HUMAN IMPACT ON THE NATURAL ENVIRONMENT

Nature provides us with food, energy, medicine, recreation, and raw materials. Balancing human needs with preserving the natural environment is essential to our survival, but pressure on the environment from humans is greater than ever before, and the relationship is out of balance. Scientists tell us that we are at the tipping point; that the need for a change in our attitudes and behavior is urgent. We have the power to make a different choice than previous generations. We can choose to have a positive impact on the natural environment and, in so doing, save our home for ourselves and for the generations that will follow.

"A species cannot occupy a niche that appropriates all resources—there has to be some sharing. Any species that ignores this law winds up destroying its community to support its own expansion." Janine M. Benyus, *Biomimicry: Innovation Inspired by Nature*.

HISTORY OF HUMAN IMPACT

In most regions of the world, hunting and gathering survival techniques were replaced by farming, and then by intensive agriculture, each step resulting in greater depletion of the natural environment. Housing development, industry, transportation, and mass tourism have all had a negative impact on forests, mountains, air, and water. Wildlife are disturbed by our noise, air, and water pollution, and we remove them from their wild homes and use them for our own needs and desires. (See Fact Sheets: Animal Experimentation; Companion Animals; Marine Mammals.)

The expansion of human activities in the form of urbanization, recreation, industrialization, and agriculture encroached further and further into the natural environment, causing the fragmentation, isolation, reduction, or complete disappearance of these habitats. Downsized habitats support smaller and smaller populations of nonhuman species, reducing genetic diversity and weakening the gene pool. Human projects are planned and implemented so quickly that species do not have time to adapt, and they often cannot survive.

AGRICULTURE, ENERGY, AND INDUSTRY

The human population on the planet has soared, and because of our current dietary choices, so has the demand for animal products. The resulting increase in animal agriculture has necessitated a dramatic increase in grain production to feed to the animals. This production is subsidized by the government in many parts of the world.

Modern intensive agriculture is the leading cause of rainforest deforestation, as trees are razed and burned to make grazing land for cattle. In addition to destroying animals' homes, deforestation also reduces oxygen output on the planet and potentially eliminates valuable medicines. According to the United Nations, animal agriculture is the second leading cause of global warming. (See Fact Sheet: Animal Agriculture.)

At our present rate of growth, the human population will reach 10 billion by mid-century. As the human population increases, so does our use of and dependence on the planet's energy sources (fossil fuels, biofuels, solar power, wind power, geothermal power, and so on). Extracting, processing, refining, transporting, and providing energy to the end user (fuel in cars, for example) all affect the environment. Agriculture and industry are heavy consumers of non-renewable resources. (See Lessons Plans: Eating Sunlight; Everyday Acts; Trash Investigators; What Is Your Message; World Without.)

Industrialized nations use far more resources per capita than less industrialized, more populated nations: the U.S. has only 5% of the world's population, for example, but consumes 30% of its

resources. Because developing countries emulate industrialized nations, their energy use will grow exponentially and will ultimately exceed the limits of the planet's resources.

Other human activities that add to the stress on the natural environment include the following:

- Draining wetlands to create more land on which to build structures for humans.

- Industrializing fishing, which pollutes waterways, destroys coastlines, and reduces the variety of marine species.

- Planting monocultures instead of a variety of plants, thereby reducing crops' resistance to pests and weather changes.

- Depleting essential topsoil, which is nonrenewable, so it is blown away by wind and washed away by rain; mowing too close to streams, causing erosion on shores.

- Intensively using fertilizers, herbicides, and pesticides, and pouring sediment, pesticides, and fertilizers into waterways, killing delicate marine life. Since 1945, pesticide use in the U.S. has risen 3300% to 1 billion kilograms (2.2 billion pounds) annually. Pesticides have made agriculture the number one polluting industry in the U.S., poisoning our groundwater, which supplies half the U.S. population with drinking water and which is nearly impossible to clean once contaminated. Pests have developed resistance to pesticides, so crop loss to pests has increased 20 percent, while our soils have become less productive.

- Building hotels, restaurants, stores, and boardwalks on beaches, where waterbirds nest, lay eggs, and raise their chicks, removing their habitat and endangering these species. Off-road vehicles and municipal vehicles collecting trash and policing the area also run over eggs and chicks, and non-native predators such as cats and dogs introduced to beach areas, as well as other predators such as raccoons, foxes, crows, seagulls, and skunks, eat bird eggs and baby chicks. These animals proliferate when people unwittingly provide them with food in the form of garbage, restaurant scraps, handouts, and food left behind on the beach.

