Introduction

Objectives
• After reading Part IV, “Ecology,” you will be able to
• Identify the historical background and major and minor issues of ecology.
• Examine the various problems, urgencies, and implications of specific ecological issues.
• Distinguish between industrialized and non-industrialized nations’ ecological issues and viewpoints.
• Analyze and use tables and graphs to promote specific and additional ecological perspectives.
• Evaluate the implications of increasing technological and industrial wastes.
• Evaluate the impact of rapidly increasing human resource use on the environment.
• Develop ethical considerations with environmental issues.
• Evaluate the strength, ethics, and potential of planned environmental approaches.
• Appreciate the importance and contributions of individual ecological involvement and action.
The Vanishing Rain Forests: Can Cities and Nature coexist?

Photo Courtesy of Ahmed S. Khan
Technology and Society: Issues for the 21st Century and Beyond

Introduction

INTRODUCTION
• The term “environment” simply means the world that is all around us. This definition, then, includes no less than all of our natural world—our ecosystem. The study of ecology examines the mutual relationship between organisms and this natural world—the environment—and therefore analyzes the changes and effects on our entire environment due to organisms and their tools.

• Of course, one section or part of a book can hardly deal with such an all-embracing subject, but it can present an overview of some of the major issues of our ecosystem as man,—along with the powerful and unpredictable use of technology—changes its balance, supportive systems, and even beauty.

• The purpose of Part IV is to enhance awareness, thought, understanding, responsibility, strategies, and involvement for a future environment that is desirable, inhabitable, and sustainable. As this part of the text is presented, historical, social, and economic views will be discussed as well to offer a more complete understanding of the issues from differing perspectives.
Introduction

INTRODUCTION
Historical Background and Major Issues
The environmental movement formally began in the United States on Earth Day, April 22, 1970, when the American public began to awaken to the ecological destruction surrounding it. At that time, pollution controls did not exist for cars. People and cities dumped untreated sewage into the nation’s rivers, some of which were so filled with chemical waste that they actually caught fire. Industrial cities were clouded with pungent, acid smoke. Since then, many of these problems have diminished and have been effectively addressed.

The Environmental Protection Agency (EPA), established in 1970, monitors air quality around the country, and toxic emissions from smokestacks, factories, and incinerators have been sharply reduced. Mandatory pollution-control standards on automobiles have led to a drop in lead emissions, and recycling as a way of reducing solid waste has made a significant impact on the health of the environment.
Introduction

However, as our use of materials continues to grow on a worldwide basis, along with an exponentially increasing population growth and level of need, new environmental strategies cannot help but involve an ecological cost of use as well as the cost of the pollution of our supportive natural resources. Based on the findings of a scientific advisory group, the EPA has ranked world environmental issues in the following manner (Wright 1995).

1. *High risk*: Global warming, species extinction, habitat destruction, ozone layer depletion, loss of biological diversity
2. *Medium risk*: Herbicides and pesticides, surface water pollution, airborne toxic substances
3. *Low risk*: Oil spills, radioactive materials, groundwater pollution
4. *Human health risk*: Indoor air pollution, outdoor air pollution, exposure of drinking water to chemicals
Introduction

BOX P4-1 THE VALUE OF NATURE
WHAT’S THE ANNUAL DOLLAR VALUE OF NATURE?

Wildlife watching in the United States.: $85 billion
Recreational saltwater fishing in the United States.: $20 billion
U.S. employment income generated by wildlife watching: $27.8 billion
State and federal tax revenues from wildlife watching: $6.1 billion
Wild bee pollinators to one coffee farm in Costa Rica: $60,000
Natural pest control services by birds and other wildlife to U.S. farmers: $54 billion

The Grim Payback of Greed

The Grim Payback of Greed*
Alan Durning
A man is rich in proportion to the things he can afford to let alone.
Henry David Thoreau
Early in the age of affluence that followed World War II, an American retailing analyst named Victor Lebow proclaimed that an enormously productive economy “demands that we make consumption our way of life .... We need things consumed, burned up, worn out, replaced and discarded at an ever increasing rate.”
The Grim Payback of Greed

The consuming society:
Skyrocketing consumption is the hallmark of our era. The trend is visible in statistics for almost any per capita indicator. Worldwide, since mid-century, the intake of copper, energy, meat, steel, and wood has approximately doubled; car ownership and cement consumption have quadrupled; plastic use has quintupled; aluminum consumption has grown sevenfold; and air travel has multiplied 32 times.

Moneyed regions account for the largest waves of consumption since 1950. In the United States, the world’s premier consuming society, on average people today own twice as many cars, drive two-and-a-half times as far, use 21 times as much plastic and travel 25 times as far by air as did their parents in 1950. Air conditioning has spread from 15 percent of households in 1960 to 64 percent in 1987, and color televisions from 1 to 93 percent. Microwave ovens and video cassette recorders found their way into almost two-thirds of American homes during the eighties alone.
Japan and Western Europe have displayed parallel trends. Per person, the Japanese of today consume more than four times as much aluminum, almost five times as much energy, and 25 times as much steel as people in Japan did in 1950. They also own four times as many cars and eat nearly twice as much meat. In 1972, one million Japanese traveled abroad; in 1990, the number was expected to top ten million. As in the United States, the eighties were a particularly consumerist decade in Japan, with sales of BMW automobiles rising tenfold.
The Grim Payback of Greed

