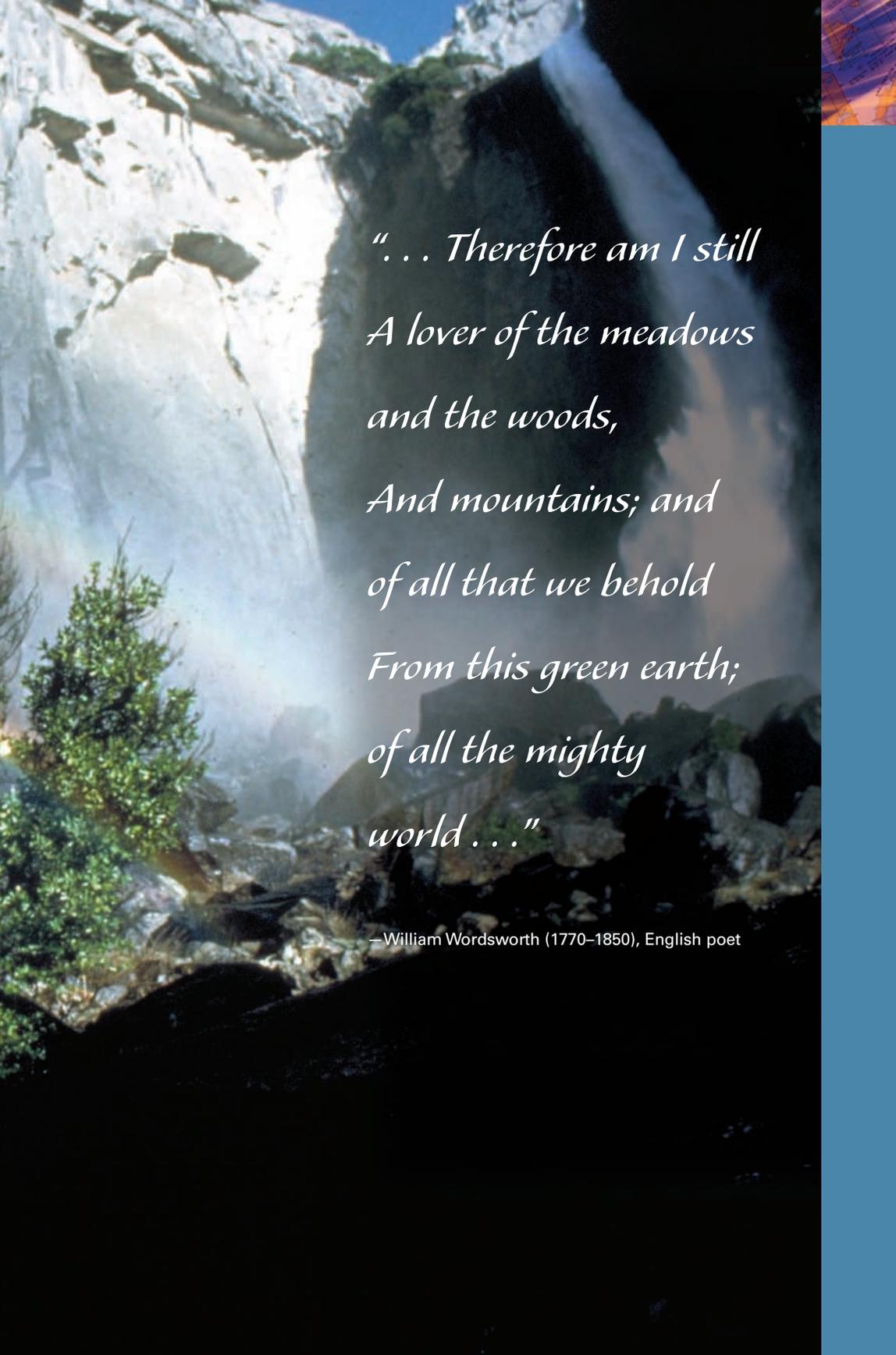


Appreciating Our Environment



*"... Therefore am I still
A lover of the meadows
and the woods,
And mountains; and
of all that we behold
From this green earth;
of all the mighty
world . . ."*

—William Wordsworth (1770–1850), English poet

CHAPTER
27



Understanding Nature

“When we try to pick out anything by itself, we find it hitched to everything else in the Universe.”

