BIODIVERSITY:
The Web of Life

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TEACHER'S RESOURCE BOOK

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INTRODUCTION

At this moment you are surrounded by an amazing mixture of organisms—some obvious, such as the people in your classroom, or the grass, trees and birds outside your window. Others are less apparent but even more immediate: your own body is the house of a wide variety of micro-organisms.

Why is biodiversity worth studying? It is one of the richest and most complex topics in biology because it comprises the enormously elaborate interactions between organisms and their environments. It is a topic that changes almost as quickly as it is analyzed. In many cases these changes are unfortunate—the viability of many species is dangerously threatened, and many will disappear entirely. The drama of extinction, however, is not the only reason to take a close look at diversity. Equally important is a look at the pattern of different species that continue to carry out their many interactions. The program ***Biodiversity: The Web of Life*** examines both aspects of diversity.

Using visually appealing live video images of organisms, a clear narrative and interesting interviews, ***Biodiversity: The Web of Life*** provides students with an engaging introduction to the topic of diversity. One of the strengths of the program is its multi-level approach. It examines biodiversity on a global scale and locally in terms of specific ecosystems. The presentation also explains many aspects of the interactions between organisms and the basic needs and relationships between a species and its physical environment. Basic concepts of diversity such as following energy flow or measuring density of diversity in a particular region are illustrated with fascinating and colorful examples.

LEARNING OBJECTIVES

After viewing the video program ***Biodiversity: The Web of Life*** and using the student worksheets and exercises in this Teacher's Resource Book, your students should be able to:

- describe biodiversity globally and locally
- be aware that niche includes the relationships between species
- be aware that ecosystem refers to the organisms and the place in which they live
- recognize that biodiversity is the result of biological evolution
- identify the factors that lead to differences in density of life in different regions
- understand that extinction has an effect on many different species because of interrelationships between species
- provide examples of the flow of energy in ecosystems
- understand the threats to biodiversity and be able to state ways that it can be protected.

A beautiful and dramatic view of Earth from space opens the video program ***Biodiversity: The Web of Life*** and creates the idea of seeing biodiversity on a global scale. The interactions between organisms have significance across the planet as well as in each separate niche. Students immediately see an intriguing montage of moving images that capture their attention and illustrate the huge range of life found on Earth today. Live action video of microscopic organisms such as bacteria and protists contrast with animals of the rain forest, desert, and ocean and with colorful flowering plants to show a sample of the more than one million species identified so far. The program also establishes humans as a part of this vast biodiversity.

Rich images of tropical rain forests then are used to examine the factors that affect the degree of diversity and density of life in any given area. Multiple habitats, climate, and the number of niches are among the influences of diversity. Beautiful views of coral reefs extend this example to another ecosystem that has tremendous biodiversity. Students see the reef that results from growth of coral polyps and the myriad of organisms that use the reef as home. In contrast, deserts have much less density of life. Yet many students will be surprised to find that even in the harsh desert environment, many different species thrive. The giant and impressive saguaro cactus demonstrates the adaptations that have enabled species to live in the desert. Its accordion-like structure rapidly soaks up a huge volume of water after a rare rainstorm and stores this precious commodity for use during the long periods of drought that will follow.

Students learn that an ecosystem is more than just a location—it includes the living things in a particular location. Organisms are not only affected by their physical surroundings, they also can alter those surroundings. The flow of energy is traced through an ecosystem, starting with photosynthetic organisms such as prairie grass and oceanic phytoplankton. Students also learn that bacteria and fungi have an important job as decomposers, breaking down and recycling organic materials to return nutrients to the physical environment, available for use by other organisms. Most importantly, students see the importance of the interdependence of living things. For example, sea stars in tide pools provide an essential control on the population of mussels.

Diversity is not only an aspect of healthy ecosystems, it is also a source of useful products for human culture. Rain forests and coral reefs are two potentially rich sources of medicines. Countries with abundant biodiversity, such as Costa Rica, also are benefiting from ecotourism. This industry often can replace revenue that might have come from damaging harvest of forests and other natural areas.