The Cost of Wealth:
• Long before all the world’s people could achieve the American dream, however, the planet would be laid to waste. Those in the wealthiest fifth of humanity are responsible for the lion’s share of the damage humans have caused to common global resources. They have built more than 99 percent of the world’s nuclear warheads.
• Their appetite for wood is a driving force behind destruction of the tropical rain forests and the resulting extinction of countless species. Over the past century, their economies have pumped out two-thirds of the greenhouse gases that threaten the Earth’s climate, and each year their energy use releases perhaps three-fourths of the sulfur and nitrogen oxides that cause acid rain. • Their industries generate most of the world’s hazardous chemical wastes, and their air conditioners, aerosol sprays, and factories release almost 90 percent of the chlorofluorocarbons that destroy the Earth’s protective ozone layer.
Clearly, even 1 billion profligate consumers are too much for the Earth.
The Grim Payback of Greed

In search of sufficiency:
Some guidance on what the Earth can sustain emerges from an examination of current consumption patterns around the world. For three of the most ecologically important types of consumption—transportation, diet, and use of raw materials—the world’s people are distributed unevenly over a vast range.

Those at the bottom fall below the “too little” line, while those at the top, in what could be called the cars-meat-and-disposable class, consume too much.
About 1 billion people do most of their traveling, aside from the occasional donkey or bus ride, on foot, many of them never going more than 100 kilometers from their birthplaces.

Unable to get to jobs easily, attend school, or bring their complaints before government offices, they are severely hindered by the lack of transportation options.
The Grim Payback of Greed

The ultimate fulfillment:
In many ways, we might be happier with less. Maybe Henry David Thoreau had it right when he scribbled in his notebook beside Walden Pond. “A man is rich in proportion to the things he can afford to let alone.”

For the luckiest among us, a human lifetime on Earth encompasses perhaps a hundred trips around the Sun. The sense of fulfillment received on that journey—regardless of a person’s religious faith—has to do with the timeless virtues of discipline, hope, allegiance to principle, and character. Consumption itself has little part in the playful camaraderie that inspires the young, the bonds of love and friendship that nourish adults, the golden memories that sustain the elderly. The very things that make life worth living, that give depth and bounty to human existence, are infinitely sustainable.
The Grim Payback of Greed

QUESTIONS
1. How much richer are Americans now than at the turn of the twentieth century?
2. What is another major cause (other than consumption) of severe environmental problems?
3. What two groups are most destructive to the environment? Give two examples from each of the groups.
4. From the article, name three statistics of the industrialized countries’ (one-fifth of the world population) destruction of global resources. Discuss.
5. Give some evidence that refutes the idea of consumerism as an avenue for happiness.
6. Which world class of people does the least damage to the environment? Give three examples.
QUESTIONS
7. Why do the industrialized nations keep accelerating their consumerism?
8. What can be done to curb this exponential consumerism?
9. Explain briefly the major points in the “Payback of Greed.” What did you learn from this article?
10. Define the consuming society. Do you think that this will continue to be a problem in the next few decades? Why or why not?
11. How has wealth affected ecological issues? Does materialism create ecological concerns? How?
Climate Change

“No single bit of scientific evidence makes a convincing argument that global warming is having an impact on wildlife and plants, but the cumulative evidence cannot be ignored. The question is no longer ‘Is global warming happening?’ The question is, what are we going to do about it?”

Doug Inkley, National Wildlife Federation, 2005

Is climate change really happening? Or is it the pronouncement of overzealous environmentalists and media hype? Scientists worldwide are trying to assess the realistic effects of accumulating greenhouse gases and incoming data from many predicted scenarios. The following discussion examines their findings from varying viewpoints about one of the most discussed topics of the twenty-first century—what is really going on with global warming?
Climate Change

Warmed One Degree in This Past Century

• How Global Warming Works
• Historic Patterns
• Effects and Changing Climate
• Geosigns
• Polar Change
• Glaciers and Ice Sheets
• Weather Events
• Ecosigns
Climate Change

The natural cycles of interdependent creatures, such as birds or animals and their diets of specific insects or flowers, may fall out of sync and thus cause populations to decline. The following list reflects a summary of some of these concerns (DiSilvestro 2005, 24).

- The tree line in Russia’s Ural Mountains has moved about 500 feet higher since the early twentieth century, and in Canada’s Banff National Park, spruces are growing up past their tree line by about 180 feet since 1990. Oak trees in England are leafing two weeks earlier than they did 40 years ago. In Europe, the vegetative growing season of trees, shrubs, and herbs has increased 11 days since 1960.
- Globally, plants are now blooming about 5.2 days earlier each decade, according to Stanford University. In Washington, D.C., data collected for 100 flowering species are blossoming an average of 4.5 days earlier than they did in 1970, while only 11 are flowering later. A similar study in Edmonton, Alberta, found that spring flowering is occurring eight days earlier than 60 years ago (DiSilvestro 2005, 24) In Europe, many plants are flowering about one week earlier and shedding their leaves five days later than they did 50 years ago (Montaigne 2004, 40).
Climate Change

- A study completed in 2002 found that 1700 species of birds and butterflies have changed their ranges to the north by four miles annually since the 1960s.