—John Muir (naturalist, wanderer, and a founder of the Sierra Club),
My First Summer in the Sierra, 1911



Turning in the rising air, a hawk drifts above a mountain forest. A lizard stands motionless in the shade of a desert cactus. Fireflies in the bushes near a prairie stream light up a humid summer evening. Tides beneath your kayak rise and fall. Geese, whales, salmon, and butterflies follow the calls of distant migrations, while an earthworm in the cool soil burrows a few feet in its lifetime. Overhead, a mere hint of universal expanse twinkles in the past light of galaxies and stars.

The natural world around us is spectacular beyond our wildest imagination. It can be gigantic—towering redwoods, rivers coursing for a thousand miles or more, great herds of animals nearly covering a grassy plain. Nature is tiny, too—the eye of an insect, the veins of a leaf, the microscopic structures of cells, the ecosystems of your neighborhood.

In the eruption of a volcano, the jolt of an earthquake, the roar of a forest fire, and the howl of a storm, nature makes itself known with explosive power. Natural phenomena also can move so slowly that we might notice no change in our lifetimes. Continents drift about the globe at mere inches a year. Through many generations, animals evolve, adapt, and sometimes disappear.

The more we learn about nature, the more we realize how interconnected are its parts. The relationships among plants, animals, and their surroundings are so intricate we can unravel only the most obvious mysteries. Even so, doing our

best to understand our world is essential to the planet's well-being and, ultimately, to our own. It is vital that we make good choices in how we treat nature.

Learning about nature is as easy as getting out into the middle of it with our senses wide open. We can step outside our homes and, wherever we are, nature is all around. Hiking can give us a sense of the shape of the terrain as it rolls beneath our feet. We can discover the folds of valleys, the heights of mountains, the breadth of deserts and prairies. Being outdoors allows us to appreciate heat, cold, wind, and precipitation firsthand. We can hear birds, the rush of water, the songs of frogs, and the drumming of grouse, or perhaps delight in the silence of a moment. Touch, smell, and taste come into play as well, as we feel the textures of stones, note the aromas of flowers in bloom, and savor the sweetness of a mountain huckleberry.

Every outdoor adventure is a doorway opening into understandings of the environment that can be as satisfying and challenging as any other aspect of a journey. In its complexity and simplicity, nature presents us

with an overwhelming certainty that we are sharing Earth with other members of a worldwide community, and that their fates—and ours—are intertwined.

The World Around Us

Gaining an understanding of nature begins with paying attention. Look around. Ask why things are as they are. Start anywhere—watching wildlife near your camp, wondering why the leaves on trees near your school change color in the autumn, poking around a beach at low tide to see what the receding waters have revealed. Enjoy the puzzles and the wonder of the planet we call home. The more you see, the more you will be

aware of what there is to notice. Nature will pull you in, presenting you with some answers and posing more questions. The mysteries are endless, and so is the delight.

You don't have to be a scientist or a scholar to enjoy nature—just interested and willing to ask questions. And you don't need to know scientific names of plants and animals, rock formations, or types of clouds to appreciate what you observe, at least not at first. It helps, though, and over time you will want to read and learn more.

One way to increase your understanding of nature is to look for the larger ways in which nature is organized—the systems, cycles, and chains providing the frameworks of existence.



Learning about nature can be as simple as a walk through a park or as involved as a lifetime career. There are many vocational possibilities in the study and management of natural resources, including fish and wildlife management, forestry, and soil and water conservation. Understanding nature is carried on in a variety of academic fields such as the following:

- **Astronomy**—the study of the heavens and celestial phenomena
- **Biology**—the study of living organisms
- **Botany**—the study of plant life
- **Geology**—the study of minerals, formations, and occurrences in the Earth
- **Meteorology**—the study of weather and atmospheric patterns
- **Paleontology**—the study of life forms and systems through fossil evidence
- **Zoology**—the study of animals



Ecosystems

A *population* is a group of the same animal or plant species living together. A *community* is all the populations of plants and animals in an area. An *ecosystem* is made up of those communities plus their physical surroundings—the land, weather, water, amount of sunlight, and everything else coming together to form the web of life.