Humans have made an enormous impact on the planet and its degree of biodiversity. For example, in the 19th century, herds of American Bison were reduced from hundreds of thousands to just a few hundred survivors. In the 20th century, careful efforts to protect these huge mammals have resulted in a partial comeback for the species. Other species may not be

so fortunate. With over six billion people on Earth, human populations intrude and sometimes destroy the habitats and disrupt the niches of many species. The cutting of a forest, for example, affects far more species than just the trees being cut. The forest provides a variety of niches for many different species, all of which will have to find other sources of food and shelter if the forest is clear cut. In some cases, the damage to an ecosystem comes from the introduction of foreign species into a particular ecosystem. Miconia, a plant introduced to Hawaii, grows so thickly that it chokes off sunlight from many native species.

The program then explores the process of extinction on a variety of levels. Students learn about the mass extinctions of 65 million years ago that destroyed the dinosaurs. Naturalists describe the high level of extinction under human influence in modern times. The program establishes the idea that human decisions about lifestyles and the value of biodiversity can alter the course of extinction and survival for other species. One step toward preservation is the reduction of pollution in air and water.

Habitat preservation is one of the most effective measures to protect biodiversity. The United States is among those countries that have set aside hundreds of natural parks and forests to protect wildlife. Beautiful images reinforce these ideas. However, in many cases, the habitat set aside is fragmented into areas too small to adequately maintain a wide range of species. ***Biodiversity: The Web of Life*** presents the need for a realistic balance between the short term needs of local inhabitants and the need for habitat and natural resource protection. The situation is not simple in many cases. For instance, in Arizona, irrigation has made it possible to grow crops that otherwise could not survive in the harsh, dry landscape—but an unfortunate side effect is that rivers and streams have decreased flow, endangering organisms that depend on these aquatic habitats. Students learn that their decisions will help determine the level of biodiversity in the future.

Students also have the opportunity to think about the threshold nature of extinction. In some endangered populations, individuals survive but at a level that may not be sufficient to maintain the species in the long run. The video uses very active visual examples throughout to remind students of the huge range of life as they consider how vulnerable it is. One difficulty is that the diversity within the gene pool of a population or species may be greatly reduced if adverse conditions kill off many individuals. Those that survive repopulate the habitat, but the level of diversity at the genetic level may be greatly reduced. If new adverse conditions arise, there may not be sufficient variety in the gene pool to provide for survivors.

A naturalist at the Desert Museum in Arizona describes the role of captive breeding programs for species such as Mexican wolf, St. Esteban Chuckwalla (a large lizard) and native fishes. These programs can be useful for producing more individuals of the species, but unless habitats are protected or restored, the programs may fail because there is no place to reintroduce the organisms. The program closes with a reiteration of the key ideas, illustrated by excellent motion imagery of a wide range of species.

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS

The topic of biodiversity touches on several of the key concept areas recommended by the National Science Education Content Standards for biology. ***Biodiversity: The Web of Life*** can be used effectively to bring these concepts to life for your students. For details, you may want to consult a print copy of the standards, or look online at:

http://www.nap.edu/readingroom/books/nses/html/6e.html

Some examples of the concepts supported by the video are summarized here:

- **Biological Evolution**
  These concepts explain how the diversity of living things came about through gradual changes over billions of years.

- **Interdependence of Organisms**
  Concepts such as the flow of energy from photosynthetic organisms to others, cooperation and competition, the tension between population size and finite resources and the effects of human impact are all presented in the video program and reviewed and expanded in the student exercises.

- **Matter, Energy and Organization in Living Systems**
  The movement of matter through ecosystems and the connection between body organization and its environment are introduced in the video.

- **The Behavior of Organisms**
  One of the advantages of a video presentation is to include movement in the illustration of concepts related to behavior. The ability to move between different areas within a local environment (or migrate to new environments) is important, as are the mating behaviors that separate species.

TEACHING STRATEGIES

How does the video program ***Biodiversity: The Web of Life*** fit into your course syllabus?

You can use the video and student exercises effectively at several different points in your biology course.

The images and interesting stories presented in the program can be used as an engaging introduction to a study of **evolution** (because biodiversity is living evidence of the results of evolutionary process).

The program provides more depth about **ecological interactions**, so it can be used to introduce, reinforce or review major concepts from units on **interdependence and the biosphere.** Human impact on environment and living systems is also presented in the program.

