055,000 kilocalories
Herbivores—2,515,000 kilocalories
Carnivores—235,000 kilocalories

Population Size

A population is defined as the number of organisms of one species living in an area. The size of a population is influenced by the environment. For example, a lack of food could limit the number of organisms. Other limiting factors in population growth are water, shelter, and space. As population size increases, competition for some needed items intensifies.

Trees provide shade, which favors the growth of ferns.

Carrying Capacity

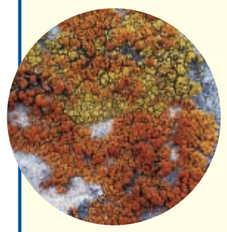
The maximum population size an environment can support is called its carrying capacity. If the population size rises above the carrying capacity, organisms die because they cannot meet all their needs.

Exponential Growth

If a population had no predators, and the organisms were able to satisfy their needs, population size would grow quickly. This fast growth is called exponential growth. This exponential growth cannot continue forever; at some point, some need will be scarce and become a limiting factor in the population's growth.

Animals often die due to disease or lack of food if population size exceeds carrying capacity.

FOCUS ON ADAPTATIONS



As lichens grow, they break down rocks and produce soil.

Pioneer Species

The first organisms to colonize new areas are pioneer species. Rocky areas, such as land recently covered by a lava flow, have different pioneer species than areas that already have soil. Rocky areas are usually first colonized by lichens.

On Rock Lichens are made of two organisms, a species of fungus and a species of photosynthetic algae or bacteria. The fungus holds its photosynthetic partner between thick fiber layers, allowing just enough light to penetrate to allow photosynthesis without drying out the lichen. The fungus provides a tough case and the photosynthetic partner supplies nutrition. Through this mutualistic relationship, lichens are able to survive in the harshest of climates such as high on mountains, in cold arctic regions, and in hot deserts.

In Soil After land is disturbed, such as after a fierce forest fire, pioneer species appear. Most pioneer plants produce many small seeds that are dispersed over wide areas, so that when land is disturbed, the seeds will be there, ready to grow. Another characteristic of pioneer species is they tend to grow and reproduce quickly. When a fresh patch of soil is disturbed, pioneer species sprout, grow quickly, and produce many new seeds to colonize other areas. Finally, pioneer species tend to like much sun and they tend to be robust.

Dandelions are effective pioneer species because they grow fast and disperse many seeds.

Portfolio

Describing Pioneers

Linguistic Ask students to write how pioneer species on rock are different from pioneer species in soil. L2 P

MEETING INDIVIDUAL NEEDS

Visually Impaired

Kinesthetic Cut three segments of 2 × 4 inch (5 × 10 cm) lumber, 10 inches (25 cm), 8 inches (20 cm), and 6 inches (15 cm) long. The first plank represents the producers, the second the herbivores, and the third the carnivores. Have students manipulate the segments to understand a biomass pyramid. L1 ELL

TECHPREP

Encouraging Pioneers

Visual-Spatial In the schoolyard or a nearby vacant lot, remove all plants from a patch of soil that is about 1 yard (1 m) square. Have students draw pictures of the first plants that begin to grow in the empty space. L2 ELL

Revealing Misconceptions

Help students realize that a population refers to the number of organisms of one species in a given area.

Concept Development

Linguistic Ask students to describe some needs that an organism might not be able to meet if its population rises too high. L2

Enrichment

Explain that exponential growth results in a J-shaped curve. Exponential growth that levels off as a population rises to its carrying capacity results in an S-shaped curve.

Revealing Misconceptions

Make sure that students realize that, although humans have increased the rates of extinction for other species, some extinctions are a natural process. For example, dinosaurs were extinct before humans walked on Earth.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Animation: *Carrying Capacity*
Disc 1

VIDEODISC
Biology: The Dynamics of Life
Carrying Capacity (Ch. 13)
Disc 1, Side 1, 17 sec.

3 Assess

Check for Understanding

Ask students to compare and contrast these terms. L1

a. autotrophs—heterotrophs
b. population size—carrying capacity
c. pioneer species—succession

Reteach

Remind students that population is the number of organisms of a species in a given area. Have them contrast population with biodiversity—the number of species in a given area.

Extension

Ask students to describe natural conditions that could lead to succession. *volcanoes, floods, fires* L2

Assessment

Performance Ask students to research in groups and find nominees for the "toughest" pioneer species. Have them present arguments, in pro-wrestling style posters, about why their nominee is the toughest. L2

Succession: Changes in a Community

What would happen if a farmer decided to quit farming a plot of land? No doubt, one of the first things to grow in the land would be those pesky weeds that the farmer had been fighting for years. These weeds are pioneer species, the first organisms to thrive in the new environment.