- Twenty bird species in the United Kingdom between 1971 and 1995 are laying their first eggs an average of nine days earlier, from an analysis of 74,000 nesting records of 65 species.

- The Sachem Skipper butterfly has expanded its range 420 miles northward from California into Washington in just 35 years; in 1998, the warmest year on record, the range expanded 75 miles alone (DiSilvestro 2005, 24).

- In Europe, a study of 35 nonmigratory butterfly species found that, in the last few decades, about two-thirds have expanded their ranges to the north by 20–150 miles (Montaigne 2004, 40).
Climate Change

BOX 28-2 HOTTEST YEARS ON RECORD

• 1. 2005
• 2. 1998
• 3. 2002
• 4. 2003
• 5. 2004
• 6. 2001
• 7. 1997
• 8. 1990
• 9. 1995
• 10. 1999

Climate Change

QUESTIONS
1. How much has the earth’s temperature risen in the past two decades? What do most scientists feel is the cause of this recent warming?
2. What is the most controversial and unknown aspect of climate change?
3. Which greenhouse gas contributes most to the warming of the atmosphere and the earth’s surface?
4. Explain how global warming works.
5. How much does the United States contribute to total global greenhouse gases? Why does it contribute so much?
6. Name three convincing geosigns that reflect significant climate change. Explain why they are important and significant indicators.
7. Identify three convincing ecosigns that reflect significant climate change. Explain why they are important and significant indicators.
8. Identify three convincing timesigns that reflect significant climate change. Explain why they are important and significant indicators.
9. Identify three solutions to global warming that make the most sense to you. How would they be most effective on local and global levels? Write a few paragraphs explaining your scenario, as well as its effectiveness and possible obstacles.
The Kyoto Protocol

Background
The Kyoto Protocol initially began as the United Nations Framework Convention on Climate Change Treaty (UNFCCC) at the 1992 Earth Summit in Rio de Janeiro and was officially enacted in March 1994. The UNFCCC Treaty established the increasingly important objectives of (1) world cooperation (2) towards the priority of stabilizing atmospheric concentrations of greenhouse gases at levels that will avoid “dangerous anthropogenic interference with global climate” and still allow economic development to proceed. Three principles were the foundation for the Treaty:

Scientific uncertainty must not be used to avoid precautionary action.
2. Nations must have “common but differentiated responsibilities.”
3. Industrial nations with the greatest historical contributions to climate change must take the lead in addressing the problem. (Dunn and Flavin 2002, 27).
The Kyoto Protocol

• The Treaty at that time committed 181 nations and the European Union to the goals of addressing climate change, focusing on effects, and reporting their actions. It committed signatory industrial and transitional countries to report their climate policies and greenhouse gas inventories. It also developed the voluntary goals of returning greenhouse emissions to 1990 levels by the year 2000 and an approach for providing financial and technical support to nonindustrial nations to help achieve these goals (Dunn and Flavin 2002, 27).

• By 1995, however, the UNFCCC signatories concluded that not enough progress was being made and launched a tighter initiative for a legally binding protocol. This developed into the Kyoto Protocol, which was adopted in December, 1997. The Protocol collectively committed 38 industrial and former Eastern Bloc nations (called Annex I nations) to reduce their greenhouse gas emissions between 2008 and 2012 by 5.2 percent below 1990 levels (Dunn and Flavin 2002). The Kyoto Protocol required the endorsement of at least 55 industrial nations that together account for at least 55 percent of 1990 global greenhouse gas emissions (Prugh 2005, 21).
The Kyoto Protocol

• The Kyoto Agreement focused on reduction of carbon-rich gases—mainly the byproduct of burning oil, gas, and coal—that scientists believe could dramatically change weather patterns. The Accord allowed for other “flexibility mechanisms” that help to reduce total emissions levels by “trading of emission permits, the use of forests and other carbons ‘sinks,’ and the earning of credits through a Clean Development Mechanism or joint implementation projects (carbon-saving initiatives that take place in developing or Annex B [Annex I] nations).” (Dunn and Flavin 2002, 27.)

• Developing countries were required to continue with their existing commitments to monitor and deal with their emissions and were included in the Treaty, but they were excluded from emission quotas on economic grounds.
• In further negotiations in Bonn, Germany, in March 2001, the United States withdrew from the negotiating process. President Bush stated that the restriction imposed by the Treaty would harm the U.S. economy and was not binding enough to the developing nations (BBC News 2001).
The Kyoto Protocol

The White House said that nations such as China and India should also have emission targets and that signing the Kyoto Protocol could cost the United States more than 5 million jobs. From the Protocol’s provisions, the United States would have to cut emissions by 7 percent from 1990 levels (Bloomberg 2005, 2-3). However, without the United States, 178 nations still reached progressive agreement on principal points, even though there were many compromises on emissions trading, sinks, and compliance that allowed more flexibility in attaining the Kyoto emission levels (Dunn and Flavin 2002, 27).
The Kyoto Protocol