The spectacular images work well as a transition to studying biological **classification.**

We suggest that you establish a foundation for thinking by using these preview questions or by letting students look over some of the worksheets *prior* to viewing the video. In either case, the purpose is to focus thinking, not to look for complete or correct answers at this point. Suggested preview questions:

- What factors determine which species live in any particular location on Earth?
- How did such a huge variety of organisms arise?
- How do human choices affect biodiversity?

Use these questions to tease out students' curiosity prior to showing the video and then re-visit them after students have completed the exercises.

Please note that in the January 2002 issue of Scientific American magazine published an extensive and careful response to refute findings in the book titled The Skeptical Environmentalist that you may find interesting.

Activity 1: Basic Biodiversity

This question is intended to have students articulate their basic understanding of the meaning of biodiversity. This term can refer to the range of species found across a huge region, such as an ocean or polar continent, or within a smaller ecosystem or habitat, such as a local pond, forest or meadow. Biodiversity is the result of millions of years of evolutionary process. Some traits are better suited to a particular environment than others. Through years of natural selection, populations begin to have a different gene pool (genetic diversity) and eventually the gap becomes so great that they no longer interbreed.

Activity 2: The Nature of a Niche

A niche is more than a location. It is the combination of where an organism lives (habitat) and its role or interactions with other organisms in that habitat. There can be more than one niche because different organisms use different aspects of a particular location. They also differ in their interrelationships with other organisms. For specific examples, students will differ. For example, in a dense forest, some animals such as monkeys may spend most of their time in the canopy. At the forest floor, insects and centipedes occupy a different niche. Some organisms, such as birds, move readily from one part of the habitat to another, so their niche lies on many levels.

Activity 3: Exploring Ecosystems

An ecosystem is a large scale division of the biosphere that includes the living (biotic) and non-living (abiotic) factors. The video showed the ocean and a desert, which are different ecosystems. Comparisons to local ecosystems will differ.

Activity 4: Energy Flow

Photosynthesis is the process through which autotrophic organisms, such as green plants and certain bacteria, make organic compounds through a process powered by solar energy. It is useful to organisms that eat the plants or that eat the organisms that eat the plants. Thus photosynthesis brings energy into living systems through the production of organic molecules. Photosynthesis puts oxygen into the atmosphere.

Activity 5: Recycling and Interdependence

Bacteria and fungi serve as decomposers to return nutrients to the non-living system. Nutrients returned to the soil can support the growth of plants.

Activity 6: Density of Life

There is much less density of life in a desert than in a coral reef. Areas with more niches tend to have a higher density of life. Rain forests have many niches. The high level of sun and rain produce lots of photosynthetic organisms, bringing a lot of energy and organic material into the system. The trees also provide protection from the sunlight, cooling through transpiration and shading, and structural support or places to hide. The variety of other organisms interact with each other to produce a very rich ecosystem.

Activity 7: Microorganisms and Diversity

Students are most likely to mention bacteria and fungi that live in soil or in decomposing bodies of animals or plants. Others might mention phytoplankton in the upper, sunlit waters of the ocean or algae that co-exist with corals. They might give examples not included in the video, such as the bacteria that inhabit the human mouth and gut. Huge populations of bacteria and rapid generation time statistically provide more opportunities for mutation and thus a good supply of genetic diversity.

Activity 8: Rain Forests

The canopy receives much more light than the midlevel or floor of the rain forest. Some organisms stay in the upper branches while others grow or crawl on the soft soil below. Some plants such as ferns grow below the taller trees and some grow on the bark. The rich sources for photosynthesis (light and water) and warm temperatures support a rapid flow of nutrients and energy into and through the living systems. The colder temperatures and relative dryness of the taiga predict a lower degree of diversity because of the harsher conditions. The narrow needles of conifers protect them from losing too much water or being burned by UV radiation at high altitudes. More surface area for photosynthesis explains the structure of many plant leaves in the rain forest, where water is not limiting.

Activity 9: Life in the Ocean

In the oceans, photosynthesis is carried out by phytoplankton. They are microscopic, photosynthetic organisms that float in the upper levels of the ocean where sunlight filters through.

Activity 10: Tide Pools and Competition

Tide pools are special in that the exposure to sunlight, predators such as birds and even air can change as the tide is high or low. Sometimes the tidal organisms are completely submerged in enough water to protect them, and at other times they are more exposed.

