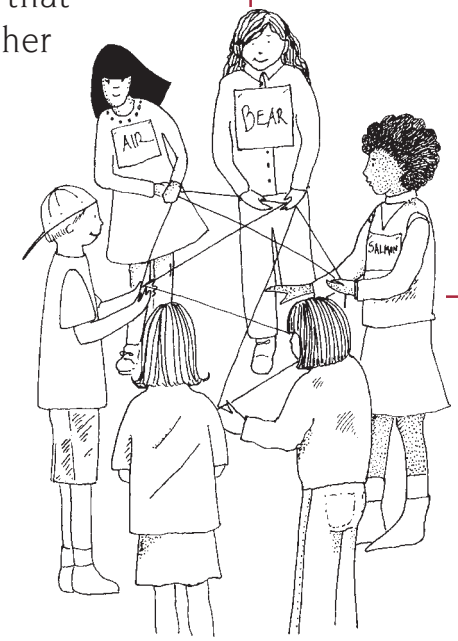
Human Impacts on ECOSYSTEMS

In tracing the web of connections within an ecosystem, ecologists are explaining how changes in the nonliving environment affect every living member of that ecosystem – because all things interact, either directly or indirectly.



PHYSICAL CATALYSTS

Alaska has an example of ecological change in geologic time and scale. Until 13,000 years ago, much of the world's northern areas were covered by glaciers and ice sheets while the interior of Alaska was ice-free. Woolly mammoths and steppe bison thrived in this grassland steppe ecosystem.

Prehistoric Global Warming. As the climate warmed over thousands of years, the ice sheets melted and the glaciers retreated. Grassland steppe ecosystems gradually became forests and tundra ecosystems. Some scientists theorize that woolly mammoths and other prehistoric animals could not adapt to life in forests, and therefore became extinct.

Similarly, but on smaller scales and shorter timeframes, flooding, drought, volcanic eruptions, fire, and earthquakes can change local ecosystems.

Quakes Shake Ecosystems. Alaska's 1964 earthquake uplifted some lands and drowned others, so each area is changing to organisms that can survive in different water regimens – wetlands changing to shrubs along the coast of the Copper River Delta; forests and former townsites turned into tidal marshes at old Valdez and along Turnagain Arm.

BIOLOGICAL CATALYSTS

Sometimes an animal's abundance triggers an ecological change. The spruce bark beetle is one recent example.

The Beetle that Roared. Weather and other natural factors allowed rapid expansion of this parasitic beetle's population. In mass, they kill large white spruce by boring into the trunk to feed and lay their eggs. Large numbers overwhelm a tree's normal defenses. Next spring all those newly hatched beetles fly to more trees and soon a forest is under siege.

Miles and miles of spruce forest in Southcentral Alaska fell victim to the swarms. As a result, the forest ecosystem is changing. Former dense spruce forests are becoming grassy meadows or changing to birch and aspen-dominated forests.

Caribou Migrate for a Reason. Alaska's caribou herds are another example of population explosions changing an ecosystem.

Caribou, always on the move, migrate hundreds of miles each year. As they move, they graze on plants and lichens. By this habit, they don't eat all their favorite plants in one area nor crush the fragile lichen that take decades to grow.

When caribou populations expand rapidly, a population crash is usually not far behind. Too many caribou eat or destroy their food sources, leading to low reproduction and starvation. They leave an ecosystem out of balance, with plant communities depleted and predators looking for new prey.

HUMAN CATALYSTS

Throughout our history, we have records of human caused changes in ecosystems. From extinction of species (the Steller's sea cow in Alaska, for example) to clearing a forest or filling of wetlands.

Oil Spill Starts Changes. The Exxon Valdez oil spill in 1989 introduced about 11 million gallons of North Slope crude oil into the marine ecosystem of Prince William Sound and west along the Gulf of Alaska to the Alaska Peninsula. Many kinds of wildlife immediately began washing up dead or dying on the beaches.