- Improperly discarding plastic shopping bags and tops from six-packs of soda and other beverages, causing birds and marine mammals to get caught in them and choke to death or become unable to fly or catch food.

FROM RAINFORESTS AND BOREAL FORESTS TO CORAL REEFS

What happens when we destroy a major link in the web of life, such as a forest or a coral reef?

When rainforests are logged for lumber or burned to create grazing land for cattle, we lose habitat for many species, oxygen-producing/carbon dioxide-ingesting trees, potential sources of medicine, and topsoil because of erosion. When a boreal (northern, subarctic) forest, such as those in Canada, is logged, greenhouse gases trapped in soil and in vegetation are released into the atmosphere, accelerating global warming.

Higher temperatures and drought caused by global warming are killing trees. In the western U.S., drought has weakened trees so they are less resistant to parasites (beetles), which kill them. In parts of Africa studied, 1 in 6 trees died between 1954 and 2002, and some species disappeared altogether. Trees that require more moisture were affected most.

Logging also makes the forest more susceptible to insect outbreaks by reducing the variety of ages and species of trees, and this in turn makes forests more susceptible to wildfires. Fires spread fastest and burn hottest in dry, windy conditions when the temperature is high. Thinning

the forest allows more open spaces for the sun to heat it up and dry it out, causing heat stress, and allows the wind to penetrate the forest. In hot weather, trees evaporate more moisture from their leaves and needles, further drying the wood and soil. Widespread forest or peat fires can cause a sudden, massive release of greenhouse gas emissions, referred to as a "carbon bomb."

Coral reefs, sometimes called the rainforests of the ocean, are among the earth's most diverse ecosystems. These beautiful living structures support over one-quarter of all known marine life, and they protect coasts from the impact of waves and ocean storms. Many human activities threaten the survival of the reefs:

- Ocean acidification caused by global warming—the ocean acts as a "carbon sink," absorbing excess carbon dioxide from human activities, but an overabundance of carbon dioxide is causing the oceans to become acidic, killing the coral.

- Rising ocean temperatures have an even greater effect on coral reefs than acidification. In 2005, the surface temperature of the ocean in the Caribbean stayed at record high levels for over three months, causing up to 60% of corals to die in some locations. Most bleached, expelling the symbiotic algae that feed them, turning once colorful reefs into white skeletons.

- Pollution from coal mining and agricultural runoff—silt and phosphorous from mowing, fertilizers, and also cleaning products wash into waterways and flow into the ocean, encouraging the growth of sunlight-blocking algae. Without sunlight, photosynthesis cannot occur and the reefs are deprived of oxygen and die.

- Overfishing, blast fishing, and the digging of canals and access ways into islands and bays—all these activities harm the reefs. Fishermen in the South Pacific and Southeast Asia stun fish with cyanide, then tear reefs apart to capture the fish. Cyanide kills coral polyps, beneficial algae, and small organisms essential for healthy reefs. Blast fishing creates shock waves that can destroy the reefs.

- Tourism—even touching the reefs slightly can harm them, as does taking souvenirs made of coral. Corals take decades to grow again.

WHAT CAN ONE PERSON DO?

The most powerful impact each of us can have is through our lifestyle choices. (See Lesson Plan: Everyday Acts.) A lifestyle based on conscious, sustainable, compassionate consumer choices has an immediate impact and influences those around us. History has repeatedly shown that a small group of dedicated people can affect an entire society's attitudes, beliefs, and customs.

Choosing to support only industries that do not needlessly harm the environment and other species is a powerful step. What we wear, eat, use for entertainment, and the goods we purchase all have an impact. We can choose products and actions that cause the least harm. Simple acts like carrying a reusable shopping bag and reusable water bottle have a huge impact when multiplied by all the people on the planet.

Above all, we can learn a new way of relating to nature—by respecting and learning from it instead of attempting to dominate it. This attitude is reflected in the new science of biomimicry (from *bios*, meaning life, and *mimesis*, meaning to imitate), which copies nature's forms, processes, systems, and strategies to solve human problems sustainably.

A NEW RELATIONSHIP WITH NATURE, A BETTER WAY TO SOLVE PROBLEMS

Biomimicry asks us to view and value the natural world for what we can learn from it instead of for what we can take from it, according to Janine Benyus, author of *Biomimicry: Innovation Inspired by Nature*. In place of harvesting animals or domesticating them to work for us, biomimicry consults organisms and ecosystems and applies their underlying design principles to innovations that will benefit humans.