Keystone species are species that influence the survival of many other species in a particular community. Sea stars are starfish that are keystone species in tide pools. Mussels are one of the sea star's main foods, so the absence of sea stars can result in an over growth of mussels.

Activity 11a: Coral Reefs—Rain Forests of the Oceans

Part I: Healthy Reefs

A coral reef is a large structure made up of a colony of organisms growing on the ocean floor in shallow, tropical waters. They need to be in shallow waters because the algae that live in them symbiotically needs light for photosynthesis. The corals are small animals known as polyps that aggregate to the limestone remains of other corals. Only the upper layer is alive even in a healthy reef. Corals have been called the rain forests of the ocean because like rain forests, they provide many niches and a rich density of diverse species. Like rain forests, they provide an abundant foundation in photosynthesis to support the life in the community.

Activity 11b: Coral Reefs—Rain Forests of the Oceans

Part II: Reefs in Danger

Student responses will vary depending on the sources they consult. From information in the video and supplied in this worksheet, students may say that corals can be bleached by warming waters associated with El Nino or other causes. Corals can be killed by cyanide used for fishing. Students may also recognize that pollution in water can be a problem for corals. Bleaching is a complex problem because it reduces the supply of nutrients which in turn reduce reproduction and growth of the coral reef. As a result, a less useful habitat is available to algae that might repopulate the reef.

Human policy could be a decision to protect key reef area for repopulation. The areas near cooler water upwelling might be useful. Another policy is to require a certification of tropic fish hunters that they do NOT use cyanide. Spot checks on some fish also could determine how they were caught. Another policy might be to form an international committee and try to build consensus for behaviors that protect the reefs.

Activity 12: Movement and Niche

Movement can be useful in a variety of ways. Predators use movement to fly or pounce toward their prey. Prey use movement (running, flying, swimming, crawling) to try to escape. The differences in the means of moving provide differences in which niche a species can occupy. On a large scale, some animals such birds migrate to entirely different areas and thus can make a change in niche. Others, including flowering plants, mostly have to stay where they have put down roots.

Activity 13: Finding Birds

This can be a very rewarding extension activity. Students generally will discover that there are far fewer species in their own area. For example, the Peterson field guides list 700 species in a huge land area of western United States and Canada, much larger than Costa Rica. The state of Texas has 540 species, and there are only 220 breeding species and 350 total listed for the British Isles. Local bird lists would be expected to be much smaller. Student responses will depend on the areas for which they report. Of particular importance is the ability of students to use evidence from a reliable source or direct observation to support their conclusions.

Activity 14: Extinction—Threshold to Disappearance

Extinction refers to the complete disappearance of all the individuals of a species. Just because a few individuals survive does not guarantee survival for the species even if the remainder are protected. In some cases a critical mass of population size is needed for survival.

Activity 15: The Story of Ivory-Billed Woodpeckers

Student responses will vary. Please note the website URL for the Nature Conservancy at the end of this guide. Killing trees removes the habitat and food source for many organisms. For some, trees afford protection. Logging could be carried out under the direction of someone knowledgeable about conservation—not every mature tree need be taken. The question about the putative 1999 sighting is really a question about scientific process. The people who reported it could be insufficiently experienced, and there was no corroborating evidence (such as another sighting or photograph). Most likely the bird is extinct, but extinction is a difficult condition to verify. (Reference: Stolzenburg, William. "Swan Song of the Ivory-Bill" in the journal Nature Conservancy Vol. 52 (3) p 38.)

Activity 16: Evolution and Diversity

Students should recall from the video that biodiversity has changed greatly. For example there was a mass extinction about 65 million years ago. That extinction likely killed the dinosaurs along with many other species. Genetic diversity means a variety of genes exist in the gene pool of a given population or species. This variety provides a collection of genes that can make a population or species robust. If environmental conditions change, a large gene pool for selection can be a great advantage.

Activity 17: Captive Breeding

Captive breeding may be the only hope for some species to survive. However, they need habitat restoration. If most of the individuals in a particular population die abruptly, the remainder may comprise a much smaller gene pool, known as a genetic bottleneck. This situation makes the population more vulnerable to future adversity.

