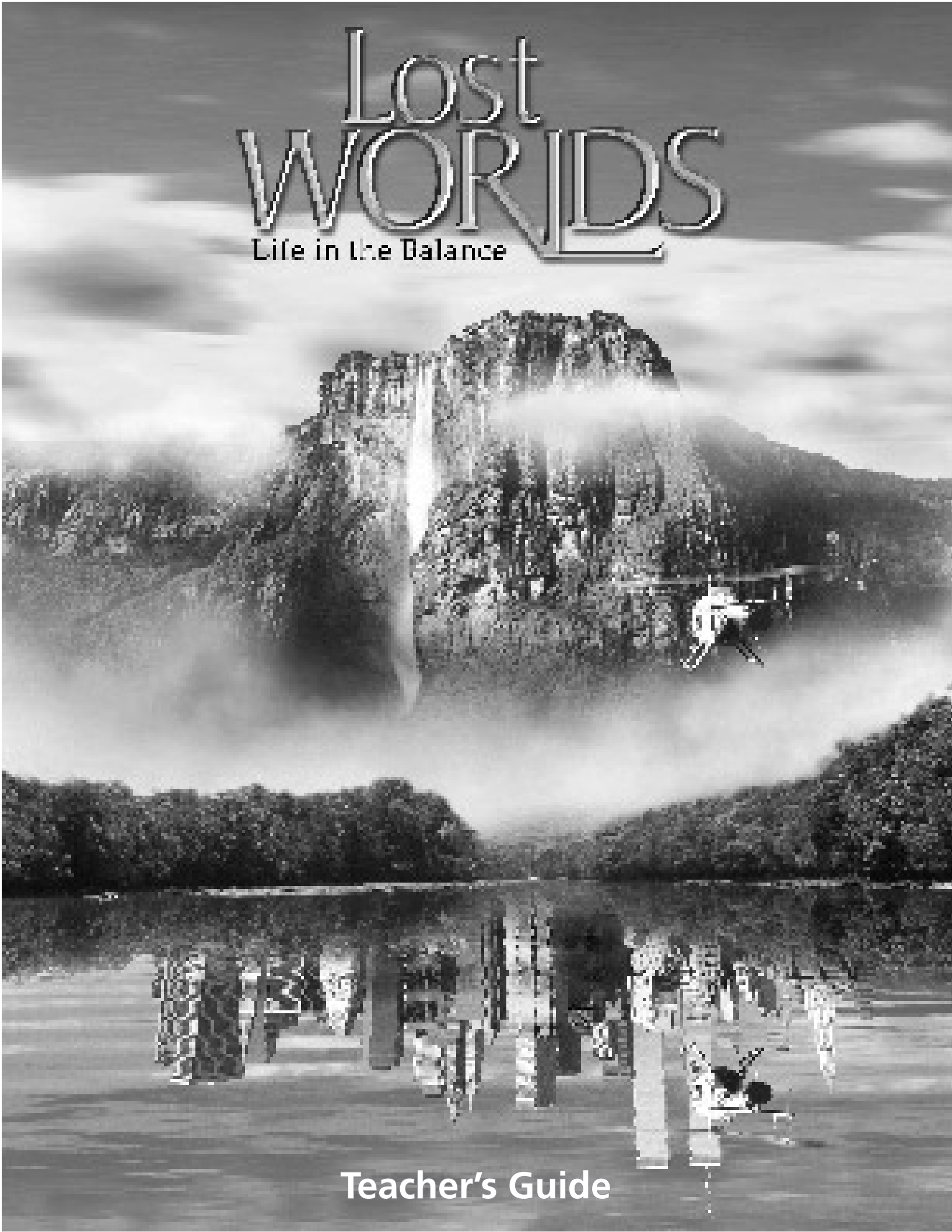
Lost WORLDS

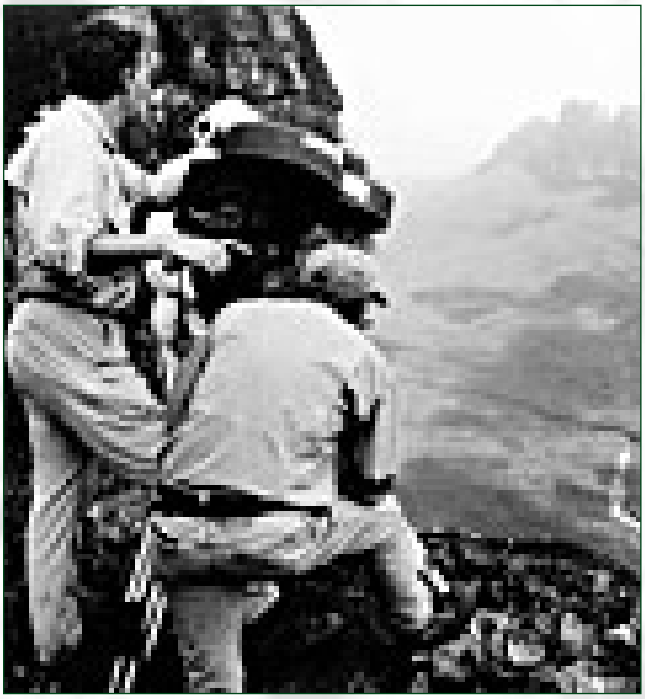
Life in the Balance



Teacher's Guide

contents / introduction

Film crew on location



The concepts featured in the IMAX film *Lost Worlds: Life in the Balance*, are both timely and compelling. The loss of biodiversity has become a topic of major concern to scientists and informed citizens alike. Many rate biodiversity loss as the single most important issue of the twenty-first century.

This guide mirrors the film, and reinforces its message through a series of activities that relate to its central concepts: the interdependence of organisms in an ecosystem, cycles in nature, evolution and adaptations, biodiversity, and the effects of human activity. Each section begins with a quote from the *Lost Worlds* script.

These supplemental activities are multidisciplinary, and include projects in science, natural history, language arts, and the creative arts. The projects are intended for use by middle-school students, but you may easily adapt them for older or younger students. They may be done as whole class activities, small group activities, or even as individual projects. Feel free to modify the activities to suit your educational needs.

We encourage you to read through the entire guide to figure out how best to use the resources. The materials are flexible, and can be used as stand-alone activities or incorporated as supplements to your curriculum on ecology, biodiversity, social studies, or conservation.

Each activity follows the same easy-to-use format. The plan begins with learning objectives, and tells how these relate to the film. Then a background section for the teacher expands on the concepts to be explored in the activity and includes suggested readings from the book, *Scientists on Biodiversity*, republished as *The Biodiversity Crisis: Losing What Counts* (New York: New Press, 2001). A materials list lets you know what to provide for the activity.

The activity itself is divided into a preparatory discussion, a hands-on project, and a follow-up discussion to process what students learned. There are also suggestions for additional explorations and extensions.

The guide was developed in accordance with the National Science Education Standards, and targets the following standards:

- Diversity and Adaptations of Organisms
- Populations and Ecosystems
- Populations, Resources, and Environments
- Personal Health
- Science as a Human Endeavor

Lost Worlds: Life in the Balance web site

Visit the *Lost Worlds* web site on the American Museum of Natural History's main site at **www.amnh.org**. Find further information about the film and a fully downloadable version of this guide, as well as links to other web sites that provide additional material on biodiversity.

synopsis of the film

A rare black jaguar prowls the ruins of the lost city of Tikal. Once the heart of Mayan civilization, the city was mysteriously abandoned a thousand years ago. What happened? What keeps cities alive?

Today's cities feel as if they will last forever. Everything we need is at our disposal. But do we ever stop to wonder where it comes from?

To trace one resource, the camera plunges into a stream of water coming from a faucet, and takes us on a wild ride through New York City's subterranean water system. We burst to the surface in a reservoir in the Catskill Mountains, 100 miles away.

We follow rainfall into the soil, and discover a miniature metropolis of microorganisms. While breaking down organic matter, they are also the agents that purify our water, create the soil in which we grow our food, and condition the air we breathe. The key to their success lies in the number of different life forms present. Scientists call this variety of life "biodiversity," and it is the diversity within each ecosystem which determines its health.

Everywhere, life has found ways to thrive. Each ecosystem shapes its own community of plants and animals, and in every ecosystem there is a balance of interdependent relationships that keep it healthy.