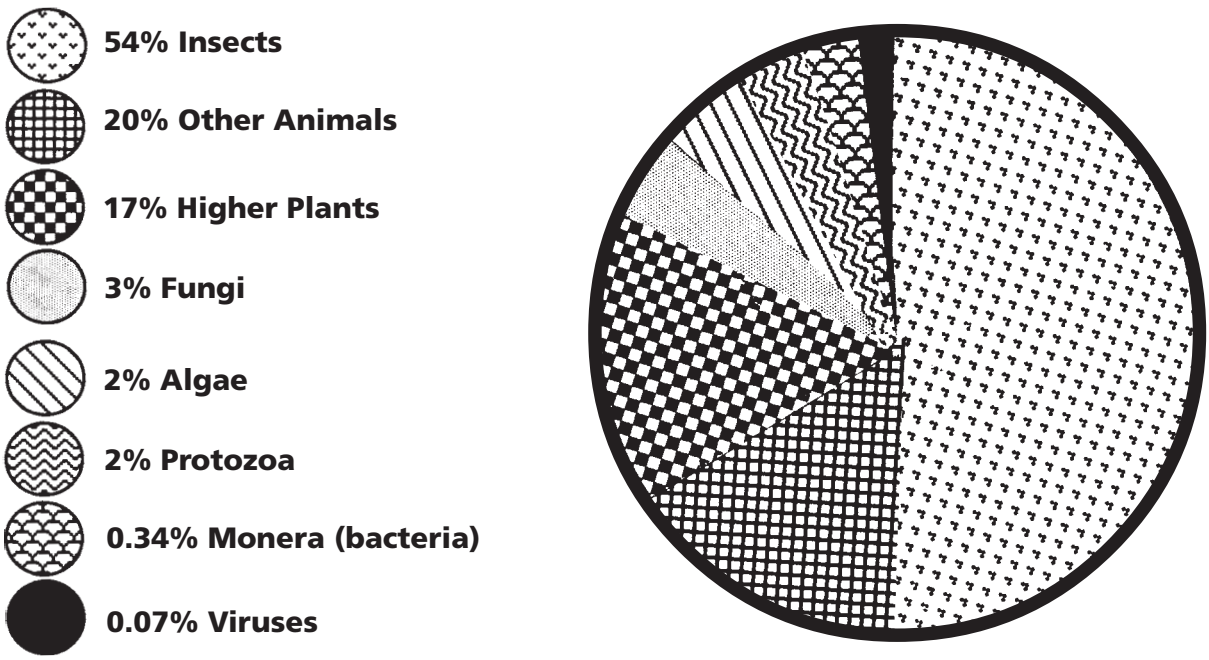
Shaking the Whole Food Web. Less visible were the deaths and changes in health of the many invertebrates and microscopic organisms so vital to the smooth running of an ecosystem. Because they are the foundation for all other consumers, their losses or damage continued to be felt years after the spill.

Are the Effects Over? In addition, hydrocarbons of oil remained present in the substrate of beaches and in the water column. Scientists continue to study and puzzle over the ecological changes.

(See the Alaska Oil Spill Curriculum published by the Prince William Sound Science Center for student activities and further background.)

Biodiversity Kingdoms

Source:E.O.Wilson.Biodiversity.1988(Washington,D.C.Nat'lAcademyPress)



Other examples of human-caused changes in ecosystems can be found in the fact sheets with the student activity "Ecology Puzzlers" in Section 4.

BIODIVERSITY – SIGN OF HEALTHY ECOSYSTEMS

The variety and abundance of living organisms in an ecosystem or habitat determine its **biological diversity** or **biodiversity.**

Why is Diversity Important? Like the old saying "variety is the spice of life," a diversity of plants, animals, and microscopic organisms fills all the "jobs" in an ecosystem.

Abundance and variety of parts give an ecosystem flexibility. That flexibility insures the smooth and continued functioning of the whole as, over time, an ecosystem is buffeted by change and damage.

Radiating Effects of Loss. Nevertheless, since all living things are connected to others in their ecosystem, impacts have a radiating effect. Removing a species shakes the whole web of life.