Activity 18: Species Density in a Burn Site

Conclusions drawn by students will vary. A number of explanations are possible, but students should realize that there is insufficient evidence to firmly support any specific explanation. For example, the marked difference in biodiversity in the two adjacent areas suggests strongly that the fire has increased the diversity in the burned area. Perhaps charring the creosote bushes has opened space to more seed germination. The softer layer of carbonized material may be better for germination than is the hard desert soil with established plants. Creosote also may secrete chemicals into the soil that discourage other plant growth. Perhaps the number and type of animals visiting the site has changed in response to its being cleared by fire: some small burrowing animals such as mice might have departed, leaving more seeds uneaten. In any of these explanations, more observations and more data are required.

Activity 19: Arctic Wildlife Refuge

Life density and biodiversity are less in the arctic because conditions are harsh and cannot support more life. The biodiversity remains important. Some species found there are not found elsewhere. The debate about drilling centers primarily on the potentially permanent loss of biodiversity (extinction) weighed against the fact that the amount of oil drawn out is very small compared with our overall needs. And this oil is a non-renewable resource.

Activity 20: Conservation

Our choices that affect remote ecosystems include our choices about burning fossil fuels that may change air quality, using products that encourage the economics of deforestation in remote places or encourage over fishing of certain locations. Student comments about local conservation efforts will vary.

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STUDENT ACTIVITIES

Name: _____

ACTIVITY 1

BASIC BIODIVERSITY

The video stated that biodiversity can be considered globally or locally. Explain that statement and give examples.

What important biological process has brought about biodiversity? Describe how this happens.

Name: _____

ACTIVITY 2

THE NATURE OF A NICHE

What is a niche?

A habitat is the physical location in which an organism or population lives. How is this different from a niche?

The video pointed out that there can be more than one niche in a given area. Explain how that is possible, using specific examples.

Name: _____

ACTIVITY 3

EXPLORING ECOSYSTEMS

Define the term "ecosystem."

Describe two ecosystems mentioned in the video.

How do these compare with the ecosystem in which your school is located?

Name: _____

ACTIVITY 4

ENERGY FLOW

What is photosynthesis?

Why is photosynthesis useful to the organisms that carry out this process?

What effect does photosynthesis have on the amount of oxygen in the atmosphere?

How does photosynthesis affect the lives of non-photosynthetic organisms?

Name: _____

ACTIVITY 5

RECYCLING AND INTERDEPENDENCE

What important role do bacteria and fungi play in moving material from living to non-living things?

Plants carry out a first step in building organic material as they carry out photosynthesis. How does the action of decomposers (bacteria and fungi) affect the ability of photosynthetic plants to carry out this important step?

Name: _____

ACTIVITY 6

DENSITY OF LIFE

Compare the density of life in a desert with that in a coral reef.

If an area has many niches, would you predict a high or low density of life?

Why does a rain forest have a high density of species?

Name: _____

ACTIVITY 7

MICROORGANISMS AND DIVERSITY

Not all of the species in an ecosystem are visible. Name examples of microorganisms and the niches they occupy.

Bacteria reproduce rapidly to produce huge population numbers. What advantages might this offer for genetic diversity?

Name: _____

ACTIVITY 8

RAIN FORESTS

A rain forest receives between 140 - 450 cm of rain per year. It includes thick growth of plants and trees with broad leaves that form a canopy. In one tropical rain forest in Brazil, over 1000 species of butterfly have been observed in a square mile. (The entire collection of butterfly species in the United States and Canada is less than half that number.)

How does life differ at different levels of a rain forest?

_____

_____

_____

_____

Why do you think life is so abundant in a tropical rain forest?

_____

_____

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_____

A taiga is a different kind of forest, one with conifer trees that have narrow needles. Huge areas of North America and Asia are the taiga type of ecosystem. Here the limited amount of rain falls mostly in the summer. Temperatures are very cold in the winter.

Would you expect greater or less biodiversity in this type of forest compared with tropical rain forests? Explain your reasoning.

_____

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_____

Why do you think the leaves of taiga trees have narrow needles while those of rain forests trees tend to be broad and flat?

_____

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_____

_____

_____

Name: _____

ACTIVITY 9

LIFE IN THE OCEAN

In the ocean, what is the first step in the flow of energy from sunlight into living systems?

What are phytoplankton?

Why do phytoplankton live in the upper few meters of the ocean?