The beds of giant kelp along the California coast illustrate this balance. Giant kelp is a nursery for thousands of species of fish and other aquatic life. But fifty years ago this ecosystem was in decline due to an imbalance of two key organisms: sea otters and sea urchins. Urchins have a voracious appetite for kelp, and because otters which kept their population under control had been hunted to the brink of extinction, the urchin population exploded. Before long, much of the sea floor was bare. Then conservation groups began reintroducing sea otters. With their return, the kelp forests flourished, and so did all the species that depend on them. Diversity is a survival strategy.

As we change more and more of the Earth, more animals are losing their habitats. About 6,000 years ago, forests covered 34% of the globe. Today, only 12% of the Earth's surface is covered by forests, and we are just beginning to realize how many other life forms we may be losing.

There are still places on Earth where the natural world is undisturbed by humans, where life adapts and diversifies as it has since time began. Three scientists take us on an expedition to one of the least explored places on Earth, the table mountains of southern Venezuela that have come to be known as "The Lost World."

En route, we see a wide variety of contrasting ecosystems—the teeming city of Caracas, vast grasslands, magnificent waterfalls, wide rivers, and the dense rain forest. Each ecosystem on the journey has its own set of inhabitants, its own set of interdependent relationships.

A helicopter carries the team to their destination: the summit of Mount Roraima, a rugged vertical column two miles high, the Lost World of our imaginations.

The scientists explore the strange life forms that have found a way to make a living in this harsh environment. They discover that many plants have adapted to the sparse, infertile soil by becoming carnivorous. They find a rare frog that lays its eggs in a carnivorous bromeliad—the only one known to science. Later, they encounter a tiny black toad threatened by a tarantula. The toad doesn't hop; it strides slowly like a turtle, and curls into a ball to roll downhill. This is biodiversity in action.

It's a long way from the table mountains of Venezuela to our own backyards, but biodiversity is just as important here, and equally fragile. Even in a small park surrounded by miles of pavement, students participating in a study called *Biodiversity Counts* discover a surprising array of life.

Until recently, the fate of Tikal was cloaked in mystery. New studies have revealed that Tikal's rapidly increasing population used up their natural resources, depleted the soil and water, stripped the trees from the hills. The outcome was drought, famine, civil war, and the collapse of the Mayan civilization.

Tikal tells us something simple: we need to rediscover our place within the web of life and find the wisdom to protect the living systems that protect us.

interdependence: web of life

"What scientists call biological diversity is the variety of life that keeps things healthy all over the planet. Everywhere nature has found ways to thrive. Each place, each ecosystem, shapes its own community of plants and animals. In every ecosystem there is a balance of relationships that keeps it working."

OBJECTIVE

Students experience how the plants and animals of the South American rain forest are linked through a complex web of interdependence. They discuss, research, and then use the information they gathered to play a game that underscores the need to maintain biodiversity in order to preserve the balance of life in the rain forest.

IN THE FILM

The film gives us a glimpse of some predator/prey relationships, such as that of the sea otter and the sea urchin in the kelp bed, and hints at the larger webs of interdependent relationships that are vital to maintaining biodiversity.

BACKGROUND

While coral reefs are the most biologically diverse ecosystems on Earth, tropical rain forests are the most diverse terrestrial ecosystems on Earth. Plants thrive in the hot and humid climate. Broad-based trees soar high in the air to catch the sunlight, while others are adapted to life in their shadows. Woody vines and lianas climb up the trunks. Begonias, ferns, and fungus thrive on the dark and humid forest floor.

An amazing array of animals have developed their specialized niches in the multilayered Amazonian rain forest. Harpy eagles perch in the tallest tree-tops while butterflies, parrots, bats, frogs, lizards, and monkeys keep to the canopy layer below. Anacondas hunt in the shorter trees below that. Large, slow-moving tapirs and capybaras feed on the ground vegetation where secretive jaguars lurk in the shadows. Underfoot, the soil teems with small animals such as ants, beetles, centipedes, and microscopic organisms.

These plants and animals depend on one another for survival. Their interconnected relationships are complex, fascinating, and fragile.

MATERIALS

- Reference materials about plants and animals that inhabit the South American rain forest
- Index cards
- A ball of twine

ACTIVITY

Talk about it

1. Ask students to recount the story of the California sea otter. Try some of these prompts:
   - What is the relationship between the sea otter, sea urchins, and the kelp forests?
   - How did helping the sea otter recover bring back other species?
2. The scientists were happy to find the tracks of a big cat in the rain forest. Why? How does this relate to the sea otter story?

California sea otter in kelp

Do some research

Ask students to do research on either a specific animal or a specific plant that inhabits the South American rain forest. You may want to assign the organisms to make sure there is a balance. Or brainstorm a class list and draw lots for organisms. The objective is for students to find out as much as they can about how their plant or animal interacts with or depends on other plants and animals. They might investigate such topics as predator/prey relationships, habitat needs, survival strategies, seed dispersal, and pollination.

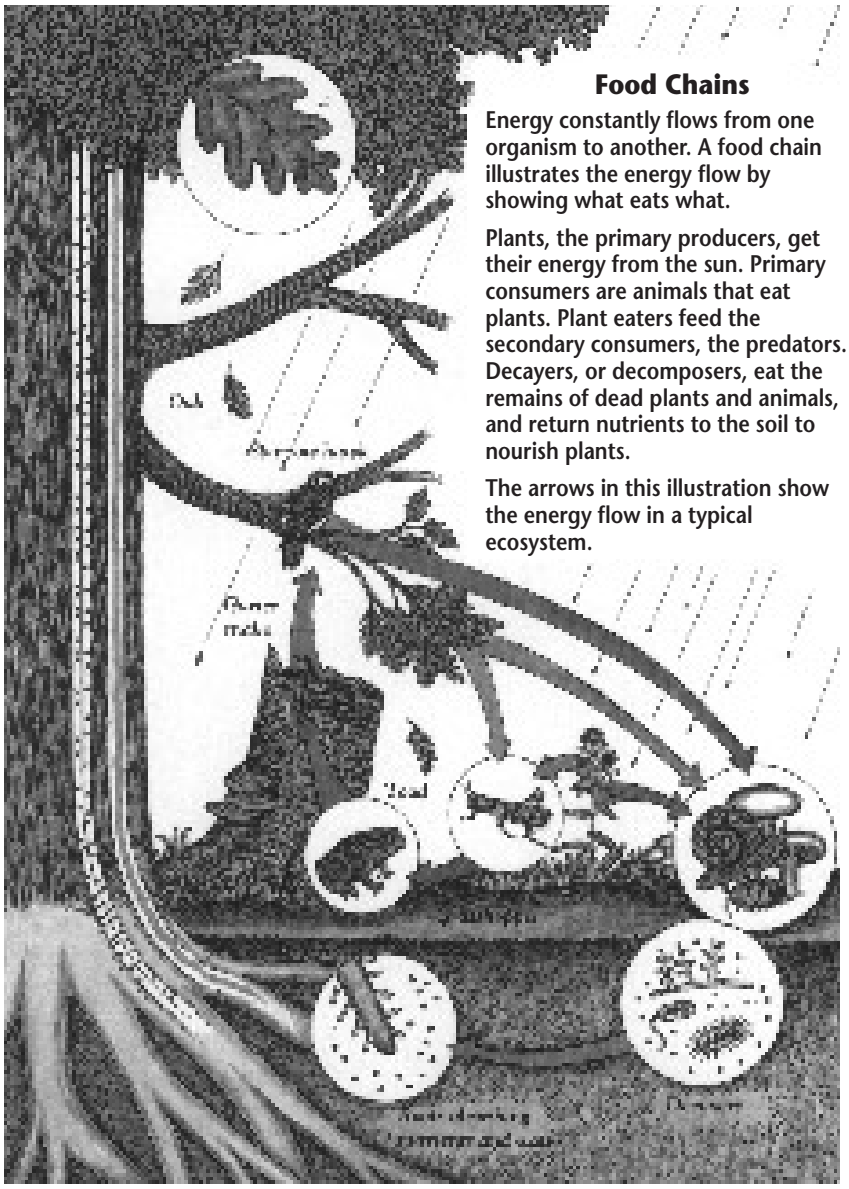
For plants, be sure to include a variety of types such as trees, flowering plants, climbers and vines, ferns, and epiphytes. For animals, include predators, plant eaters, scavengers, and pollinators of different kinds: mammals, birds, reptiles, arthropods, and amphibians.

further information on biodiversity can be found on the

Do it

BUILD A WEB OF INTERDEPENDENCE

1. After they have completed their research, ask students to write the name of their organism on an index card.
2. Seat the group in a large circle, and ask students to hold their cards in front of them so they are visible to the whole group.
3. Toss the ball of twine to someone in the circle. Starting off with a plant usually works well. That person keeps a tight grip on the end of the string, and tosses the ball to someone else in the circle who represents an organism with which the plant interacts.
4. The person who catches the ball tries to explain how the organisms on the two cards interact. The rest of the group can offer ideas, too.
5. The second person keeps a tight hold on the string and tosses the ball to another person who represents an organism with which his or her organism interacts. The third person tries to explain the relationship of this organism to the previous one.
6. The game goes on until everyone in the circle has had a chance to describe an interaction with another organism, and each organism is linked to another in the ecosystem. The result is a remarkably complex and tangled web of twine.
7. Ask students to predict what would happen if one or more of the plants were removed from the web. What if one of the big predators was removed? Then select one student to drop the string and become extinct. What organisms are affected by the extinction? Did this match your prediction? What will go extinct next? Why?