Scientists are still learning about all the interactions in ecosystems. Our decisions and actions regarding wildlife today may have consequences tomorrow that we do not currently understand.

Habitat Key to Diversity. The greatest threat to biodiversity is loss of habitat. Destroying habitats can threaten the extinction of species and the destruction of entire ecosystems. Humans are reducing the world's biodiversity at an increasing rate. In the United States scientists estimate that more than 125 types of ecosystems are either threatened or endangered.

CONSERVATION – USE FOR THE FUTURE

Conservation is the *use of mineral, plant, and animal resources in a way that assures their continuing availability to future generations.*

Two Categories of Resources. Resources are **renewable** if they have the capacity to replenish themselves over time through natural processes. Solar energy and wind are examples of inexhaustible resources. Pure water, plants, and animals are renewable resources – provided humans practice conservation and do not pollute or consume them faster than they are naturally reproduced.

Nonrenewable resources are limited in supply and can only be replaced in geologic time, not human time. Examples include oil, coal, copper, and gold. They require humans to think and conserve for *all* future generations.

THE BIODIVERSITY OF ALASKA

How many species ... a sampling

	ALASKA	WORLD
Amphibians	6	+4,200
Birds	452	+9,000
Fishes	430	+18,800
Mammals	108	+4,000
Plants	+1,500	+248,000
Reptiles	0	+8,300

NO HUMAN IS EXEMPT

People often see themselves as separate from the surrounding wilds. Like all other living things, however, humans are a part of the Earth's ecosystems.

Can We Do Without Land, Oxygen, Food? We need water, minerals, and air from the nonliving environment. We need plants and algae to produce oxygen and maintain the composition of our atmosphere. We also need these producers to make food for animals and ourselves.

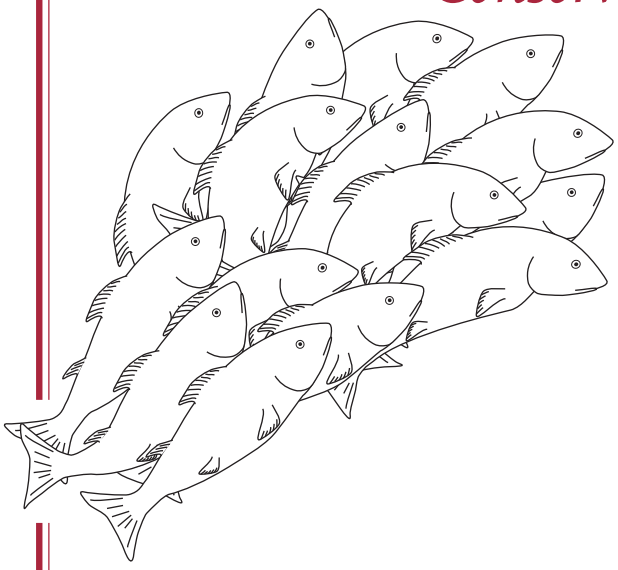
We depend on plants to reduce soil erosion, moderate our climates, and maintain the water cycle. We depend upon nitrogen-fixing bacteria and denitrifying bacteria to maintain the nitrogen cycle.

Global Garbage Recyclers. We need other bacteria and fungi to break down waste materials to replenish the soil for plant growth. About 80% of each year's biological production (leaf litter, dead animals, fecal wastes, for example) is ultimately broken down by **detritivores**. Without detritivores, all that biomass would accumulate in a mountain of waste.

Humans also use certain chemicals produced by bacteria, fungi and other organisms as medicines. We need many of the materials made by plants and animals for clothing, shelter, and tools (*for example, wood, paper, cotton, silk, wool, rayon, rubber, certain oils*).

Balance in the System. We also depend on predators, parasites, and disease-causing microscopic

Conservation Case Study



What does it take to ensure a future for something we value? Let's look at salmon. During the life cycle of a salmon, it uses the following ecosystems:

- Clean, cool **streams** water and gravel beds (where the salmon eggs are laid and hatched).
- Unobstructed, clean **rivers** that the salmon use to migrate to and from the sea.
- Food-filled, unpolluted **ocean** (where the salmon feed and grow to adult size).