Name: _____

ACTIVITY 10

TIDE POOLS AND COMPETITION

Why is the habitat of tide pools different than other sea floor habitats?

What is meant by the term "keystone species?"

How does the population of sea stars in a tide pool affect the number of mussels?

Name: _____

ACTIVITY 11A

CORAL REEFS— RAIN FORESTS OF THE OCEAN

Part I: Healthy Reefs

Coral reefs get their brilliant colors from a symbiotic or mutually useful interaction between the coral polyps and algae known as zooxanthellae. These algae carry out photosynthesis and convert wastes from the corals into useful nutrients (amino acids).

Based on this information and what you have learned in the video, explain what a coral reef is and how it forms.

How much of a healthy reef is actually alive?

Why are coral reefs found in relatively shallow waters?

Why are coral reefs known as "the rain forests of the ocean?"

This activity is continued on the next page.

Part II: Reefs in Danger

Coral reefs are rich in life, but they also are threatened. Use information from the video, from these reports and from sources you find to propose a human policy regarding coral reefs. Your report should include a diagram to show how corals, algae, fish, climate/water temperature and humans are inter-related. State your opinion about whether or not the survival of reefs should be a goal. Describe the factors that threaten coral reefs and the effect of coral death. Support your conclusions with evidence. Use a *Resource Tracker* (Activity 11c) to organize your research.

- Eighty-five percent of tropical fish supplied for saltwater aquariums come from coral reef ecosystems in Indonesia and the Philippines. There, in the 1990s, many reef fishermen were using a poison, cyanide, to stun fish in order to make them easy to capture. Not only did 70 percent of the fish die, but reef corals also were dying. An organization known as the International Marine Alliance began training fishermen to catch the fish by hand, and by 2001 over half of the Philippine's reef fishermen were trained for hand-collection of fish without using cyanide.

- A marine biologist at the University to South Carolina did experiments to test the effect of cyanide sprayed directly on ten species of corals. All ten died within three months. Cyanide causes zooxanthellae algae to come out of the reef structure. Loss of algae in a reef is called "bleaching." Bleached corals lose much of their resistance to disease or pollution hazards. Breeding of new coral polyps may be delayed for one or two years. The bleached corals can survive only for a limited time without their relationship to the photosynthetic algae.

- Bleaching can be caused by sudden warming of water temperatures. A shift in weather and ocean currents known as "El Nino" can cause an increase in water temperatures. The 1997-98 El Nino bleached huge amounts of coral reefs, as much as 85 percent of reefs in the Indian Ocean. Patches of reefs near cooler upwelling currents were resistant to bleaching. Algae from these areas might be used to re-establish a population in bleached corals.

For reference see:

Summerhays, Soames. (Fall 2002) "Rescuing Reefs in Hot Water" in the journal Nature Conservancy Vol. 52 (3) p 20.

Gorman, J. (16 February 2002) "Biodiversity Hot Spots" in Science News Vol 161 (7) p. 100.

Simpson, Sarah (July 2001) "Fishy Business" in Scientific American Vol.285 (1) p.83.

Name: _____

ACTIVITY 11C

RESOURCE TRACKER

Title of book or article:	Title of book or article:
Author(s):	Author(s):
Published by:	Published by:
Copyright date:	Copyright date:
Subject covered:	Subject covered:
Quote(s):	Quote(s):
Notes:	Notes:

Name: _____

ACTIVITY 12

MOVEMENT AND NICHE

Think about the examples of diverse species you viewed in the video: humans, fish, plants, flying birds, crawling insects, and so on. How does movement influence what niches they occupy? Explain your answer below.

Name: _____

ACTIVITY 13

FINDING BIRDS

The video program mentioned that there are 850 species of birds in the tropical rain forest of Costa Rica. Is that a large or average number compared to other places? In order to find out, you need to do some investigation. Your sources can be:

- field guides such as those by Roger Tory Peterson or David Sibley
- your local Audubon chapter
- bird lists from local parks or bird refuges
- observation of local birds by all your class members
- natural history books or articles about ecosystems other than the tropical rain forest.

After you seek out this evidence, draw your conclusions and report them in writing or an oral presentation according to your teacher's instructions. You can put a summary here. Be certain to include the sources of your information.