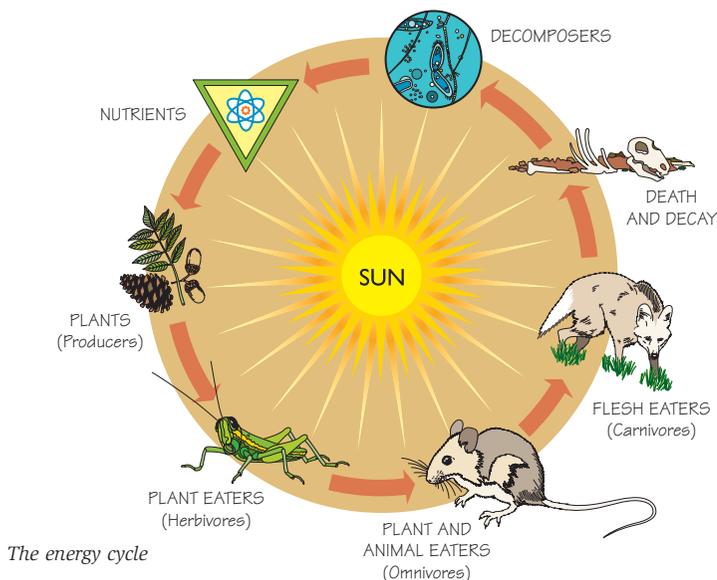
No two ecosystems are alike. Many, however, share general similarities based on their locations, elevations, and other factors. Those similarities enable us to compare one area to another, and help us better comprehend what we are seeing.

Examining ecosystems can help us understand why the principles of Leave No Trace are important guidelines to follow during every outdoor adventure. It also can heighten our awareness of the importance of stewardship—giving something back to the environment that provides us not only pleasure and challenge, but also the basic necessities of life for all species.

For more on exploring ecosystems, see the chapter titled “Observing Nature.”

ECOLOGY

Studying animals and plants in the context of their surroundings is called *ecology*. The term comes from the Greek words *oikos*, meaning “house,” and *logos*, meaning “word” and “reason.”



The energy cycle

Energy Cycles

Living things must have nourishment in order to exist, to grow, and to reproduce. Calories providing that nourishment move through the environment, changing form as they transfer from one being to another. Solar energy propels the cycle. Combined with water and nutrients from the soil, for example, sunshine provides the means for plants to produce leaves.