Changing Species

After the weeds take hold, other plants appear, including annual flowers, grasses, and then bushes. These provide shade, so now when a tree seed germinates, it receives protection from the hot, drying sun. As the tree saplings grow, they block the sun from the plants underneath. The pioneer plants and the annual flowers, without the strong light they need, begin to die back. The changes that take place are called ecological succession. As species appear, they change the ecosystem and help create conditions suitable for other organisms.

VITAL STATISTICS

Extinction Estimates
Shallow water mussels of the Tennessee River Shoal—44 of original 68 species are extinct.
Plant species extinct in the United States—200
Plant species in the United States in danger of extinction—680
Current loss from tropical rain forests—27,000 species a year

The California condor is one of many species threatened with extinction.

After the extinction of the dinosaurs, mammals, such as this wooly mammoth, thrived.

The most dramatic examples of extinctions are the dinosaurs. When they lived on Earth, they were the dominant animals, and now they are all extinct.

Polacanthus

Biodiversity

In succession, the species living in an ecosystem change over time. Earth's biosphere, the part of our planet that supports life, has experienced changes over time. As new forms of life evolved, other species became extinct.

Some ecosystems took millions of years to form. Millions of different organisms evolved to live in these areas. They are rich in biological diversity, or biodiversity. The most common measure of biodiversity is the number of species that live in an area.

Earth's biodiversity is facing a new crisis due to a new dominant animal—people. As land is converted for human use, organisms lose their habitat and the likelihood of extinctions increases.

Biodiversity adds beauty to our planet. The living world also provides oxygen and food and materials for clothes, drugs, and buildings.

BIODIGEST ASSESSMENT

Understanding Main Ideas

1. A species of fluke called Schistoma lives and obtains nutrients from cells in the human bladder. It produces about 300 to 3 000 eggs per day. This is an example of:
   a. mutualism **c.** commensalism
   b. parasitism **d.** extinction
2. Evaporation, condensation, and precipitation are all part of the _____ cycle.
   a. carbon **c.** nitrogen
   b. water **d.** biomass
3. Which of the following is an abiotic factor in an ecosystem?
   a. amount of light received
   b. number of predators
   c. the biomass of the area
   d. the number of endangered species
4. You observe an animal. It "oinks," eats plants, and eats insects. It is probably:
   a. a producer **c.** an autotroph
   b. a herbivore **d.** an omnivore
5. You are on land that has very warm temperatures and little rain. This biome is most likely a:
   a. deciduous forest **c.** desert
   b. tropical rain forest **d.** grassland
6. You sample an area and find the biomass of the producers is 3 143 kilograms and the biomass of carnivores is 37 kilograms. Which number is the best estimate for the biomass of herbivores in the same area?
   a. 4.1 kilograms **c.** 39 kilograms
   b. 299 kilograms **d.** 32 128 kilograms
7. You played in a meadow as a child. When you visit the area again as an adult, it is a forest. Which of the following accounts for the change?
   a. extinction of species
   b. ecological succession
   c. pyramid of biomass
   d. carrying capacity

Thinking Critically

1. Describe how a specific abiotic factor and a specific biotic factor could affect the life of a deer.
2. Explain the difference between commensalism and mutualism.
3. Is a lichen more of a heterotroph or more of an autotroph? Explain your answer.
4. What eventually happens to a population experiencing exponential growth? Why?

4 Close

Activity

Have students make concept maps of these groups of terms.

a. parasitism, symbiosis, mutualism, commensalism
b. carrying capacity, population size, exponential growth

Resource Manager

Content Mastery, pp. 25-28 L1
Reinforcement and Study Guide, pp. 23-24 L2

PROJECT

Checking Theories

Linguistic Have students hypothesize why a specific organism became extinct and research whether most scientists agree with their hypotheses. L3

BIOLOGY JOURNAL

Preserving Pioneers

Kinesthetic Encourage students to create a leaf press of one or two common weeds in your area. Have them put these into their portfolios and explain why the weeds are good pioneer soil species. L1 P

BIODIGEST ASSESSMENT

1. b
2. b
3. a
4. d
5. c
6. b
7. b

Thinking Critically

1. Answers will vary. Abiotic factors could include temperature, precipitation, and sunlight. Biotic factors could include plants, predators, and parasites.
2. In commensalism, one organism benefits and the other is neither helped nor hurt. In mutualism, both organisms benefit.
3. Since lichens don't consume other organisms, they are more autotrophic than heterotrophic.
4. Growth slows as the population reaches its carrying capacity.