Food Chains

Energy constantly flows from one organism to another. A food chain illustrates the energy flow by showing what eats what.

Plants, the primary producers, get their energy from the sun. Primary consumers are animals that eat plants. Plant eaters feed the secondary consumers, the predators. Decayers, or decomposers, eat the remains of dead plants and animals, and return nutrients to the soil to nourish plants.

The arrows in this illustration show the energy flow in a typical ecosystem.

What's going on?

The tangled skein of twine is a graphic illustration of the complexities in the web of life in an ecosystem. Changes in any part of the web are felt throughout the whole.

Taking it further

- Repeat the activity using a local ecosystem, such as temperate forest, prairie, desert, or wetland.
- Repeat using a coral reef; a hydrothermal vent.
- Add humans to the web.
- What effect would logging or another disruptive activity have on the web?
- Ask students to reflect on their experiences in this activity and write about what they discovered.

FURTHER READING

from *Scientists on Biodiversity:*

Teachers

E.O. Wilson, *Biodiversity: Wildlife in Trouble.*
E.O. Wilson describes the causal factors behind today's biodiversity crisis and suggests possible solutions to halt it.

Paul R. Ehrlich and Simon A. Levin, *Biodiversity: What It Is and Why We Need It.*
The authors argue that we are dependent on biodiversity for every aspect of our lives. They describe the importance and complexity of ecosystems and the benefits they provide us.

Biodiversity Counts. Chapter 1, pp.16-18

Students

Barbie Bischof, *Reefs in Crisis.* Threats to the health of coral reefs.

Melanie Stiassny, *Lake Victoria.* How the entire ecological balance of an African lake is under threat from one introduced species.

evolution/adaptations

"Surrounded by the marvels of a modern city, we believe we are masters of our destiny. But everything in our homes, everything that keeps us alive, comes from nature."

OBJECTIVE

Students design, construct, and explain model animals that demonstrate how species evolve in response to their environments.

IN THE FILM

A lichen takes its nutrients from bare rock, a pitcher plant traps and eats insects, a tiny frog strides slowly along without once hopping—these are striking images of adaptation.

BACKGROUND

Living things respond to the challenges of survival in a particular environment by going through gradual changes in both physical features and behaviors. The evolutionary changes occur over generations, through the process of natural selection, and result in species that are adapted to cope with their environment.

Some adaptations originate from the necessities of surviving in a particular habitat. The streamlined bodies of fishes, the thick insulating fat layers of polar animals, and the reduced or needle-like leaves of some desert plants are examples. Some adaptations, such as thorns or poisonous stings, the ability to run fast, or hard protective shells, originate from the organism's need to defend itself from predators.

The adaptations allow an organism to survive and to reproduce, thus passing along the changes to successive generations.

Above (L-R): black jaguar, pitcher plant, dwarf antelope, epiphyte

MATERIALS

For 3-D constructions: a variety of recycled materials such as egg cartons, styrofoam packing, paper scraps, milk cartons, straws, bottle caps, and yogurt cups; or natural materials such as seeds, twigs, rocks, leaves, pine cones, and shells

For drawings: paper, markers, crayons, or paint

ACTIVITY

Talk about it

1. List a number of seemingly silly questions on the board, such as:

- Why doesn't a cow eat rabbits?
- Why can't an eagle swim? Why does a duck have flat feet?
- Why do mice run from cats?
- Why can't a cactus live in a pond? Or a pond lily in the desert?
- Why might a frog lose its ability to hop?

Feel free to add more.

2. Then analyze several of the questions with the class. Help them to come to the conclusion that animals and plants are specially adapted to survive in their particular environments. For example, the cow's body is well adapted to grazing, not hunting. It is bulky and placid, and has teeth and a digestive tract for processing plant food. Its sense of smell is not well developed. Its eyes, placed on the side of its head, do not

further information on biodiversity can be found on the



provide the keen binocular vision a predator needs. Even if the cow were interested, the rabbit has speed, agility, and good camouflage to protect it from its predators.

Do it

1. Invite students to create 3-D models or drawings of imaginary creatures that are especially well adapted for life in their environments. Anything goes, even classroom critters, as long as the adaptations serve a purpose in the chosen environment. If the creative pumps need priming, try some of these prompts:

- Where does your creature live? What is the climate?
- How does your creature get nourishment? What is its food? What kinds of mouth parts does it need?
- How does it move, if it does move? What kinds of limbs does it have? Why does it have to travel? To find food, a better climate, or a mate? To escape predators?
- How does it protect itself? Who are its predators?
- What color is it? Why?
- What is the name of your creature? Why is it called that?

2. When they have completed the project, give students the opportunity to describe their creations. Then display their work for others to enjoy.

What's going on?

When creating their imaginary organisms, students also had to consider the environments that necessitated the adaptations.

Taking it further

Some amazing adaptations students can research:

- Blind cave fish
- The giant, stinky Rafflesia flower
- The 17-year cicada
- The pepper moth of England
- The finches of the Galapagos Islands
- Figs and fig-wasps
- The moose
- Humans

FURTHER READING

from *Scientists on Biodiversity:*

Teachers

Niles Eldredge, ***Evolution, Extinction, and Humanity's Place in Nature.*** Eldredge believes we are in the middle of a sixth mass extinction. Unlike previous mass extinctions, Eldredge contends, this current one is human-induced. It is therefore our collective responsibility to think globally to reduce the rate of extinction.

Ross D.E. MacPhee and Clare Flemming, ***Brown-Eyed, Milk-Giving… and Extinct: Losing Mammals Since A.D. 1500.*** The puzzles of mammal extinctions over the last 500 years.

Students

Howard Rosenbaum, ***Humpback Whale Conservation Genetics Program, Madagascar.*** A study of humpback whales in Antongil Bay, Madagascar.

the water cycle/plants

"A hundred years ago, the people of New York had the foresight to preserve a critical part of their life-support system: the mountains, forests, and soils that clean its drinking water."

OBJECTIVE

Students carry out a simple, controlled experiment to demonstrate that plants are part of the water cycle.

IN THE FILM

The forests of the world are shrinking. One effect of deforestation is the reduction of rainfall. In Tikal, stripping the surrounding forest resulted in drought.

BACKGROUND

In a large tract of uninterrupted rain forest, the plants themselves can be said to create the atmosphere in which they grow best. The great mass of plants in a rain forest releases a huge amount of water vapor that forms towering, moisture-laden clouds. As the clouds climb up into the colder atmosphere, the moisture condenses and some of the water rains back down on the forest. Some of it is carried away by the wind to other parts of the globe.

There is now less rainfall in places where rain forests have been cut. Reduced stands of trees do not generate the amount of moisture needed to produce the rain-making clouds, and the daily downpours have decreased. The addition of paved surfaces and barren, abandoned land where trees once flourished also contribute to the loss.

MATERIALS

- 2 identical clear containers for each team of four students (large drinking glasses, wide-mouthed jars, small plastic aquaria, and plastic shoe boxes all work well). Note: Different teams may have different sets of containers, but as an experimental control, the two containers each team uses must be the same as one another.
- pencil and paper

PREPARATION

Select an outdoor area that has both planted spaces and barren or paved spaces in close proximity. Plan to conduct the experiment on a sunny day.