The salmon also depends on the following nonliving and living parts of these ecosystems:

- Non-acidic rain water (to fill the stream and river).
- Organisms that produce the oxygen in the water (so the salmon can breathe – phytoplankton and aquatic plants).
- Shrubs and trees that grow beside the stream (to provide cover and shade that keeps water cool)
- All the living things the salmon eat (stoneflies and other aquatic insects – after salmon hatch; herring and sand lance – as adults)
- The organisms that feed these prey species (dead plant materials and zooplankton)
- Detritivores that recycle minerals, the animal pollinators and seed carriers, and the fungi or bacteria that help them obtain certain minerals.

Thus, if we intend to conserve salmon populations, we must also conserve the entire ecosystem in which they live.

organisms to keep populations of other organisms in check. *Predators, parasites and disease-causing micro-organisms also effect humans, but not enough to limit human population growth in modern times.*

Changes in the earth's ecosystems, therefore, have direct effects on people as well as all other living things. Even an activity that seems to affect only insects, only fungi, only the upper atmosphere, or only ground water supplies can have far-reaching consequences. Can we live with each change or the cumulative effects of many changes? What kind of environment will future generations inherit?

SOLVING PROBLEMS LOCALLY

If your students notice something is askew in the ecosystem around your school, then you have a great opportunity to make learning both tangibly productive and fun. Your class can transform creative thinking into problem-solving actions that make a difference in your school and your community.

Ecology contributes to the understanding of environmental problems.

I *Can Make a Difference*! Students should not feel responsible for solving all the world's problems. But that doesn't mean they can't try to solve some. Vital steps that give students a feeling of "I can make a difference" include the following.

- **SINGLE PROBLEM**: Allow students to choose a single problem to solve.
- **MANAGEABLE FOCUS**: Help students keep the size of the problems manageable.
- **BUILD SKILLS**: Help students build the skills they need for accomplishing each step.
- **TIME:** Give students time and resources to work on their problem.
- **SUPPORT**: Help students gather community support.

Perhaps the school uses disposable packaging for school lunches. Students might propose that the school purchase reusable plates and a dishwasher, and look for ways to raise money to purchase them.

Perhaps your town or village has a problem with drinking water pollution by leaking gas storage tanks. Students could mount a campaign to encourage clean-up and prevention of leaks.

Perhaps your community has a problem keeping garbage away from bears. Students could survey possible solutions such as incinerator installation or bear-proof cans or dumpsters.

Problems that seem small, such as moose browsing in a playground near young children, may be excellent research subjects that lead to resolution by the students. Students could solve the moose problem by providing moose with better access (for example, snow removal) to an alternative browse area. Trees and shrubs that attract moose could be replaced by plants less attractive to moose.

Chosen (Owned) by Students. Whatever the problem, it is important that it be identified by students. Teachers may think a particular project is fascinating, but it does not capture the interest of students. Then the teacher gets exhausted trying to motivate and invigorate their class.

Ask students to look around their ecosystem and see if there's anything that bothers them. Their own energy can be limitless (while your energy may not be!).