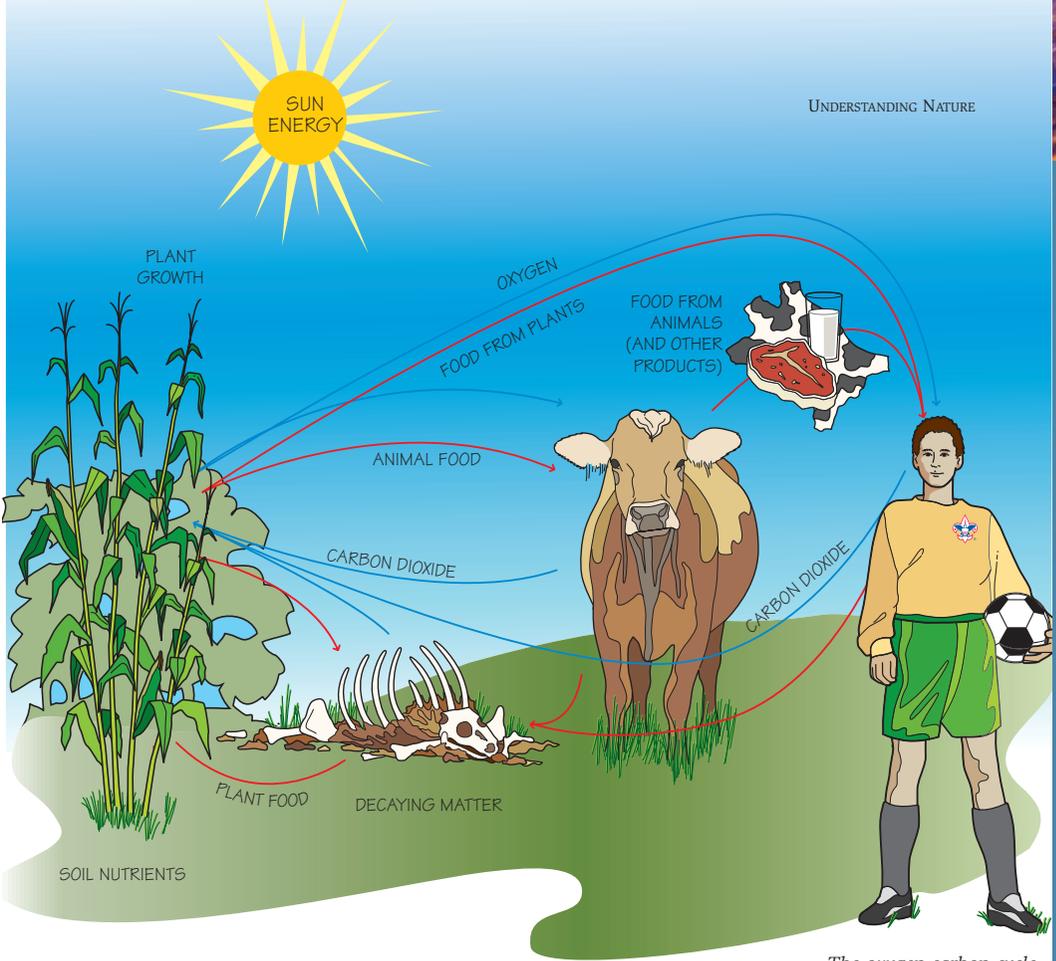
Insects eat those leaves. Spiders snare the insects in their webs and feast on them; the spiders, in turn, are devoured by field mice. Hawks swoop down and make meals of the mice. As the birds die, their remains decay and become nutrients enriching the soil, cycling back into the growth of new vegetation that insects can eat.

Every living organism, humans included, is part of an energy cycle. While all share a common need for nourishment, species have developed nearly endless variations in the ways they have adapted, both to thrive in the environments in which they find themselves and to give shape to the ecosystems of which they are a part.

For more on the complexities of species, see the chapters titled “Plants” and “Wildlife.”

“There is value in any experience that reminds us of our dependency on the soil-plant-animal-man food chain, and of the fundamental organization of the biota.”

—Aldo Leopold, *Sand County Almanac*, 1949 (His writings explore the complexity of the environment and the importance of caring for it.)