ACTIVITY

Talk about it

- Ask students to share their prior knowledge of the water cycle. Where does the rain come from? How do plants affect the water cycle? Where does our water come from? What local factors affect our supply? What would happen if we lost the vegetation in our area?
- You may want to construct a simple illustration of the water cycle on the board or on chart paper to help students visualize the process and the role that plants play in it. Ask students to trace the flow of water from plants to rain and back again.

Do it

- Ask students to design their own experiments using the available materials to answer the question below. As an alternative, have them conduct the experiment as outlined.

THE QUESTION

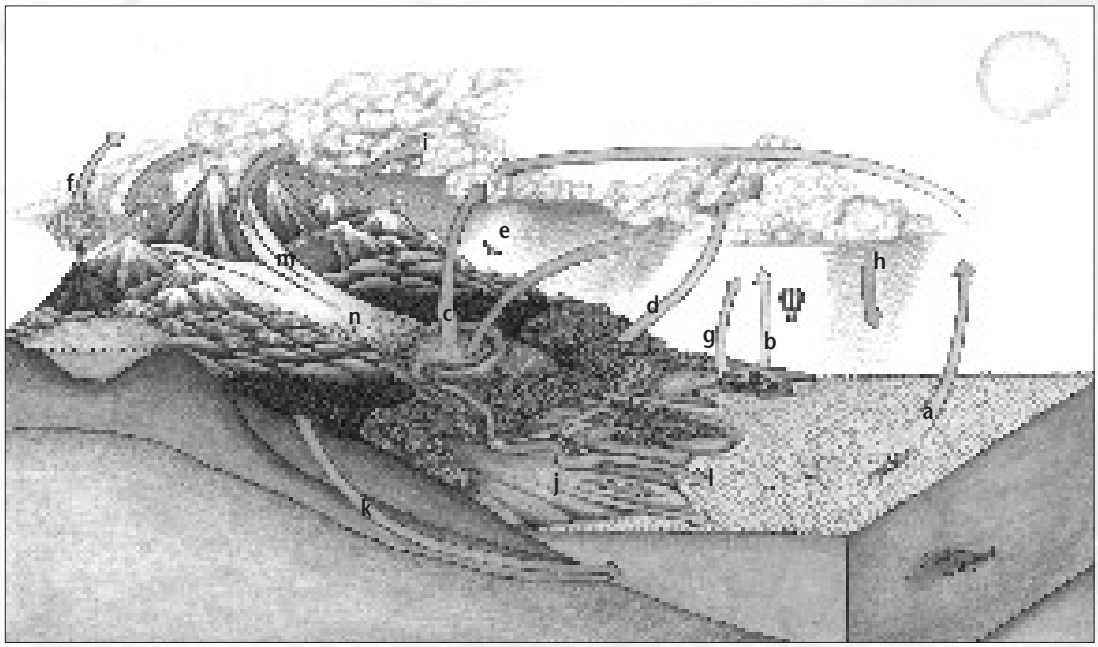
Which area gives off more water vapor: a surface covered in plants or a surface that has no plants?

- Have students transform the question into a hypothesis they can test.
- Ask students to predict the outcome of the experiment.

THE EXPERIMENT

1. Divide the class into teams of four, and give each team two identical clear containers. Take them to the outdoor area you have selected for the activity. Be sure students bring along pencils and paper to record their observations.
2. Have each team of students pick two sunny spots fairly close to each other to test. One spot should have some small plants growing on it, and the other should have no plants and be dry.
3. Ask students to place their two containers upside down over the two spots they have selected to test.
4. Then wait for about 10 minutes. While the class is waiting

further information on biodiversity can be found on the



The water cycle never stops. Water evaporates from the sea (a), land (b), and lakes (c), and enters the air as a gas called water vapor. Water vapor is also given off by plants (d), animals (e), erupting volcanos (f), and some machines (g). In the air, water vapor cools to form the tiny droplets that make up clouds. Rain (h) and snow (i) from clouds fall on land and sea. Water also returns to the sea as runoff from rain (j), as groundwater (k), and as river water (l). Water locked in glacier ice (m) returns to the sea when glaciers melt (n).

for results, gather them together to discuss some of these questions:

- What do you predict will happen in the container over the area that has plants? Over the dry area with no plants? Why do you think so?
- Why do you think it was important to use two different spots for your test?
- Why are both the containers the same for each team?
- Why are they both in the sun?
- About how many plants are under your container? Do you think that will make a difference in the results of the experiment?
- What is the importance of repeated trials in an experiment?
- How will you record the results of the experiment?

5. Send students back to their test sites to record their results. Encourage them to describe the results both in writing and by drawing. Then ask them to pick up the materials, and leave the area the same way they found it.

Suburban deforestation

What did we find out?

THE RESULTS

Invite each team of students to report on the results from their experiment. Compile their data on a class chart.

THE CONCLUSION

Based on the data they collected, ask students to draw a conclusion. Which containers collected more water? Where did it come from? Were their hypotheses correct? What have students found out that helps them to understand why losing vegetation means losing rain?

What's going on?

In the intense heat of the sun, plants evaporate moisture. Through the process of transpiration, plants give off water vapor through tiny pores in their leaves called stomata. This water vapor becomes part of the water cycle and helps to generate the clouds that provide precipitation. In an enclosed container such as students used in the experiment, the water vapor will accumulate on the top and possibly on the sides as well.

Taking it further

Try some of these questions with the class. They may want to conduct more experiments.

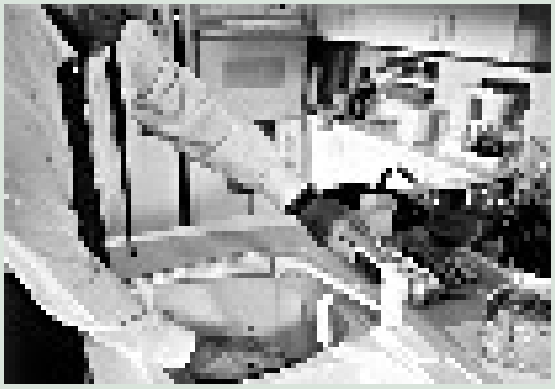
What would happen if…

- you tied a clear plastic bag around a leafy branch of a tree? How could you measure the amount of water the leaves gave off? How could you calculate how much water the whole tree gives off in a day?
- you put an ice pack on the top of the bag after it had collected a lot of water vapor? How does that model the water cycle?

"Surrounded by the marvels of a modern city, we believe we are masters of our destiny. But everything in our homes, everything that keeps us alive, comes from nature."

OBJECTIVES

By taking a home inventory, students determine the extent to which humans depend on the resources of the natural world. They design a classification system for objects and analyze the data they collect.



IN THE FILM

The kitchen of the high-rise apartment in New York City is full of examples of how many North Americans enjoy the riches of nature: water, building materials, foods, medicines, furniture, and familiar household products.

BACKGROUND

Where does it all come from? Ultimately, everything we eat, drink, sit on, ride, wear, read, write with, or wash with can be traced back to its origins in the natural world. Some items like bread, milk, socks, bricks, and newspapers are easy to trace. Others are much more difficult. But even complex manufactured synthetics like plastics begin as common organic materials such as cotton, coal tar, and petroleum.

It is important to clarify the meaning of biodiversity with students, and to emphasize that the term refers to the variety of life on Earth. Help them understand that even though an object originates in natural resources, not all natural resources are or were once living. Rocks and minerals, for instance, are natural resources that fall into this category.

An inventory of the kind students will do in this activity also presents a good opportunity to discuss renewable and non-renewable resources, sustainability, and what it means to be a conscientious consumer. It is also an opportunity to talk about how those of us in the U.S. and other wealthy countries are relatively few yet consume so many of the world's natural resources.