After 3.8 billion years of evolution, the planet's inhabitants (plants, animals, and other organisms) have learned what works and what endures. Rather than search for entirely new solutions to our energy, transportation, food production, or climate control problems, biomimicry scientists look to nature's engineers—the living organisms—for existing solutions and copy them. For example, studying how a leaf takes in and processes sunlight inspired the creation of a solar cell to heat our homes.

Nature meets the needs of the earth's inhabitants while simultaneously taking actions to preserve the planet for future generations, like building soil and cleaning air and water. Nature operates by certain laws, strategies, and principles shown to be successful in creating conditions in which life can prosper. Healthy ecosystems, such as redwood forests, tidal marshes, coral reefs, and prairies:

- Run on sunlight
- Use energy efficiently
- Fit form to function
- Recycle everything (waste is another resource, so nothing is wasted)
- Reward cooperation
- Diversify to fully use available habitat
- Rely on local expertise
- Curb excesses

Companies throughout the world are beginning to understand that we should copy nature's way. Here are just a few examples:

- Using a system referred to as industrial symbiosis, four companies in Kalundborg, Denmark, share waste, energy, and resources in a prototype "eco-industrial park." Waste steam is piped from one company to power the engines of two others. Another pipeline delivers the remaining waste steam to heat 3,500 homes in the town, eliminating the need for oil furnaces. Waste steam from the power company heats another company's fermentation tanks, which produce insulin and enzymes, creating 700,000 tons (635,000 metric tons) of nitrogen-rich slurry annually. Instead of dumping the slurry into the fjord—the old way—farmers now use it (free) as fertilizer for plants, which are harvested to feed the bacteria in the fermentation tanks. Waste gas that used to go up a smokestack is purified. Some is used internally as fuel, some is piped to the power company, and the rest goes to the wallboard maker next door. And so on.

- Do Nothing or Natural Farming in Japan uses no machines, no prepared fertilizer, no chemicals, and almost no labor (throwing down straw left from the crops replaces weeding), yet it produces yields equal to or greater than that of the average Japanese farm. Farmer Masanobu Fukuoka said it took him 30 years to mimic nature's simplicity, and since then, natural farming has spread throughout Japan and to a million acres in China. Rice, clover, and barley are grown in the same field for many years without damaging soil fertility, and they are self-fertilizing and self-cultivating. In his book *The One-Straw Revolution*, Fukuoka wrote that, forsaking reliance on modern agricultural techniques and human cleverness, he joined in alliance with nature's wisdom.

- New laws in Europe will require companies to take back their durable goods (refrigerators, washers, cars), so it is in the interest of the companies to design products that will last a long

time or that will come apart easily for recycling or reuse. This type of asset recovery can save companies millions of dollars. In Germany, companies must take back all their packaging or hire middlemen to recycle their packaging for them. Packaging currently made from many materials will be made from only one, and it will be marked with a universal material code, making it easier to recycle, so less will go to landfills. Being green is good for profits.

“We have to adapt to the earth, not the other way round,” writes Benyus. “All native cultures that have survived have acknowledged that nature knows best, and have had the humility to ask the bears and wolves and ravens and redwoods for guidance….All our inventions have already appeared in nature in a more elegant form and at a lot less cost to the planet.”

THE FUTURE—MIMICKING NATURE’S MODELS

Scientists who understand the importance of biomimicry are changing the way we find solutions to human problems. For example:

- Studying mussels to learn how to make packaging that dissolves on cue (timed degradation). The threads that attach mussels to rocks dissolve after two years.

- Studying mother-of-pearl shells to learn a self-assembly process that can be applied to many other processes. How are these shells, twice as tough as our high-tech ceramics, formed from seawater in or near the organism’s body, rather than in a kiln? Can we mimic this process to make a self-assembling coating process for ceramics that works at room temperature, or to assemble computers that protect themselves like an immune system and do not use silicon chips that leak carcinogens into our water, or to spray the precursors to a solar cell onto a roof and have it self-assemble into a layered structure? Can we mimic the protein that stops scaling in seashells (made of calcium carbonate) to stop the buildup of minerals (also calcium carbonate) in pipes?

- Studying Namibian beetles and crustaceans called pill bugs to learn how to pull water from fog or from the air to quench our thirst.

- Studying organisms who endure for long periods without water, like the tardigrade, a one-millimeter-long (0.04 inch) aquatic animal, to make (for example) dry vaccines that require no refrigeration. The tardigrade, or water bear, is found in habitats ranging from the Arctic Ocean to tropical forests. Some live on lichens, mosses, leaf litter, soil, or the grains of sand on a beach. Their cells contain sugars that allow them to dry up and contract into a barrel shape when conditions are unfavorable, resisting high pressure, radiation, and extremes of temperature over long periods of time. Live tardigrades have been regenerated from dried-up mosses more than 100 years after being collected.