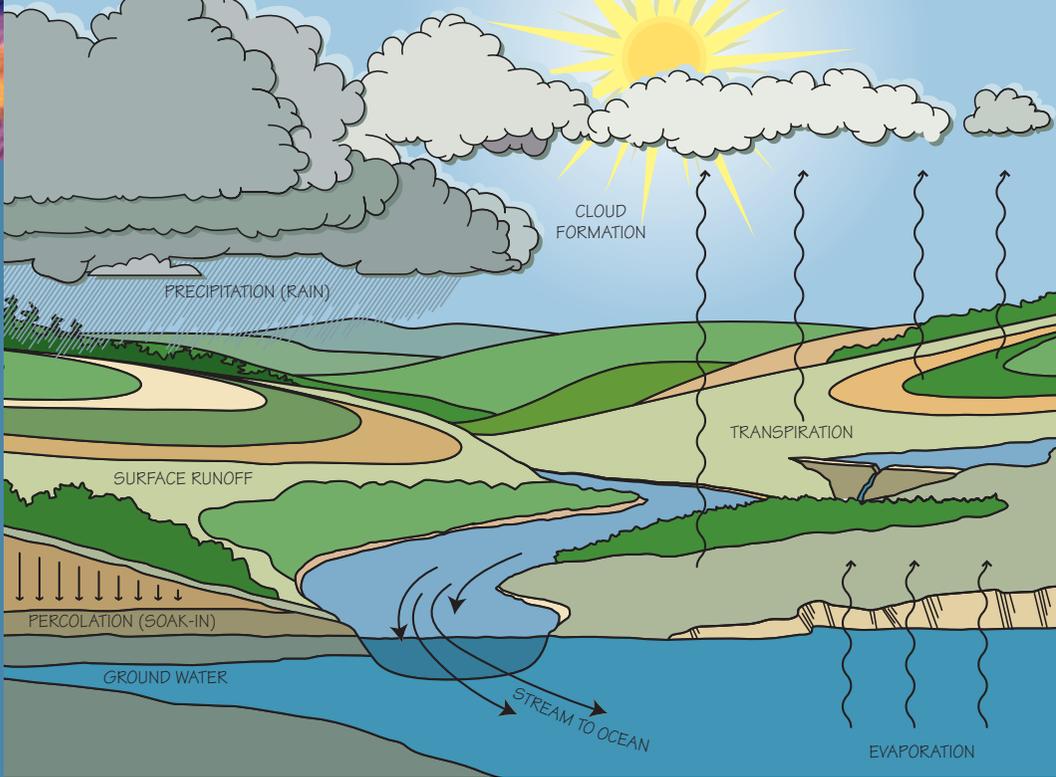
The oxygen-carbon cycle

Oxygen-Carbon Cycle

Animals absorb oxygen, use it in processes that provide energy for their bodies, and exhale carbon dioxide. Carbon dioxide is also produced when plants and animals decay, and when wood, coal, and other carbon-based materials burn.

Plants must absorb carbon dioxide in order to survive. In a chemical reaction powered by sunlight, chlorophyll allows plants to combine water with carbon dioxide to produce the simple sugars that plants use for food. The process is called *photosynthesis*—making something with the aid of light. A by-product of photosynthesis is the oxygen relied upon by animals.

Animals use oxygen and exhale carbon dioxide. Plants absorb carbon dioxide and give off oxygen. Animals and plants are dependent upon one another, interacting in ways that make it possible for many species to thrive. These cooperative arrangements are forms of *symbiosis*—interdependence of species—and are an essential aspect of life on Earth.



The water cycle

Water Cycle

From the driest desert cactus to fluid creatures in the ocean's depths, all living things must have water. Water allows nutrients and gases to pass through the cells of plants and the tissues of animals. It washes away wastes and regulates temperatures. It serves as a means of transportation for many species and a lifelong habitat for many others.

Water circulates through the environment in a cycle that, like the energy cycles and oxygen-carbon cycle, is energized by the sun. Heat from the sun evaporates water from oceans, lakes, and streams. The vapors form clouds that can be carried long distances by the wind. When the air cools or becomes loaded with moisture, the vapor can fall as rain, snow, sleet, or hail.

Much of the precipitation percolates into the soil where it can be absorbed by the roots of plants. Some finds its way into underground aquifers and other natural reservoirs, then rises again to flow from springs or wells. Small streams join together to form rivers returning water to lakes and oceans and, through evaporation, once again to the sky.

As with the intricacies and variety of the energy cycles and oxygen-carbon cycle, the Earth's water cycle interacts with all beings in remarkable, far-reaching ways. Marine scientists, for example, are discovering that water in the Earth's oceans circulates in patterns as profound as air masses overhead. Warmer water cools and sinks as it approaches the Arctic Ocean and Antarctica, and cold, dense currents deep beneath the surface can flow for thousands of miles. Water warming and swelling back toward the surface churns nutrients upward where they can be utilized by great varieties of sea life.

Change/Succession

Nature is forever changing. Regions of the planet that once were sea beds now are prairies, deserts, and mountain ranges. Shifts in the climate have sometimes transformed lush jungles and wetlands into snowfields and glaciers, then changed again to create conditions in which animals and vegetation could thrive. Plants and animals must adapt to meet the challenges of their environments. Species unable to change have disappeared forever—traces of them today are found only in fossils unearthed by paleontologists.