MATERIALS

- Pencil and paper
- Several common objects such as a book, an article of clothing, or a can of tuna fish
- Chart paper or the chalk board

ACTIVITY

Talk about it

1. Hold up a common object and ask student to trace its origins back to the natural resources that compose it. For example, students could say about a book that it is made of plants: a tree for the paper and soybeans for the ink.
2. Then ask students to take an inventory of the objects in one room of their home, and classify the objects into categories. Develop the categories together. Students might suggest something like the following:

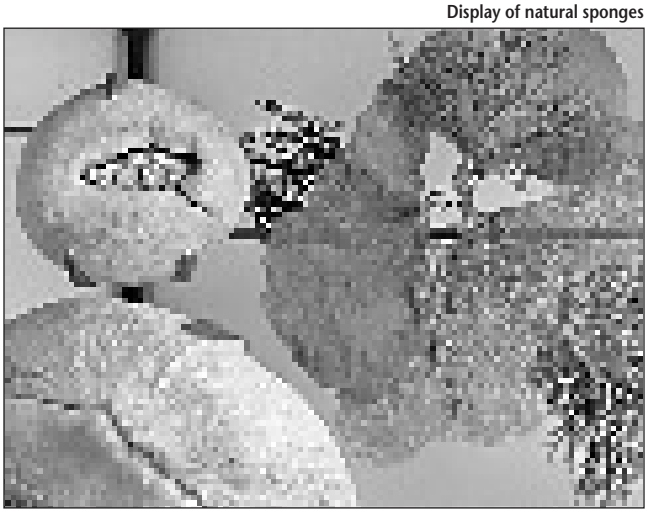
   Animal Plant Mineral Other

3. Encourage students to use reference materials if they are not sure how to classify an object, and to place it in the "Other" category only as a last resort.

Do it

1. When students return with their inventories, compile their findings on a large piece of chart paper or on the chalkboard. Use the categories students developed to classify the objects according to the natural resources that went into them. To avoid duplications, as each student adds an object to the chart, have the rest of the class check off that object if they had included it in their own inventory. Encourage students to defend their classification systems and reach some consensus on how to organize all the data from the class. Why did they put an item in a certain category? Do others agree? What happens if some items fall in more than one category?
2. Analyze the data with the class. Use some of these questions to spark the discussion:

Display of natural sponges



further information on biodiversity can be found on the

Margarita Lampo

CAREERS

Associate Researcher in the Ecology Department, Venezuelan Institute for Scientific Research

RESEARCH: Margarita Lampo's research relates to a big problem that threatens biodiversity: the introduction of non-native species. For the past seven years she has collaborated with Australian scientists to study a population of toads that is native to South America but was introduced into Australia as a non-native species. The researchers are looking for ways to control the toad population in Australia and stop the toads from spreading into wetlands where they threaten native populations of amphibians.

It is a team effort. Ecologists on the team are trying to find out why the toad is so much more abundant in Australia. They hope to discover the ecological factors that are present in South America (but are not present in Australia) that help regulate the toad population. Virologists are trying to discover viruses present in the native areas that might serve to reduce the populations of toads in Australia. Geneticists are researching the genetic makeup of the toads in both areas to find out if they differ.

EDUCATION: Margarita has always loved animals, and up until the age of 12, she was determined to be a veterinarian. In high school, an inspiring biology teacher rekindled her interest in animals. She went on to earn a bachelor's degree in zoology at the University of Maryland, and a doctorate from the Universidad Central de Venezuela.

ADVICE: Margarita's career advice is simple: do whatever it is you want to do, but do it with passion.

REWARDS: Margarita enjoys almost everything about her job. She admits that processing reams of data is the least exciting part, and can often be tedious. But the field work is very exciting, and takes her to some unique places. She finds that analyzing the data is fascinating because it is here that the real story emerges from the numbers. And writing scientific papers is a chance to tell that story to others.

- Do you notice any patterns? Do we seem to depend on some types of resources more than others?
- What kinds of objects (in the "Other" category, for example) did we have the most trouble classifying? Why? How could we find out more about what goes into them?
- Did you find any objects that did not come from the natural world?
- Are some natural resources easier to replace than others? For example, is it easier to replace crop plants than trees? Which resources cannot be replaced? What does this mean to the conscientious consumer?
- How does this inventory demonstrate that humans depend on natural resources? How does our dependence relate to biodiversity?

What's going on?

Students collected their own data, developed a system for classifying objects, and then analyzed the data to show the extent to which humans depend on diverse natural resources.

Taking it further

- To make the point that we depend on resources from all over the globe, ask students to find out more about where in the world some of the items on their lists originate. For example, they may trace cacao beans for chocolate to South America; ginger, rice, and soybeans to Asia; exotic woods to Africa.
- Students have compiled a great deal of information that they could use to create a number of different games. For example, they might play Twenty Questions or Jeopardy, or even develop a board game to share with younger students.

FURTHER READING

from *Scientists on Biodiversity:*

Teachers

Norman Myers, ***What's This Biodiversity and What's It Done for Us Today?***
What does biodiversity do for us? Norman Myers explains how species diversity benefits our health, our food production, and even our economies.

Thomas Eisner, ***Chemical Prospecting: The New Natural History.***
Thomas Eisner emphasizes the need for naturalists and explains how, as scientific explorers, they can make new discoveries about the chemical properties of natural substances.

Francesca T. Grifo, ***Biodiversity and Human Health.***
Why does a wealth of biodiversity benefit our health? Francesca Grifo explains the importance of biodiversity for our food and water supplies, and how it helps us prevent or cure disease.

Students

Carl Safina, ***The Audubon Guide to Seafood.***
A chart that shows the number of marine fish at risk from overfishing.

ecosystem diversity

"Like the kelp forest, the health of the rain forest is maintained by the variety of its inhabitants, as long as the natural balance is undisturbed."

OBJECTIVE

Students examine the importance of diversity in ecosystems by constructing and explaining terrariums or dioramas.

IN THE FILM

Our journey takes us into the rain forest surrounding Tikal, to the cities of New York and Caracas, to a reservoir in the Catskills, through South American grasslands, up a river, onto table mountains, to the California seacoast, and into a small woodland. Each locale represents a unique ecosystem, and each ecosystem supports its unique species of plants and animals.

BACKGROUND

The Earth is made up of a number of different biomes, or ecological regions. Each of these biomes has its own defining climate, determined by factors such as the temperature range, the prevailing winds, the amount of precipitation, and the amount of daylight in the region.

Soil type and depth also play an important role in determining the type of plant life a biome supports. And plants determine what kinds of animals can thrive in the region. So it is not surprising to learn that most biomes have been given names that describe their predominant type of vegetation. Some of the major terrestrial biomes are coniferous forest, deciduous forest, tropical forest, temperate grassland, savanna, desert, and tundra.

An ecosystem is made up of all the living things (biotic factors) and all the nonliving things (abiotic factors) in a given region that interact with each other; ecology is the science that studies the relationships between biotic and abiotic factors.

An ecosystem may be as large as a rain forest, but it may be made up of many smaller self-contained ecosystems, such as the communities of plants and animals living in leaf litter or in a rotting log on the forest floor. It all depends on the interactions, and which ones you choose to look at.

MATERIALS

For the terrariums:

- Clear containers (wide mouth jars, clear plastic containers, aquariums)
- Soil
- Plants
- Small animals (insects, snails, worms, etc.)

For the dioramas:

- Boxes (shoe boxes and computer paper boxes work well)
- Assorted arts and crafts materials
- Reference materials

PREPARATION

Be sure to check on endangered and protected species in your area if students plan to collect materials for the terrariums locally.

ACTIVITY

Talk about it

1. Open a discussion about the variety of ecosystems pictured in the film. Ask students to draw up a list of as many of them as they can recall.
2. From their lists, select two contrasting ecosystems to discuss in more detail. Have students describe each ecosystem, literally from the ground up. Ask:
   - What kind of soil would you expect to find in each of the ecosystems?
   - What kinds of plants? What kinds of animals?
   - What is the climate?
   - How do the biotic (living) elements interact in the ecosystem? How are they influenced by abiotic (nonliving) factors?
   - What do the two ecosystems have in common? How are they different?
   - How is our own local ecosystem unique?

Do it

BUILD A TERRARIUM

1. Have students do research on an ecosystem of their choice. Note: The project would be easiest to carry out and least expensive if students focused on your own locality. It is not too difficult to replicate conditions in other ecosystems, but it may be expensive. For example, unless you live in the desert, you would probably have to purchase the soil as well as the plants.
2. Using what they have found out, have students construct terrariums. They should provide the appropriate kind of soil, select typical plants, regulate the temperature and

further information on biodiversity can be found on the

Geralyn Abinader

CAREERS

Senior Media Producer, American Museum of Natural History, New York, NY

Geralyn Abinader works closely with the exhibition team at the American Museum of Natural History and with scientists to produce films, videos, and interactive displays that become part of the exhibitions. Recently, she traveled to the Central African Republic to film material for the Museum's Hall of Biodiversity. Her job was to document the state of the rain forest, and the measures that are being taken by the government of the country, international organizations, and local people, to save the remaining wildlife and their habitats.