Additional Evidence on Climate Change by the IPCC

- Also in 2000–2001, the Intergovernmental Panel on Climate Change (IPCC), comprised of more than 1,500 scientists from approximately 100 countries, published *Climate Change 2001*, an encompassing and ambitious study that brought strong evidence and concern about climate change to the Kyoto Protocol climate negotiations.
- The IPCC announced increasing climate change concern and accumulating evidence that “unless greenhouse gas levels are stabilized, Earth’s average surface temperature will rise by up to 5.8 °C by the end of the century. …if unchecked, CO2 levels in the air will be between 650 and 970 parts per million (ppm). To stabilize CO2 at 450 ppm (twice the pre-Industrial Revolution level), which would limit global warming to about 2 °C, total global greenhouse gas emissions must be cut by 60–80 percent of today’s emissions within 50 years at the latest.” (Dixon 2004, 2).
- If the polar ice caps remain constant, climate change by greenhouse gases could raise sea levels between 20 centimeters and 1 meter by 2100. There will be more severe and extensive flooding, storms, and droughts. The poorest countries would be the most affected and least able to adapt (Dixon 2005, 2).
### The Kyoto Protocol

Table 29.1

<table>
<thead>
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<td>+18.1</td>
</tr>
<tr>
<td>European Union</td>
<td>–8</td>
<td>–1.4</td>
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<td>+10.7</td>
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<tr>
<td>Russia</td>
<td>0</td>
<td>–30.7</td>
</tr>
<tr>
<td>All Annex B countries</td>
<td>–5.2</td>
<td>–1.7</td>
</tr>
</tbody>
</table>
The Kyoto Protocol

The Kyoto Protocol, as of February 2005, is realized as a global enforcement among signatories and represents important progress on an urgent global problem. Both the World Wildlife Fund (WWF) and Greenpeace stated that a 50-percent global drop in emissions from 1990 levels by 2050 is needed to stop climate change from becoming dangerous; however, they feel that Kyoto is the first step toward tackling the problem. WWF European Director of Climate and Energy Stephan Singer stated:

“This shows that the majority of the world can work together to tackle one of the biggest global challenges, climate change…We need to see increased and strengthened caps for industrialized nations and we need to broaden the participation of developing countries such as China.” (Bloomberg 2005, 1)

Kyoto requires signatories to reduce emissions with a range of national targets that vary by country between 2008 and 2012. Iceland and Norway have caps set at a higher level from 1990 emissions. European Union nations have individual requirements, but have a collective goal of reducing emissions by 8 percent from 1990 levels. Germany—Europe’s biggest emitter—has an 8-percent emissions cut requirement, but has given itself a national target of reducing greenhouse gases by 21 percent by 2012, the highest reduction goal of all industrialized nations.
The Kyoto Protocol
The Role of the United States

After 2001 and the incongruity of the U.S. pullout from the Kyoto Accord (despite the fact that they produce about one-third of the world’s CO2 emissions), further developments, progress, and political implications continue with the Kyoto Accord both with and without the input of the United States. Most of the nations of the industrialized world (31 of 34 except Australia, Monaco, and the United States) and many from the developing world (141 total nations) have elected to adopt the Kyoto Accord, despite its rejection by Washington.

The Kyoto Accord has become somewhat “watered down” during the years of negotiation, in which it “has reduced the average cut in greenhouse gas emissions required by the year 2012 from 5.2 percent below 1990 levels and has incorporated a number of negotiation positions…such as crediting nations for maintaining large forests to serve as ‘carbon sinks’ to soak up the offending gas.” (Karon 2005, 2)
The Kyoto Protocol

The Role of the United States

These negotiation positions are in response to the demands of industrialized countries, such as Japan and Canada, even though they were originally initiated by the Clinton administration. Yet the Kyoto Protocol is generally being heralded as an historic breakthrough by the nations of the world and environmentalist activist groups, for the Treaty’s signatories still collectively produce more than twice as much greenhouse gas as the United States (Karon 2005).

McCain-Lieberman Bill

With the withdrawal of the United States from the Kyoto Protocol, the McCain-Lieberman “Climate Stewardship Act of 2003” proposed by Senators John McCain (R-AZ) and Joseph Lieberman (D-CT) suggests an alternative proposal for addressing climate change in the United States. This Bill requires domestic, mandatory, and economy-wide emission reductions not only in carbon dioxide, but also in sulfur dioxide, nitrogen oxides, and mercury. The Bill also involves a climate research program, an emissions registry, and a trading program. The legislation would establish a limit on greenhouse gas emissions beginning on January 1, 2010. During the first six years of the program (2010–2016), annual greenhouse gas emissions would be reduced to the amount released in 2000. In following years, the limit would be allocated to 1990 emission levels (Pizer and Kopp 2003, 1–2).
Box 29-1 CARBON EMISSIONS TRADING

Carbon emissions trading is increasing and entails the trading of permits that allow countries to emit carbon dioxide and other greenhouse gases, which are calculated in tons of carbon dioxide equivalent (tCO2e). This is an option that enables countries to meet Kyoto Protocol levels to reduce emissions and slow global warming. According to sources, “107 million metric tons of carbon dioxide equivalent (tCO2e) have been exchanged through projects in 2004, a 38% increase relative to 2003 (78mtCO2e) (http://carbonfinance.org/docs/CarbonMarketStudy2005.pdf).”
The Kyoto Protocol