Name: _____

ACTIVITY 14

EXTINCTION—THRESHOLD TO DISAPPEARANCE

What is meant by "biological extinction?"

If there are any surviving members of a species, can that species truly be in immediate danger of extinction? Explain.

Name: _____

ACTIVITY 15

THE STORY OF THE IVORY-BILLED WOODPECKER

Imagine that you were the last human to photograph a species that now appears to be extinct. That is what happened in 1938 to a naturalist named James Tanner. He made photographs and sound recordings of Ivory-Billed Woodpeckers in a forest known as the Singer Tract in Louisiana. But the tract was sold to a lumber company and cut heavily. In 1942, one female Ivory-Billed Woodpecker remained, but she had no mate. Now the species is thought to be extinct. The birds ate insects living below the bark of huge, old, dead trees. It took about three square miles of forest to provide enough food for one pair of birds.

After thousands of years of growth, the forests of this region were reduced to less than 10 percent of the original by human cutting. To save some of the remaining habitat, naturalist Richard Pough worked with others to form a conservation organization known as the Nature Conservancy. Then in January 2002 a team of scientists hunting for clues of the bird saw marks on trees similar to those made by the woodpeckers. At one point they thought they heard a rapping sound of the bird, but it turned out to be gunfire. No one saw the woodpecker—thus, the question of extinction remains.

Is there a Nature Conservancy preserve in your state?

_____

_____

_____

Why does killing trees threaten other species?

_____

_____

_____

Can logging be carried out without destroying the wildlife in a forest?

_____

_____

_____

There were reports of someone seeing an Ivory-Billed Woodpecker in 1999. Why are scientists still uncertain about whether or not the species is extinct?

_____

_____

_____

Reference: Stolzenburg, William. "Swan Song of the Ivory-Bill" in the journal Nature Conservancy Vol. 52 (3) p 38.

Name: _____

ACTIVITY 16

EVOLUTION AND DIVERSITY

Has the biodiversity of the planet ever been very different than it is today? Explain.

What is meant by "genetic diversity?"

What is the importance of diversity in a gene pool?

Name: _____

ACTIVITY 17

CAPTIVE BREEDING

What is the role of captive breeding in maintaining biodiversity? Explain using examples from the video.

How could captive breeding programs produce a genetic bottleneck?

What is the importance of preserving or restoring a habitat for species that are maintained in a captive breeding program?

Name: _____

ACTIVITY 18

SPECIES DENSITY IN A BURN SITE

A fire burned across a small area of the Mojave Desert. On one side, the fire was trapped and stopped by a tall pile of boulders. On the other side, the progress of the fire was halted by a paved road over which the fire did not jump.

A couple of years after the fire, a naturalist documented the number and distribution of wildflower species blooming on a particular day in May. There were 21 different species of flowers blooming. In the center of the burn site, a small shrub known as creosote plant was putting out new growth on the charred base. Other shrubs remained blackened.

In the area across the road, the land was similar to the burn site except not scorched by fire. Mainly there were healthy creosote shrubs. Only four species of wildflowers were blooming.

Based on these field observations, describe what you can infer about biodiversity in this desert location.

Name: _____

ACTIVITY 19

ARCTIC WILDLIFE REFUGE

How does the density of life in the arctic compare to that in tropical areas? The May 2001 issue of Scientific American describes the scientific data related to the risks and benefits of drilling for oil in the refuge.

Read the article and then report on what you think are the key issues and evidence. What conclusions do you draw about the issue?

Name: _____

ACTIVITY 20

CONSERVATION

You may have heard the expression "Think globally, act locally." Consider how can this expression be applied to conservation efforts. For example, how can your communities decisions and actions affect the maintenance of habitats in a rain forest in Latin America? In a coral reef in the Philippines?

What conservation programs are at work in your area? Compile a list and report on the goals and level of success of each one. You may visit them if possible.

FACT SHEETS

Name: _____

FACT SHEET 1

GLOSSARY OF TERMS

Biodiversity: the varied collection of organisms that inhabit the planet. Biodiversity can be considered on a global or local scale.

Canopy: upper level of a dense forest that gets sunlight.

Desert: area that gets less than 25 cm of precipitation per year.

Ecosystem: large scale division of the biosphere that includes the living (biotic) and non-living (abiotic) factors.