EDUCATION: Geralyn has always had an interest in both science and film. She is a self-proclaimed Public Television junkie, and admits to watching children's programs even today to gain a better understanding of how to get the message across to people of all ages. She attended film school at New York University, but became frustrated with making movies for the commercial film industry in Los Angeles, so returned to New York. While working as a secretary at the AMNH, she volunteered to make videos for the Museum, filming festivities, lectures, and special events. Eventually this grew into a whole new media department, which Geralyn heads up.

ADVICE: Geralyn's career advice is to keep your mind open to new ideas, and new ways of understanding people, science, and the world. It is also important to stay open to new opportunities. When she started at the Museum, videos were not part of exhibitions yet, but she knew what she wanted to do, and jumped at the first opportunity that came along.

REWARDS: Geralyn enjoys the research aspect of her job. She loves to learn and enjoys the creative process of expressing new information in a way that draws in the visitors and helps them learn.

JOB QUALIFICATIONS: Geralyn's job combines creativity, technology, and research. These are some of the skills she thinks are important: (1) The ability to tell a story, both visually and verbally; (2) good communication skills—Geralyn interacts with scientists and museum officials, her own team, and with museum visitors; (3) a willingness to learn, and to do research on all kinds of topics. Geralyn has worked on projects about everything from outer space to anthropology.

moisture, and perhaps even include a very small animal such as an insect.

3. Here are some hints for setting up the live mini-ecosystems.
   - Get a suitable clear container, such as a wide mouth jar, a large soda bottle with the top cut off, or an old aquarium.
   - Start by shoveling several inches of soil into the container. The soil should be of the type found in the ecosystem you intend to replicate.
   - Then select plants that grow in that type of soil, and in your chosen ecosystem. Gently dig them up, and transplant them into the terrarium. Leave enough space for them to grow.
   - If the habitat is large enough, and if there is an appropriate food source, add a small animal too.
   - Monitor the amount of light, heat, and moisture in the terrarium. Try to control these abiotic factors so that they resemble those in the real ecosystem you are replicating.
4. When students have completed their work, give them an opportunity to present what they learned to the class. Ask them to describe both the biotic and abiotic elements in their ecosystem, and to explain how they interact.

What's going on

Biodiversity is the product of the variety of ecosystems on Earth. Every ecosystem is important in maintaining the total biodiversity of the planet.

Taking it further

Invite students to create dioramas of an ecosystem of their choice. They may want to show one of the ecosystems pictured in the film such as a kelp bed or the soil, another ecosystem that interests them such as the tundra, or perhaps your own local ecosystem. Provide resource materials to support their research.

FURTHER READING

from *Scientists on Biodiversity:*

Teachers

Helen F. James, ***Prehistoric Extinctions and Ecological Changes on Oceanic Islands.***
Helen James outlines the complex reasons for the extinction of island bird species both before and after the arrival of humans.

biodiversity in your own backyard

"In just one square meter, young explorers on a field trip can find a lot of life. If they look hard enough they'll find things even scientists haven't seen before. We all need to know what lives here, what it does, what it means to us."

OBJECTIVE

Students recognize and experience the variety of life present in a small area of their own neighborhood by designing and conducting an outdoor survey.

IN THE FILM

Surrounded by suburban housing, schools, malls, and miles of pavement, children explore a few square meters of a local woodland. They make surprising discoveries, and find much more life than they had imagined existed in their own environment.

BACKGROUND

As is evident from even a cursory survey of our everyday environment, life on Earth is extraordinarily diverse. Biodiversity means more than this spectacular variety of life, however. The definition also encompasses the complex network of interconnected relationships that bind the variety of living things together.

It is this very interconnectedness that serves to maintain biodiversity. The natural world can be seen as an immense web of intricately balanced ecosystems, each supporting unique communities of species that depend on the health of their ecosystem to survive. When the balance in one ecosystem is changed, reverberations are felt throughout the web.

Due largely to human activity, biodiversity is now seriously threatened, and the loss of species is occurring at a higher rate than ever recorded in the planet's history. Major threats to biodiversity include habitat loss and fragmentation, the introduction of non-native species, pollution, population growth, and overconsumption of resources.

A first step toward preserving biodiversity is to develop an awareness and an appreciation for what we have. Close, firsthand observation of your own environment can be a powerful way to generate feelings of stewardship at home, and gradually to extend this sense to the whole natural world.

MATERIALS

- Hand lenses
- Pencil and paper
- Collecting jars
- Hand trowels or shovel
- Field guides and identification keys
- Meter sticks or yard sticks
- Stakes and twine for marking off the squares outdoors

PREPARATION

1. Select a local site for the outdoor survey. If the school grounds are not suitable, consider getting permission to use a vacant lot, a neighborhood park, a community garden, or even a cemetery. Look for an area with a variety of vegetation (such as trees, bushes, weeds, grasses, flowering plants, leaf litter, or dead wood), because it will support a greater variety of animal life.
2. Divide the class into teams of three or four.

ACTIVITY

Talk about it

1. Explain to students that they are about to take a field trip to the site you have selected to study biodiversity. They will take a survey and count all the different kinds of life they find in the area. Ask them to make some predictions:
   - How many different kinds of plants do you think we will find at the site? Name some that we might see.
   - How many different kinds of animals might live at the site? What are they?
   - How do you think the plants and animals at the site depend on each other? Give some examples.
2. Talk about safe behavior on a field trip, and about the importance of leaving the site the way you found it.
3. Develop a plan with students for how to conduct the survey. Consider some of these questions:
   - How big an area should each team study? (A one-meter square works well.)
   - How will you count the number of different kinds of plants and animals you find?
   - Will you count only the organisms on the surface of the ground, or include those that may fly over your square? Will you dig below the surface of the soil?
   - How will you record your findings? (Try to encourage writing, drawing, and even taking photographs.)
   - How will you identify the plants and animals? (Provide field guides for your region for use back in the classroom.)

further information on biodiversity can be found on the

- Should we collect any specimens? (Discuss responsible collecting. Catch-and-release is recommended for animals.)

Do it

1. Take students to the outdoor site you have selected, and have them work in teams to mark off the squares they will survey.
2. Then, following the plan they developed, have students conduct a survey of the diverse life forms in their squares. Circulate among the groups as they work. Encourage them to observe closely with hand lenses. Prompt them to record their finds in a detailed, organized way. Have them assign their own names to organisms they do not know. Tell them that they can use field guides for further identification back in the classroom.

3. If students choose to collect specimens, be sure that they provide adequate temporary living quarters. Small insects, worms, and snails, for example, can all survive for a short time in an artificial habitat (like a jar) that reproduces conditions in the natural habitat. They will need air, food, water, the appropriate temperature range, and enough space. Students should plan to return the creatures to where they found them within a few days.
4. Remind students to leave the area in the same condition as they found it.
5. Back indoors, invite students to share their findings. Have each team report out on the numbers of different kinds of plants and animals they discovered. Compile the class data to find out the total number of different kinds of organisms students recorded.
6. Ask students to select several organisms from their list, and to explain how they interact. For example, an oak tree provides both food and shelter for the squirrel. The squirrel, by burying acorns to eat later and then forgetting about them, inadvertently plants new oak trees. The two organisms have an interdependent relationship. How would biodiversity be affected if one or the other disappeared from the site?
7. Discuss the importance of maintaining biodiversity in your neighborhood. Have students analyze some hypothetical situations to illustrate how people have an impact on biodiversity. For example:
   - What would happen if the area you surveyed was sprayed with herbicides? With pesticides?
   - What if it were cleared out and paved over for a parking lot?
   - What if it were turned into a corral for livestock?
   - What if it became a nature reserve with a pond?

What's going on

Students have calculated the variety of different kinds of life that exists in a very small area, and come to the realization that the web of life in their own neighborhood is both complex and fragile.

Taking it further

- Discuss sampling techniques. How do researchers determine the number of organisms in a very large area?
- Find out about other biodiversity surveys, such as the Christmas Bird Count conducted by the Audubon Society.
- You may consider using *Biodiversity Counts*, developed by the American Museum of Natural History, with your class. A supplementary unit for middle school, *Biodiversity Counts* is an inquiry-based program that promotes hands-on collaborative learning through the study of the local environment. You can find *Biodiversity Counts* online at **www.amnh.org/learn/biodiversity_counts/**.