QUESTIONS
1. What were the three principles used as the foundation of the UNFCCC treaty? Explain what you think were the reasons for those three principles.
2. What was the reason that the Kyoto Protocol developed from the UNFCCC treaty? Why do you think it might have been necessary?
3. Why did the United States withdraw from the Kyoto Protocol? Using numeric reasoning and other research, further investigate or evaluate what you think were the principal reasons for U.S. withdrawal. Do you think the United States was justified in withdrawing? Please justify your answer.
4. Do you think the IPCC report influenced the Kyoto Protocol? Research and explain your answer.
5. Why do you think Russia signed the Kyoto Protocol? Consider different scenarios.
6. Do you think the Kyoto Protocol has enough significance? What do you think should happen after 2012? Explain your answers.
7. What was the momentum for the Kyoto Accord to be ratified, even without the United States? List your answers.
8. Explain your reaction to the McCain-Lieberman Bill. Do you think it is an adequate approach for the United States in addressing their global greenhouse emissions? Support your answers.
QUESTIONS
8. Explain your reaction to the McCain-Lieberman Bill. Do you think it is an adequate approach for the United States in addressing their global greenhouse emissions? Support your answers.
9. Research the current status and modifications of the McCain-Lieberman Bill and other U.S. greenhouse emission bills being proposed.
Children get 12 percent of their lifetime exposure to dioxin in their first year of life. On a daily basis, the infant is getting about 50 times the exposure an adult gets during what may be a critical developmental stage.

EPA Toxicologist Linda Birnbaum

During the eight years after an industrial dioxin (a group of chlorine-based chemicals from wastes of papermaking incineration of chlorinated plastics and other processes) pollutant explosion in Seveso, Italy, an unusual scarcity of male babies being born was noticed—twice as many girls were born as were boys—differing from the usual ratios of baby boys slightly outnumbering girls. In addition, excess cancers turned up among Seveso’s adults. Clinical pathologist Polo Mocarelli theorized that the dioxin interfered with hormonal balances in developing embryos, either making normal male growth impossible or killing males. Such an effect of dioxin affecting sex ratios is well known in wildlife. For example, crossed bills in double-crested cormorants with the presence of dioxin in the Great Lakes region during the 1980s occurred almost always occurred in females; scientists speculated that the males died before they hatched with this deformity (Monks, 1997, p. 18).
DEFORMED NEWBORNS
DAMAGED IMMUNITY
LOWERED INTELLIGENCE

BOX 30-1 Dioxin’s Effect on Fish Raises Questions of Effects on Higher Animals
Pollutants are considered dioxin-like if they connect to the Ah receptor in cells (a protein that reacts to these pollutants and turns genes on or off). The receptor was identified in fish in 1988 after being recognized in mammals in 1986. Since then, researchers have been examining other lower species to see how far down the evolutionary ladder this receptor exists and as well as the accompanying vulnerability to dioxin with it. Scientists at Woods Hole Oceanographic Institution have been examining various types of animals for this Ah receptor and have so far found sharks to be the most primitive animal with the Ah receptor. (Sea lampreys have something that resembles the receptor, but this substance does not appear to bind to dioxin-like compounds.)
SEXUAL IMPAIRMENT

Sexual development in the growing fetus may be as sensitive to toxic effects as the brain is. When certain chemicals bind to hormone receptors, they can interfere with the work of natural hormones in the development of male or female organs, resulting in any number of reproductive disorders. These chemicals, known as endocrine disrupters, include PCBs, dioxins, and many pesticides. The growing body of evidence suggests reason for concern about the effects of endocrine-disrupting chemicals found in the environment. Among the Yu-Cheng children of Taiwan, the boys with high PCB exposures had smaller than average penises. University of Florida biologists found the same phenomenon in alligators born in a lake poisoned by pesticides. In the highly polluted St. Lawrence River, biologists found a male beluga whale with a fully developed set of female organs in addition to the whale’s male apparatus. This male carried a very high load of endocrine-disrupting contaminants in its blubber.
SEXY IMPAIRMENT
According to a 1996 study by U.S. and European scientists, data from several countries show substantial increases since the 1950s in the number of baby boys born with undescended testicles and other sexual abnormalities. One London study found that 5.2% percent of low-birthweight boys born in the 1980s had undescended testicles, as compared with 1.74% percent from the 1950s. Testicular cancers nearly doubled among older teenagers in the United States between 1973 and 1992.
BOX 30-2 Success in Curbing Toxic Emissions

Significant Results of the Inventory of Sources of Dioxin in the U.S. (2005 External Review Draft) are listed below.

1987–2000: 89-percent reduction in the release of dioxin-like compounds to the circulating environment of the United States from all known sources combined.

2000–2005: 92-percent decline from all known sources combined.

a. In 1987 and 1995, the leading sources of U.S. dioxin emissions were municipal waste combustors.

b. Bleached chlorine pulp and paper mills were significant sources of dioxin to the aquatic environment in 1987, but a minor source in 1995 and 2000.

c. A major source of dioxin in 2000 was the uncontrolled burning of refuse in backyard burn barrels in rural areas of the United States.