Changes in ecosystems can occur in shorter time spans, too. For example, picture a pond near a forest. Over a period of years, soil washing from hillsides into the water slowly collects along the edges of the pond. Grass seeds carried by the wind sprout in that new mud. As the grasses die, they mat down and decay, creating a nutrient-rich bed for larger rushes and cattails. Increasing numbers of fish and amphibians find safety among the roots and stalks, and insects lay their eggs on the leaves.

The remains of those plants and animals also sink into the mud, building more of the fertile soil and slowly raising and drying the edge of the pond. Shrubs and small trees move in, with slower-growing trees establishing themselves in the shade of trees that have grown more quickly. They, too, will live, die, and form more soil. At last, large trees mature into a stand called a *climax forest*.

The pond might have disappeared completely, and the forest might stand for many years. Change will continue to occur, though. Fire might sweep through the trees, or an insect blight might dramatically alter the forest's composition and appearance, and a new phase of the plant succession cycle will begin.

Change and Diversity

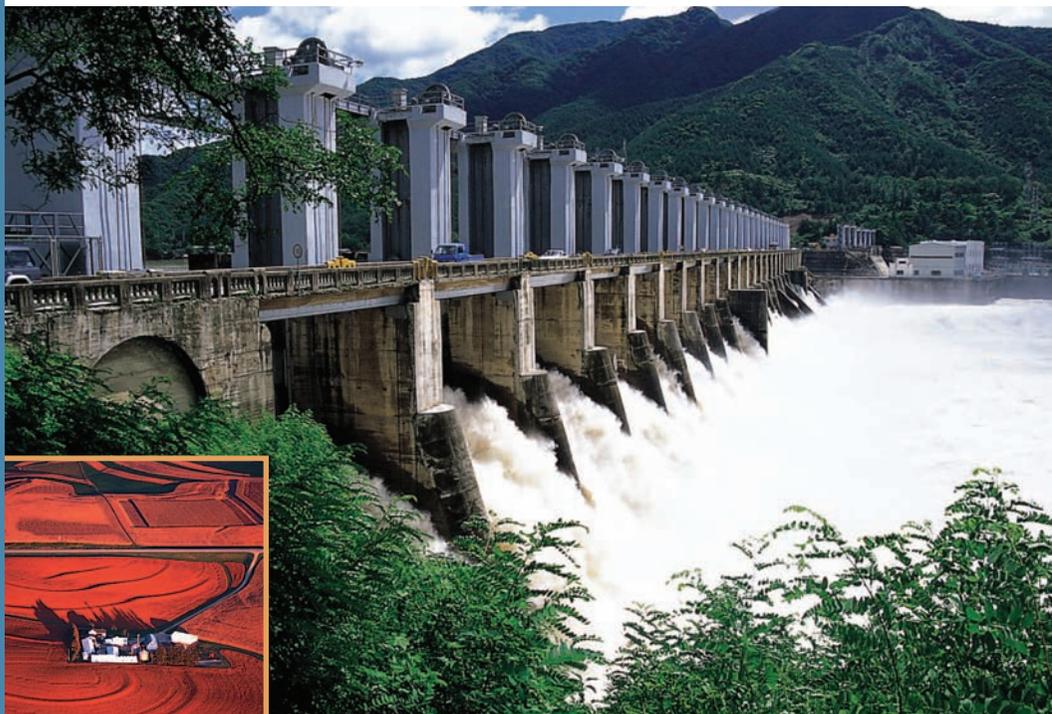
From microscopic bacteria to eagles, bears, wolves, and other predators at the top of a food chain, an ecosystem is healthiest when it is rich in the variety and numbers of species thriving within it. The more species in an area, the more flexible the ecosystem is as a whole, and the better able plants and animals will be to adapt to change. A *diversity* of species—that is, many plants and animals that are unlike one another—provides a storehouse of environmental possibilities, the raw material for adaptation and survival.