FURTHER READING

from *Scientists on Biodiversity:*

Teachers

David Ehrenfeld, *Hot Spots.*
The author argues that we should respect all kinds of ecosystems, not only those rich in species diversity.

Students

The Green Guerillas, New York City.
A group committed to the idea of greening urban areas.

"When we protect nature, we protect ourselves."

OBJECTIVE

Students recognize the threats to biodiversity, and become aware of positive steps that people can take to help preserve the natural world.

IN THE FILM

The film presents a series of sharp contrasts. On the one hand, we see examples of the impact of human activity in the bustling cities that drain resources and produce pollutants. Taken to the extreme, the lost city of Tikal is the result.

On the other hand, we delight in the untouched wilderness the scientists explore in Venezuela, and share their hope that we will have the wisdom to preserve it.

BACKGROUND

Human activity has had a profound effect on biodiversity. The diversity of species is threatened by a multitude of factors, including over-population, loss and fragmentation of habitats, introduction of non-native species, overexploitation of commercially valuable species, pollution and contamination due to pesticides and acid rain, and changes of global dimension, such as warming and the depletion of the ozone layer.

In order to make sound political, economic, and ecological decisions, we need to know more about what species exist, where and how they live, and how they interact with each other and with their environments.

There is hope, and there are positive steps we can take. We must stabilize population growth, reduce our consumption and waste, develop clean technologies, protect and preserve habitats, and limit the harvesting of our natural resources.

On the following pages are just a few examples of people and organizations working in many different ways and in many different environments, all with the same goal: to preserve biodiversity. The first two examples highlight action projects that involve students working to preserve their local resources. The next describes the CAMPFIRE project in Zimbabwe, which is helping local people to recognize that wildlife is one of their most valuable resources. The article on the Kayapó points out that preserving biodiversity can be a successful strategy for farming in the rain forest. In the profile on Jim Enote, we learn about one man's commitment to preserving native cultures.

The Monterey Bay Salmon and Trout Project

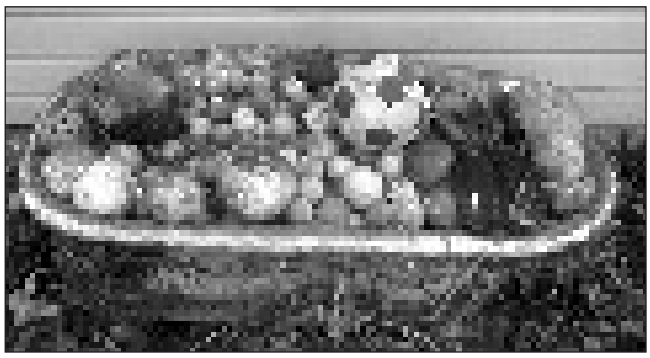
Progress has taken its toll on California rivers. Dams were built, forests cut, and riverbeds mined for gravel. As a result, the salmon and trout lost crucial habitats. Recently, new partnerships have been forged to help restore the fisheries. Commercial and sport fishermen, Native Americans, legislators, scientists, and over 70,000 school children have joined forces to reestablish an important natural resource.

In Monterey Bay, California, school children of all ages are helping to reverse the dangerous decline of the salmon and steelhead trout populations. They are hatching and raising thousands of young fish in an incubator program, and then releasing them into the rivers from which their kind had nearly vanished.

The Potomac Watershed Cleanup

Every spring since 1989, increasing numbers of volunteers have gathered on the shores of the Potomac from its headwaters to its mouth for the annual river cleanup day. Last April they collected an amazing 50 tons of trash of all kinds: tires, gas cans, milk jugs, yogurt cups, fishing gear, and lots and lots of plastic.

One particular kind of trash popped up in surprising numbers—balls of every imaginable kind. Most were tennis balls, but there were also basketballs, footballs, super balls, golf balls, beach balls, soccer balls, and even one beat-up bowling ball. One group of volunteers in one day collected 1,066 balls, enough to fill up a big old-fashioned bathtub.



further information on biodiversity can be found on the

Jim Enote

CAREERS

Associate Director, Indigenous Communities Mapping Initiative; Senior Advisor, the Mountain Institute; President, A:shiwi A:wan Museum and Heritage Center; President, Zuni-A:shiwi Publishing; former Project Leader, Zuni Conservation Project; farmer; artist

A MAN WITH MANY CALLINGS: Jim Enote is committed to conserving and protecting his own and other native cultures and environments. He is a major player behind a unique mapping project that is assisting native peoples such as Eskimos, Pueblos, and Hawaiians to map their homelands. These maps are intended to capture much more than what you would find on conventional maps. They include areas that are sacred to native peoples, some of which may be underground or even underwater. Place names contain stories that are dense with meaning. Because of this close connection between landscapes and native languages, the two are often mapped together.

In his own Zuni community, Jim founded and formerly directed a conservation project sponsored by a tribal trust fund. The Zuni have lived on the same land for thousands of years, in a place where most people live within five minutes of every living relative. Zunis have developed a sophisticated approach to standards of conservation and environmental protection. For example, certain species, such as the red-shafted flicker, turkey, and deer, receive greater attention because of their significance in Zuni culture. State and federal laws do not address the significance of the many species of cultural importance for Zuni and other native people. When conflicts arise, Jim and others work with state and federal agencies to come up with agreements that respect and validate culturally important species and environments.

A farmer, Jim has 35 acres of land that he leaves mostly in grass and sedge. He raises mostly Zuni native crops, such as corn, beans, chiles, and a few other varieties, on five acres.

An artist, he creates large environmental sculptures on the rest of his land. At first his work focused on traditional Zuni designs, but now he creates more metaphorical and political works. Once he collected many pieces of mirrors and placed them in such a way that he could climb a hill at sunset and see the sun reflected in each fragment.

PHILOSOPHY: Zuni people feel a very real attachment to the cosmos, as if an umbilical cord joined them to their environmental womb. The landscape beats through them like a pulse, and they feel they can control what happens to it.

ADVICE: Jim advises young people to develop their own real connections to the natural world. He encourages them to farm, to plant seeds, to watch the seasons come and go, and to learn to read natural signs. There is, he says, an interconnectedness that we can only learn to appreciate by paying attention to the patterns in the natural world.

Jim can be contacted at enote@igc.org

The Girl Scouts of the National Capital Area have decided to try to solve the ball mystery. Where are they coming from? Why are there so many on the riverbanks? They plan to collect data from several points on the river and enter the data on their computers to compare with tallies in future cleanups.

CAMPFIRE: Communal Areas Management Program for Indigenous Resources in Zimbabwe

In Zimbabwe, economic problems are closely bound to ecological problems. In many parts of the country, the semi-arid land cannot support intensive farming or grazing. The soil is infertile, exhausted, or eroding. Native species of plants, well adapted to survival in the harsh conditions, were destroyed in order to plant crops. In the process, natural habitats for wildlife were also lost.

The CAMPFIRE movement is offering people an alternative to destructive farming and hunting practices by helping them to realize that wildlife is their most valuable resource. Rural communities in Zimbabwe are being granted the legal authority to manage the wildlife in their districts, and are reclaiming stewardship over their local natural resources.

Communities develop their own projects for taking advantage of their unique ecosystems. Many sell concession rights to tour operators; some sell photographic equipment. Others hunt within the quotas they establish in cooperation with the wildlife department. The money earned from these projects goes directly back to the community, and they decide how best to use it.

Not long ago, villagers in Zimbabwe routinely smashed crocodile eggs and shot elephants for invading their fields. Now they are protecting both their wildlife and the habitats they need to survive. They see it as a real investment in the future.

Kayapó Indians: Farming in the Rain Forest

The Kayapó Indians inhabit an area in the Xingu River basin, south of the Amazon, where the rain forest meets the dry

/ continued on page 16

stewardship *(continued)*

savanna. In these diverse environments, they have developed techniques for growing enough food while at the same time preserving natural resources.

The Kayapó have a profound understanding of their land. They use carefully planned techniques for enriching the soil, preserving natural ground cover, controlling temperature and humidity, managing pests, and timing crops.

In the forest areas, they plant crops in concentric circles. Each circle contains different crops and is managed differently. In the center they typically plant sweet potatoes, aerate the soil by hand, and add ash and organic matter. In the next circle they plant crops such as beans, papaya, melons, and cotton. The outer circle is the buffer zone between the crops and the forest, full of useful medicinal plants as well as those high in nectar production. The combination lures potential pests away from the food crops.