Ecotourism: travel based on the goal of exploring interesting ecosystems; ecotourism provides areas such as rain forests with money-making alternatives to harvesting the wildlife.

Extinction: the complete disappearance of a species.

Gene pool: the collection of genes of all the individuals in a population or species.

Habitat: the place in which an organism (species or population) normally lives.

Mass extinction: abrupt decrease in the number and variety of species living on Earth.

Niche: combination of where an organism lives (habitat) and its role or interactions with other organisms in that habitat.

Polyps: tiny animals that attach to remains of others of their species to form coral reefs.

Photosynthesis: process through which autotrophic organisms, such as green plants and certain bacteria, make organic compounds through a process powered by solar energy.

Phytoplankton: tiny photosynthetic organisms found in huge numbers in the upper few meters of the ocean in which sunlight is available.

Rain forest: forest receiving as much as 450 cm of rainfall per year. Rain forests have the greatest density of biodiversity of any ecosystem.

Tide pools: shallow areas at the edge of the ocean which are underwater at high tide and are exposed or partially exposed at low tide.

Name: _____

Books of Interest

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Articles of Interest

Biodiversity is frequently featured in articles ranging from technical research reports to articles in the popular literature. This list, arranged chronologically, is a sampling of some reports in reliable and accessible scientific publications rather than research reports.

Summerhays, Soames. (Fall 2002) "Rescuing Reefs in Hot Water" in the journal Nature Conservancy Vol. 52 (3) p 20.

Stolzenburg, William. "Swan Song of the Ivory-Bill" in the journal Nature Conservancy Vol. 52 (3) p 38.

Osterfeld, Richard S. (May 2002) "Little Loggers Make a Big Difference" in Natural History Vol 111 (4) p. 65.

Milius, S. (May 25, 2002) "Better Mosquito" in Science News Vol 161 (21) p. 234.

Bogo, Jennifer (March-April 2002) "Going the Extra Yard" in Audubon Vol 104 (2) p. 64. (This report includes stories about how people have designed their own back yard to be habitats friendly to wildlife.)

Gorman, J. (16 February 2002) "Biodiversity Hot Spots" in Science News Vol 161 (7) p. 100.

George, Ryan (January–February 2002) "Biodiversity: Earth's Catalogue" in Audubon Vol 104 (1) p. 19.

Rennie, John, Editor in chief (January 2002) "Misleading Math about the Earth" in Scientific American Vol.286 (1) p.61.

Simpson, Sarah (July 2001) "Fishy Business" in Scientific American Vol.285 (1) p.83

Gibbs, W. Wayt (May 2001) " The Arctic Oil and Wildlife Refuge" in Scientific American Vol.284(5) p.62.

Name: _____

FACT SHEET 3

INTERNET RESOURCES

Some websites useful for studying biodiversity are given in the following URLs. Please keep in mind that web addresses change from time to time. You may also find it helpful to do a search with keywords such as "biodiversity," "extinction," or enter the name of a particular ecosystem.

For accurate botanical photographs of wildflowers, consult sites such as the one maintained by University of California at Berkeley: http://calflora.org/

You will find useful and scientifically reliable information about ecosystems, pollution and other topics at the site of the United States Geological Survey (USGS).

General sites on biodiversity include:

http://investigate.conservation.org/

http://www.nhm.ac.uk/index.html

http://www.unep.org/geo2000/ov-e/index.htm

http://www.amnh.org/naturalhistory/index.html?src=h_nh

http://aquarium.ucsd.edu/

http://www.audubon.org/

http://www.botanic.cam.ac.uk/GardIntro.html

OTHER BIOLOGY PRODUCTS FOR GRADES 8-12 FROM HUMAN RELATIONS MEDIA

Cellular Respiration: Energy for Life	video/print
Classification of Living Things	video/print
Homeostasis: The Body in Balance	video/print
Introduction to Cells	video/print
Meiosis: The Key to Genetic Diversity	video/print
Mitosis: Sending the Genetic Message	video/print
Organic Compounds in Action	video/print
Patterns of Inheritance: Understanding Genetics	video/print
Photosynthesis: Light into Life	video/print
The Rising Threat of Infectious Diseases	video/print
Translating the Code: Protein Synthesis	video/print
Understanding Evolution	video/print
Viruses: The Deadly Enemy	video/print

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