For instance, when bees harvest nectar from clover blossoms to make honey, pollen sticks to their legs and they carry it from one clover plant to another. It's a symbiotic relationship that benefits both species. The clover provides nourishment for bees, and the bees play a vital role in the pollination of the vegetation. If bee populations don't survive a harsh winter, though, or if they succumb to pesticides sprayed too near their hives, the clover will have lost a reliable means



of spreading pollen and might not be able to reproduce. Other species dependent on the clover might also go into decline.

A diverse ecosystem might include hummingbirds, insects, and other animals who carry pollen, too. By helping to fertilize the clover, they will have filled the void created by the absence of the bees. If there are no pollen-carrying alternatives to the bees, the clover may be replaced by plant species that don't rely on insects for pollination. Diversity of this sort cushions the effects that change has upon an area, and that increases the stability and health of an ecosystem.



As individuals and as a society, our treatment of the environment is our legacy to the future. Our legacy is up to us.

Human-Caused Change

Healthy, diverse ecosystems tend to be stable and to evolve slowly. Aside from the effects of storms, droughts, volcanic activity, and fire, the forces of nature in forests, prairies, riparian zones, and other environments often take decades or centuries to create perceivable change.

When humans become involved, however, ecosystem change can happen quickly. We can pave open land for highways, parking lots, and developments; and plow under prairie grasses to make way for crops.

Our vehicles, factories, and power plants can pump exhaust into the atmosphere, and the waste products of modern society often find their way into our landfills and waterways. A dam built across a river will generate electricity for dozens of cities and bring an end to annual floods, but it also will alter fish migrations, shoreline vegetation, and the lives of river species for dozens of miles up and down the stream.

Our ability to cause dramatic change carries with it the responsibility to make wise decisions on issues and actions that can affect the health of the environment. While humans are capable of activities that are destructive to ecosystems, we also can do much to conserve and heal the environment.

Small actions matter, and personal choices are important. As individuals, we can become informed consumers and active recyclers. As groups of people, we can work toward creating sustainable communities that exist in harmony with the environment. As citizens of our states and nation, we can learn about the issues and take part in the political processes that determine the fates of our public lands.

For more on caring for the environment, see the *Fieldbook* Web site and the chapter titled “Being Good Stewards of Our Resources.” 

Wilderness Recreation

The national park system came into existence to protect America’s natural and cultural heritage. The USDA Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Soil Conservation Service, and other federal, state, and local agencies were established with the goal of managing America’s natural resources with conservation stewardship that endures long-term sustainability for future generations. Many legislative mandates have attempted to guide our relationship with the environment. Among the most striking is the Wilderness Act, passed by Congress in 1964, to set aside large tracts of unspoiled lands to be protected in their natural states.