Between the cultivated areas, the Kayapó preserve the natural stands of old forest. These serve as biological preserves that help the forest grow back into unused fields.

In the savanna, the Kayapó create forest islands. Using a soil mixture they prepare from termite and ant nests plus compost, they cultivate hundreds of different useful plants. The forest islands also attract wildlife, such as birds, reptiles, and mammals, a valuable food source.

The Kayapó methods are successful in large part because they preserve biodiversity. Their methods provide a sharp contrast to the modern plantation style of farming where whole forests are destroyed and the land is planted in a single species crop.

FURTHER READING

from *Scientists on Biodiversity:*

Students

Alan Rabinowitz, *Jaguars.*
Alan Rabinowitz describes how the collaboration between different groups of people restored the jaguar population of the Cockscomb Basin, Belize.

Restoration of the Elwha River by Dam Project, Washington.
Read how the removal of a dam will make a difference to an area's fish populations.

Profiles of:

- **Jane Goodall**
  Information on the activist group **Roots and Shoots.**
- **Abebe Getahun**
  A portrait of a scientist committed to conservation in his own country, Ethiopia.
- **Jaime A. Pinkham**
  Meet a Native American forester committed to natural resources management.

credits

Lost Worlds: Life in the Balance
A Primesco/Blue Mountain Film

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Visit Lost WORLDS Life in the Balance at www.amnh.org

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If you'd like further information on biodiversity, here are some recommended readings.

Teachers

Caduto, Michael J. and Joseph Bruchac. ***Keepers of Life: Discovering Plants through Native American Stories and Earth Activities for Children.*** **Fulcrum, 1998.**
Interdisciplinary curriculum (K-12) in botany and plant ecology with a focus on environmental and stewardship issues.

Carson, Rachel. ***Silent Spring.*** **Houghton Mifflin, 1994.**
The book that exposed the dangers DDT posed to the environment when it was first published in 1962. Thanks to *Silent Spring,* DDT was banned and the environmental movement was launched.

Dobson, Andrew P. ***Conservation and Biodiversity.*** **Scientific American Library, 1996.**
An accessible handbook to the scientific and economic value of biodiversity with case studies and wonderful illustrations.

Earle, Sylvia. ***Sea Change: A Message of the Oceans.*** **G.P. Putnam's Sons, 1995.**
Former chief scientist of the National Oceanic and Atmospheric Administration, Earle recounts three decades of undersea exploration and appeals for the preservation of the world's fragile and rapidly deteriorating ocean ecosystems.

Eldredge, Niles. ***Life in the Balance: Humanity and the Biodiversity Crisis.*** **Princeton University Press, 1998.**
Eldredge outlines the wonders of and threats to biodiversity and shows that humans, the cause of the threats, must be part of any solution.

Gore, Al. ***Earth in the Balance.*** **Penguin Books, 1993.**
Gore argues that only a radical rethinking of our relationship with nature can save the Earth's ecology for future generations.

Menzel, Peter. ***Material World: A Global Family Portrait.*** **Sierra Club Books, 1995.**
Sixteen of the world's foremost photographers traveled to 30 countries around the world to live for a week with families who are statistically average for that nation. Using over 300 images, *Material World* puts a human face on the issues of population, environment, social justice, and consumption.

Myers, Norman (ed.). ***The Gaia Atlas of Planet Management.*** **Anchor, 1993.**
The definitive guide to the management of our natural resources, with contributions from many leading thinkers on environmental, political, and social issues. A great source of data and graphics.

Novacek, Michael J. ***The Biodiversity Crisis: Losing What Counts.*** **New Press, 2001.**
A representation of different views of the threats to life on Earth posed by the current mass extinction crisis. Published in conjunction with the American Museum of Natural History, the book includes essays by experts, profiles of conservationists, and case studies.

Quammen, David. ***The Song of the Dodo: Island Biogeography in an Age of Extinctions.*** **Scribner, 1996.**
Quammen explains how the isolation of islands makes them hotbeds of both evolution and extinction.

Suzuki, David and Peter Knudtson. ***The Wisdom of the Elders.*** **Bantam, 1993.**
This unique and remarkable book collects the wisdom of the Sioux, Pueblo, Hopi, Navajo, and other native peoples, and juxtaposes it with thoughts from some of the most respected scientists of our time in a stunning synthesis that provides a blueprint for saving the planet.

The Biodiversity Collection: A Review of Biodiversity Resources for Educators. **World Wildlife Fund, 1998.**
A compendium of exemplary environmental education resources that focus on biodiversity. Developed by educators, scientists, evaluators and others, the resources in the book cover K-12 and range from curricula to books, from CD-ROMs to videos.

Tudge, Colin. ***The Variety of Life.*** **Oxford University Press, 2000.**
A survey and a celebration of all the creatures that have ever lived.

Wilson, E.O. ***The Diversity of Life.*** **W.W. Norton and Company, 1992.**
In this essential text, Wilson describes the evolution of the great diversity of species on Earth, the threats posed to this diversity by contemporary human behavior, and the shift in priorities needed to rescue ecosystems from extinction.

Students

Cone, Molly. ***Squishy, Misty, Damp, and Muddy: The In-Between World of Wetlands.*** **Sierra Club, 1996.**
An introduction to the many kinds of wetlands and the incredible variety of life they support. Beautifully illustrated with photographs, this book informs and inspires young readers.

Goodman, Susan E. ***Bats, Bugs, and Biodiversity: Adventures in the Amazonian Rain Forest.*** **Atheneum, 1995.**
Seventy-four seventh and eighth graders from Western Michigan describe, in their own words, a week spent in the Peruvian Amazon.

Pringle, Laurence. ***Taking Care of the Earth: Kids in Action.*** **Econo-Clad Books, 1999.**
This guide to environmental projects describes young people in action, from local improvements such as recycling to raising money for groups to purchase rain forest acreage. Addresses of environmental action groups and governmental officials are included.

Scott, Michael. ***The Young Oxford Book of Ecology.*** **Oxford University Press, 1998.**
Scott shows how plants and animals are designed to survive, how they rely on the natural resources around them, and how they all, ultimately, depend on one another.

Suzuki, David and Kathy Vanderlinden. ***You Are the Earth: From Dinosaur Breath to Pizza from Dirt.*** **Greystone Books, 1999.**
The authors show how we're all connected to each other and all other living things on the Earth, past and present. We learn about ways that some young people have made a difference in the world and how all young people can make a difference.

World Wildlife Fund. ***WOW!—A Biodiversity Primer.*** **World Wildlife Fund, 1994.**
Targeted at middle-schoolers, this full-color magazine helps students understand biodiversity.

For links to biodiversity-related web sites, see the *Lost Worlds: Life in the Balance* web site at www.amnh.org

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Photography and illustration credits: Front cover—*Lost Worlds.* Inside front cover—Filming *Lost Worlds*; [background] Insects, Spectrum of Life, Hall of Biodiversity, American Museum of Natural History (D. Finnin). 1—Helicopter approaching tepui. 2—Small frog (Margarita Lampo); California sea otter (American Museum of Natural History). 3—Food chain (Patricia J. Wynne). 4—*Heliamphora* (Margarita Lampo); black jaguar *(Lost Worlds).* 5—Pitcher plant *(Lost Worlds);* dwarf antelope (American Museum of Natural History); epiphyte (Hugh Raffles). 6—Rain forest diorama, Hall of Biodiversity, American Museum of Natural History (D. Finnin). 7—Water cycle (illustration by Patricia J. Wynne, text by Donald M. Silver); suburban deforestation *(Lost Worlds)*; [background] rain forest canopy (Andrew Sych). 8—Kitchen scene *(Lost Worlds);* sponges, Hall of Biodiversity, American Museum of Natural History (D. Finnin); [background] field of cotton, South Carolina, USA (© Corbis Images). 9—Margarita Lampo (Andrew Sych). 10—Gran Sabana *(Lost Worlds);* [background] river, forest, and tepui (Andrew Sych). 11—Geralyn Abinader (Joel Cracraft). 12—[background] Landscape of a town (© Charles E. Rotkin/Corbis Images). 13—Releasing young fish back into the river (Monterey Salmon and Trout Project). 14—Delivering eggs to the classroom (Monterey Salmon and Trout Project); tub of balls (Silesia Pembleton). 15—Jim Enote (courtesy of Jim Enote). Back cover—*Lost Worlds.*