Young at Risk: Dioxins and Other Hazardous Chemicals

BOX 30-4 Not for the Squeamish! Possible Low-Tech Solution for a High-Tech Problem

THE HUMBLE EARTHWORM MAY HOLD THE KEY TO REMOVING ONE OF OUR MOST DEADLY ENVIRONMENTAL TOXINS: PCBS

Charles Darwin admired the earthworm extravagantly. “It may be doubted,” he wrote in 1881, “if there are any other animals which have played such an important part in the history of the world as these lowly organized creatures.” The earthworm is a natural organic chemist, cultivator, and fertilizer. But it may have yet another talent, one that Darwin would never have discovered: toxic cleanup specialist. It turns out that PCBs—among the nastiest of modern pollutants—may be no match for the humble earthworm.
Fisheries Exploiting the Ocean—What Will Be Left?

Developing countries hire private companies to conduct surveillance and enforcement of new fisheries laws. These companies are zealous: One has proposed to watch over fisheries from a blimp, which could descend to launch a patrol boat.

Michael Parfit
Technology has applied its increasing power to the fish of the ocean . . . and there is now trouble at sea. “There are too many fishermen and not enough fish” (Parfit 1995, p. 9). Fifty years of rapidly improving fishing technology has created an immensely powerful industrial fleet—37,000 freezer trawlers that catch and process a ton or more of fish an hour, manned by about a million people worldwide. This fleet contrasts with small-boat fishermen, who probably number about 12 million, but who catch only about half the world’s fish.
Fisheries Exploiting the Ocean—What Will Be Left?

According to the U.N. Food and Agriculture Organization (FAO), almost two-thirds of the world’s 200 commercially important distinct fish populations are either exploited or fished to the edge, and another 10 percent have been harvested so heavily that it will take years for fish populations to recover. “In 2004, marine scientists estimated that industrial fleets have fished out at least 90 percent of all large ocean predators—tuna, marlin, swordfish, sharks, and flounder—in just the past 50 years!” (Halweil 2005, 26).
Fisheries Exploiting the Ocean—What Will Be Left?

As governments struggle to solve the problems at sea, they inevitably create laws that challenge traditional freedoms. Throughout the world’s seas, fishing vessels are attacked in competitive territorial battles and ownership of waters. The following are common examples.

In Patagonia, an Argentinian gunboat chases and fires on a vessel from Taiwan; the crew is rescued, but the trawler sinks.

In the North Atlantic, the Stern trawler REX is arrested west of Scotland for trespassing in British waters. REX is officially multinational to evade fishing laws and is owned by Icelanders, registered in Cyprus, and crewed by fishermen from the Faroe Islands.

In the South Atlantic, a patrol boat from the Falkland Islands chases a Taiwanese squid boat 4,364 nautical miles from home waters, all the way past South Africa. The boat gets away.
Fisheries Exploiting the Ocean—What Will Be Left?

• HIGH-TECH FISHING VESSELS AND METHODS
• AQUACULTURE BEGINS TO AUGMENT WILD FISHING

BOX 31-1 The Seas . . . Now and Then . . .

When my father began diving in the Mediterranean Sea in the early forties, the water was clean. Great beds of seagrass and algae thrived there, along with dense schools of fish and rich invertebrate fauna. Gorgonians were abundant, and so were huge groupers and spiny lobsters. It was the rich sea-floor community the world was seeing in the early Cousteau films. Since those days, the Mediterranean coast has become densely populated. Industries, hotels, and homes line the coast. Sewage and other wastes stream into the sea. Sadly, the same waters where the first Aqua-lung divers discovered the sea’s beauty and diversity are today biologically impoverished. And this scene—where urban development meets the water—is spreading rapidly around the world today.
The very survival of the human species depends upon the maintenance of an ocean clean and alive, spreading all around the world. The ocean is our planet’s life belt. Marine Explorer Jacques-Yves Cousteau (1980)

SOME FACTS
The world fishing fleet has doubled in size over the past two decades and now includes 37,000 “industrial” vessels of more than 100 tons. U.S. and other government subsidies encouraged this growth.

The ocean catch has exploded from 18 million tons in 1950 to 93 millions tons in recent years. Fish stocks began to decline in the 1990s, and production could no longer increase at the same rates. If the same fishing practices continue, the average marine catch could decline by 10 million tons a year.

In 2004, marine scientists estimated that industrial fleets have fished out at least 90 percent of all large ocean predators--tuna, marlin, swordfish, sharks, cod, halibut, skates and flounder--in just the past 50 years. (Halweil 2005,. 26)
The impact on seafood prices has been moderate due to aquaculture of new fish, shrimp, and scallop farms in China, Thailand, and elsewhere. Fishing jobs directly or indirectly employ about 200 million people in the world. There are an estimated 3 million fishing vessels worldwide made up of mostly small vessels in developing countries. The 3 million vessels include the supertrawlers of 37,000 ships of more than 100 tons. These ships caught 90.7 million tons of marine and inland fish in 1995. Aquaculture produced 21.3 million tons in 1995 (Hanley 1997, 1–2).
THE MAGNUSON FISHERY CONSERVATION AND MANAGEMENT ACT

Enactment of the Magnuson Fishery Conservation and Management Act (MFCMA) in 1976 extended fishery jurisdiction to 200 nautical miles offshore and established the current federal fishery management structure. This act, however, did little to preserve fisheries—its intended objective. By banishing foreign competition from U.S. coastal waters and offering generous subsidies to U.S. fishers, it has encouraged thousands of new U.S. boats and, in most cases, imposed no restrictions on the amount of fish an individual fisher could take. As a result of this “open access” policy, U.S. fisheries have become packed with competing boats in an intense, dangerous race for any fish left in the water. In 1992, eight lives were lost in a frenzied race for halibut in which the entire season was compressed into a 48-hour time period. MFCMA also intensifies problems by letting fishery managers use economic and social factors to modify scientists’ estimates of levels for sustainable catches. Then, because of monetary and social pressure, the managers reset the allowable catch to be high.
Fisheries Exploiting the Ocean—What Will Be Left?