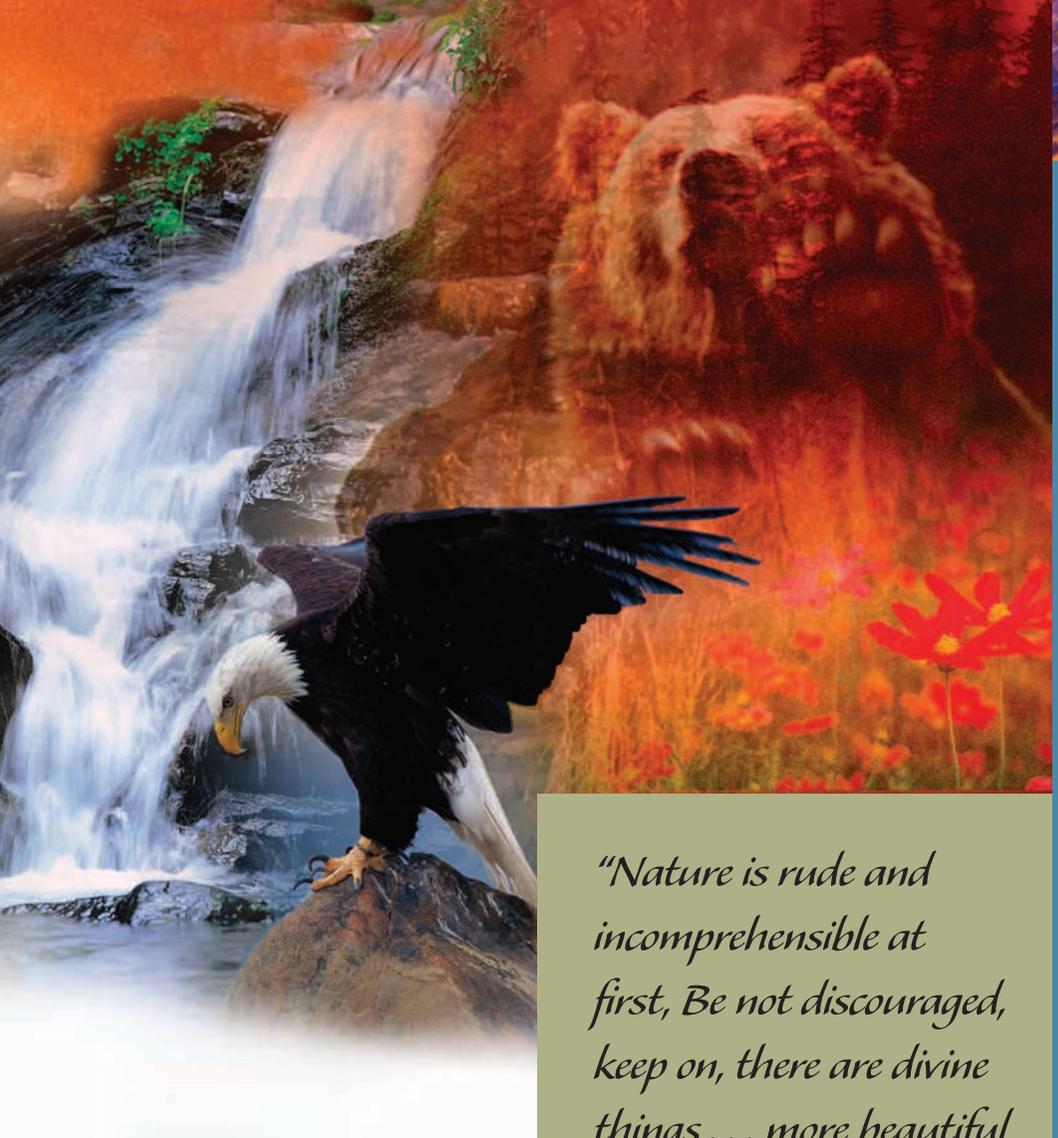
“A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.”

—from the Wilderness Act of 1964,
U.S. Congress



As a result of the Wilderness Act of 1964, Congress established the National Wilderness Preservation System to protect some of America's remaining wild lands. To be considered wilderness, an area had to be at least 5,000 acres in size. No public roads could penetrate it, and it could have no significant ecological disturbances caused by human activity. The intent of Congress is that people should be able to see and enjoy environments unchanged by the influence of humans.

Identifying wilderness areas is one way to help preserve environmental complexity and diversity to the greatest extent possible, and to allow the processes of nature to run their courses. Wilderness landscapes give us examples of how the environment functions when we leave it alone, and that can help us better understand and manage areas that have been developed. Wilderness also serves as an environmental bank account, preserving a storehouse of species and systems that might otherwise disappear.



In addition to its infinite scientific value, wilderness can nourish the human spirit and refresh the soul. By bringing us close to nature undisturbed, to these remnants of our once-wild continent, wilderness allows us to recognize and cherish the complexity of ecosystems everywhere and to act with the best interests of the environment foremost in our minds.

For more on understanding nature and discovering hands-on ways to protect and improve the environment, see the other chapters in the “Appreciating Our Environment” section, especially “Examining the Earth.”

“Nature is rude and incomprehensible at first, Be not discouraged, keep on, there are divine things . . . more beautiful than words can tell.”

—Walt Whitman (American poet), “Song of the Open Road,” 1856