- Studying locusts' sensing/responding neurons to learn how to create collision-avoidance circuitry for cars. There can be 80 million locusts in one square kilometer (0.4 square mile), but they never collide, while there are 3.6 million car collisions a year in the U.S. alone.

- Studying the tubercles on the fins of whales, which increase efficiency of movement by 32%, for fossil fuel savings.

- Studying ecosystems like prairies to learn how to increase land fertility, thereby increasing the capacity of the planet to create opportunities for life. For example, there is eight times as much runoff from a wheat field as from a prairie.

- Studying how bees locate the shortest route between flowers in different locations faster than a computer, to improve networks such as traffic flows, internet information and business

supply chains.

Resources

Fact Sheets:

Animal Agriculture
Animal Experimentation and Xenotransplantation
Animals in Entertainment
Companion Animals

Books:

Benyus, Janine M. *Biomimicry: Innovation Inspired by Nature.* New York: Harper Perennial, 2002.

Garlough, Donna, Wendy Gordon, and Seth Bauer. *Green Guide: The Complete Reference for Consuming Wisely.* New York: Random House and National Geographic, 2008.

Gladwell, Malcolm. *The Tipping Point: How Little Things Can Make a Big Difference.* New York: Back Bay Books, 2002.

Wuerthner, George, ed. *The Wildfire Reader: A Century of Failed Forest Policy*. Sausalito: Foundation for Deep Ecology, 2006.

Websites:

Biello, David. "Rising Temperatures Could Cook Coral to Death." *RSN (Reader Supported News)*. 4 February 12.
http://readersupportednews.org/news-section2/312-16/9788-rising-temperatures-could-cook-coral-to-death **OR** http://tinyurl.com/ceuoy64

Biello, David. "Corals Face Catastrophic Bleaching." *Scientific American* podcast. 12 September 2010.
http://www.scientificamerican.com/podcast/episode.cfm?id=corals-face-catastrophic-bleaching-10-09-13 **OR** http://tinyurl.com/cxsk7k4

"Causes of rainforest destruction." Save the Rainforest.
http://www.savetherainforest.org/savetherainforest_006.htm **OR** http://tinyurl.com/26lzqm

"Climate change and developing countries." World Resources Institute.
http://archive.wri.org/page.cfm?id=1284&z=? **OR** http://tinyurl.com/ckwqal

"Coral reef fish danger." BBC Worldwide: *The Blue Planet TV Series.*
www.youtube.com/watch?v=cbN161yBBGA **OR** http://tinyurl.com/cc68e5

"Green Guide for Everyday Living." *National Geographic*.
http://www.thegreenguide.com/

"Human Well-Being." The Environmental Literacy Council, 2008.
http://www.enviroliteracy.org/article.php/1502.html **OR** http://tinyurl.com/dnd5t6

Leonard, Annie. *The Story of Stuff.* Washington, D.C.: Free Range Studios, December 2007.
http://www.storyofstuff.com/movies-all/story-of-stuff/ **OR** http://tinyurl.com/7o6o4ju
(20-minute animated video about the impact of products on the natural environment at every stage of their lifecycle)

Lindsey, Rebecca. "Tropical Deforestation." NASA. March 30, 2007 http://earthobservatory.nasa.gov/Features/Deforestation/ **OR** http://tinyurl.com/dn4lv2

"Pesticides in the United States." *Wikipedia, The Free Encyclopedia.* 29 April 2012. http://en.wikipedia.org/wiki/Pesticides_in_the_United_States **OR** http://tinyurl.com/7r3crce

"Population and Human Resources." UN Documents: *Gathering a Body of Global Agreements* http://www.un-documents.net/ocf-04.htm **OR** http://tinyurl.com/chb6ud

"Reefs in Danger." 12 November 2001. http://www.riverdeep.net/current/2001/11/111201_reefs.jhtml **OR** http://tinyurl.com/c7am9t

Yang, Sarah. "Climate change blamed for dead trees in Africa." UC Berkeley News Center. 12 December 2011. http://newscenter.berkeley.edu/2011/12/12/climate-change-kills-trees-in-africa/ **OR** http://tinyurl.com/7gc6r75

"Zipper's Green Tips." *National Geographic Kids*. http://kids.nationalgeographic.com/Stories/SpaceScience/Green-tips **OR** http://tinyurl.com/c2yteb