BOX 31-2 WHAT CAN WE DO ABOUT BYCATCH?

How much fish do fishermen throw away that is caught in the nets of large-scale fishing operations? It is estimated that, in 2000, U.S. fishermen discarded 2.3 billion pounds of sea life (called bycatch), roughly 25 percent of the catch. Species are scooped up accidentally and some, such as the barndoor skate, are near extinction. The bycatch is typically thrown back into the ocean in poor shape, where most of the fish die. It is of great concern that the fish ecosystem will be impacted by waste of such high numbers. The following list provides some of the species involved and solutions to the problem.

Red snapper: The Gulf of Mexico’s shrimping industry has one of the worst bycatch records. For every pound of shrimp caught, up to 10 pounds of other species will be netted, such as juvenile members of the overfished Gulf red snapper. Bycatch Reduction Devices let fish escape through a small hole and can cut bycatch by 50 percent.
Box 31-2 What Can We Do About Bycatch?

Waved albatross: As many as 12,000 hooks can be attached to a single longline. When a fisherman unfurls it into the sea, birds such as the albatross fly in to snag the bait. Too often, they also snag a hook. Simple devices, such as bird-scaring lines—essentially streamers that flap in the wind—are just $260 per pair and can reduce seabird bycatch by 92 percent.

Leatherback turtles: Gillnets—a wall of net up to 1,200 feet long—are used along the coast of California to catch sharks and swordfish. The nets can also ensnare the endangered leatherback turtle. Large areas of ocean are now closed to gillnets during the turtle’s migratory season.
BOX 31-2 WHAT CAN WE DO ABOUT BYCATCH?

Blue shark: A common deepwater species, the blue shark is also routinely caught on lines set to catch tuna and swordfish. A 1996 study by the National Marine Fisheries Service noted that 100,000 blue sharks per year were caught by Hawaiian longliners—more than the numbers of targeted species.

Yellowtail flounder: In southern New England and around Cape Cod, hundreds of tons of yellowtail flounder are discarded every year by the fisheries that catch scallop, haddock, cod, and shrimp. The flounder population in the region is just 2 percent of what is considered healthy.

What Will Happen to the Endangered Species Act?

“Nothing is more priceless and more worthy of preservation than the rich array of animal life with which our country has been blessed.”

…..President Nixon on signing the Endangered Species Act, December 28, 1973

The Endangered Species Act (ESA) still stands as a monument after 30 plus years as an environmental powerhouse that places species conservation over development concerns. It has earned the highest respect for its many notable successes and the simple yet powerful nature of its law. When the law was enacted in 1973, there were 109 species listed as endangered; today there are about 1,500 endangered species, both U.S. and foreign. The bald eagle, brown pelican, and peregrine falcon were all in danger of extinction from thinning eggshells due mostly to dichlorodiphenyltrichloroethane (DDT) and other pesticide pollution. The American alligator was threatened from overexploitation and loss of habitat. Since 1973, however, it appears that species disappearance is accelerating.

Hjorth, Technology and Society, Third Edition
What Will Happen to the Endangered Species Act?

“Nothing is more priceless and more worthy of preservation than the rich array of animal life with which our country has been blessed.”

…..President Nixon on signing the Endangered Species Act, December 28, 1973

**BOX 32-1 Definitions**

*Endangered species*: A species that could become extinct in the future.

*Threatened species*: A species that could become endangered soon.

*Recovery point*: The time at which the measures provided by the Endangered Species Act are no longer necessary.

Some ESA classic case studies include the Northern spotted owl, snail darter, red-cockaded woodpecker, and gnatcatcher.
Air Poisons Around the World

There are studies showing that on days when there are more particulates in the air, more people die. You can’t get more basic that that.... This country has a law called the Clean Air Net, which says that Americans should be able to breathe without harm.

John H. Adams, Executive Director, Natural Resources Defense Council

Air pollution in its many forms—sulfur dioxide, ozone, fine particles, carbon monoxide, and nitrogen oxide—is causing a deathly fog around the world. “From Hong Kong to Mexico City, the toll taken in terms of human death and disease caused or aggravated by air pollution almost certainly is measured in the millions,” says Dr. Alfred Munzer, past president of the American Lung Association and respiratory specialist.
Air Poisons Around the World

Association and respiratory specialist. In Japan, various respiratory illnesses suffered by thousands of citizens living in heavily polluted areas of Japan were deemed indisputably to be caused by sulfur dioxide. Within the next year, the Japanese government set up a tracking program and medical reimbursements for certified victims of air pollution ranging from bronchitis to asthma. Even though the program monitored only sulfur dioxide and was limited to just a few industrial areas, it still certified more than 90,000 air pollution victims before it was stopped in 1988 because of pressure from polluters.
**Air Poisons Around the World**

- Mexico City’s air, which contains some of the world’s worst ozone pollution, reaches unhealthful ozone levels about 98 percent of the time. Healthy men newly exposed to Mexico City’s air developed precancerous cell alterations in nasal and airway passages. Mexico City residents are generally in the second of three stages of cancer in which the third stage is the production of cancer.