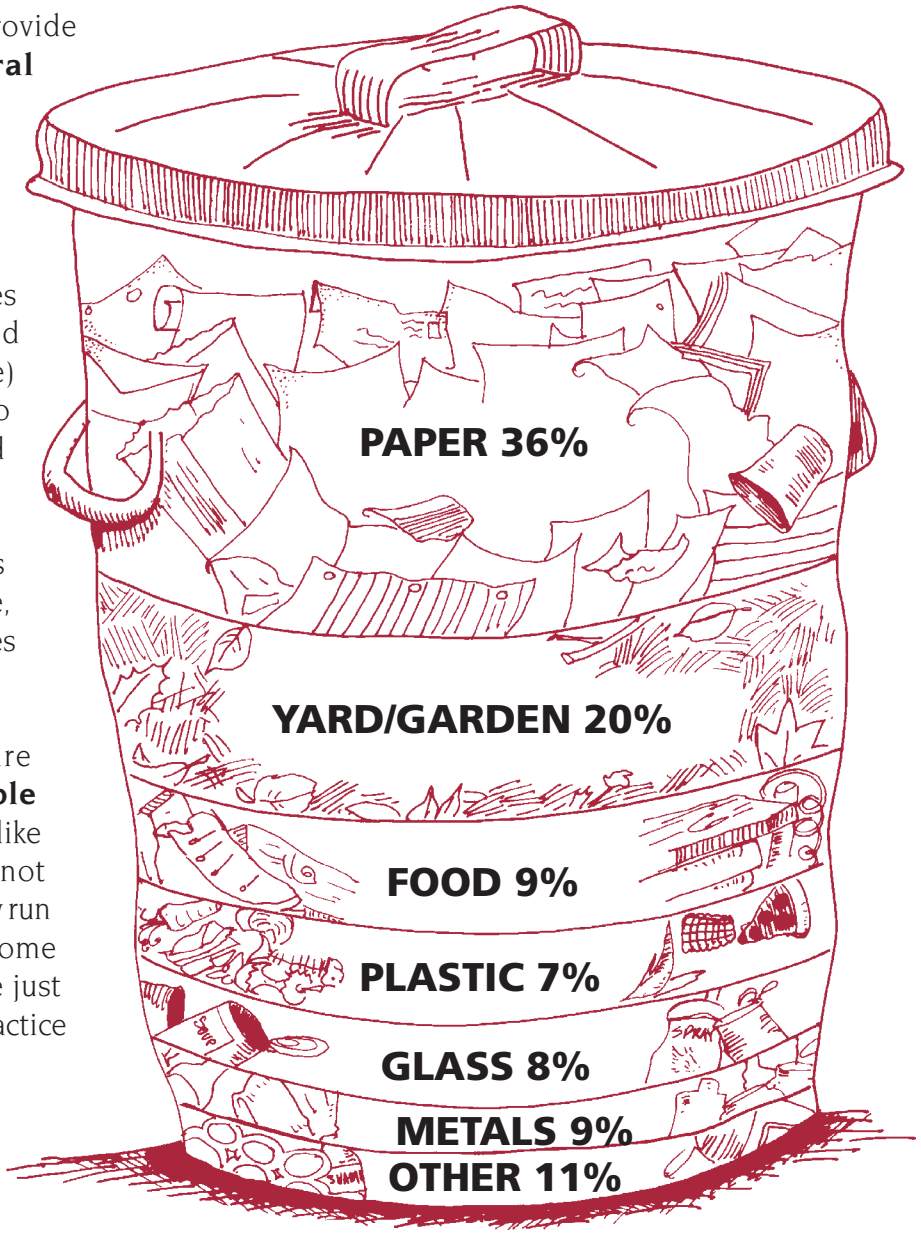
ECOLOGY FACTS – WATCHING YOUR WASTE

Our human population has grown so large that the amount of garbage we produce overwhelms the population of naturally-occurring **detritivores** that decompose and recycle dead things.

Detritivores are absolutely essential to **ecosystems** because they provide renewed sources of **mineral nutrients** and help keep our surroundings clean. But they cannot keep up with our wastes without our help.

The average American generates about 1,300 pounds of solid waste (other than bodily waste) each year. This material has to go somewhere! Much of our food and sewage waste is recyclable back into the soil with detritivore help. But humans produce a lot of **synthetic** waste, such as plastics, that detritivores don't eat.

Many synthetic goods are produced from **nonrenewable resources** (limited in nature like aluminum). If materials are not recycled, future generations may run out of them. We can make some waste items available for reuse just as the detritivores do if WE practice recycling.



Solid Waste in Anchorage, Alaska

Statistics reported by Anchorage Recycling Center, Anchorage, Alaska