- In Los Angeles, one in four fatal accident victims aged 14 to 25 had severe lung lesions of the sort caused by ozone, which is a destructive, irreversible disease in young people. Los Angeles residents exposed to ozone had double the risk of cancer compared with residents of cleaner cities.

- Particulates are a catch-all term for everything from road dust to soot to mixtures of pollutants—solids as well as liquids, microscopic and as well as larger grains that vary in the environment. Scientists believe that fine particles which are small enough to lodge deep into the lungs are the most dangerous. Fine particles result from the burning of coal, oil, and gasoline as well as; they also result from the atmospheric change of oxide of from sulfur and nitrogen into sulfates and nitrates.
Air Poisons Around the World

U.S. HISTORICAL AND SOCIETAL PROGRESS REGARDING AIR POLLUTION

After a lawsuit was initiated by the Natural Resources Defense Council in 1973, the Environmental Protection Agency (EPA) created a five-year program to gradually reduce the lead content in gasoline. At that time, tetra-ethyl lead (TEL) was routinely added to lower-grade gasoline to create more efficient burning and prevent gasoline “knock” caused by uneven combustion. For decades, the nation had allowed the combustion of leaded gas to emit millions of tons of lead into the air, where it was breathed in or deposited in soil and dust. Lead, however, is toxic, even in the smallest amounts. Children with elevated blood–lead levels can suffer lowered IQs, slower neural transmission, hearing loss, and disruption of the formation of hemoglobin red blood cells; acute lead poisoning causes even greater physiological damage.
Air Poisons Around the World

U.S. HISTORICAL AND SOCIETAL PROGRESS REGARDING AIR POLLUTION

As of 2005, the 1990 Clean Air Act remains the most recent version of U.S. law that regulates air standards. It was originally passed in 1970 and has federal jurisdiction under the EPA that pertains to the entire country, even though the states must create the mechanisms to enforce the Act, such as granting permits or enforcing fines. The Act establishes standards that set limits on how much of a pollutant is allowed into the air throughout the United States. Even though some states have elected to set tougher laws, the Clean Air Act regulates firm basic standards for the entire country. The following list details some of the areas covered by the Clean Air Act.
Air Poisons Around the World

U.S. HISTORICAL AND SOCIETAL PROGRESS REGARDING AIR POLLUTION

Enactment of state implementation plans that explain how each state will perform its job under the Clean Air Act

Development of standards and infrastructure concerning interstate air pollution and its enforcement; institution of public participation programs and market approaches as well as economic incentives for reducing air pollution

Regulation of smog and other “criteria” (based on scientific standards for protecting health, environment, and property) air pollutants. Changes were revised in 1997 to include higher standards for ground-level ozone (smog) and particulate matter.

Maintenance of standards for mobile sources of air pollution (cars, trucks, buses, off-road vehicles, planes). Cars today produce 60–80 percent less pollution than cars in 1960, but motor vehicles still release more than 50 percent of the hazardous air pollutants.

Reduction of acid air pollutants that cause acid rain

Establishment and maintenance of standards that eliminate the production of chemicals that destroy the ozone layer. All significant ozone-destroying chemicals are no longer produced in the United States including chlorofluorocarbons (CFCs)
U.S. HISTORICAL AND SOCIETAL PROGRESS REGARDING AIR POLLUTION

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Reduction of acid air pollutants that cause acid rain

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Regulation of consumer products for release of smog-forming volatile organic compounds (VOCs) and ozone-destroying chemicals (EPA 2005).
Rain Forests May Offer Miracle Drugs

• In the remote rain forests of Suriname, families have traditionally used local plants to treat common illnesses, such as fever and stomachache, and more exotic ailments, such as leishmaniasis, an Amazon parasite that produces skin lesions. Folklore knowledge not only includes which plants are specific to certain diseases, but also prescribes the methods of preparation and application of the health-restoring tinctures.

• Synthetic production of drugs has been the primary focus of Western pharmaceutical companies since the 1940s. Producing drugs in the laboratory allows these companies to safeguard their investment in research and development through intellectual property legislation enacted via patents and licenses. In recent times, international drug companies, such as Bristol-Myers Squibb, are refocusing their interest on the natural laboratory that lies beneath the canopy of the rain forest, which is able to offer an albeit undocumented but nevertheless tried and perfected methodology toward drug refinement and employment.
Rain Forests May Offer Miracle Drugs

• Significant discoveries include tree extracts from Indonesia help fight HIV infection, a Brazilian shrub that is used to treat diabetes, and fungi and bacteria from the Philippines that show promise in treating a variety of ailments.
• The process of searching for new natural medicines is called bioprospecting. Recent technological advances in screening samples of plants, animals, and other natural substances for curative ingredients has made it cost effective to collect and analyze the large number of specimens needed to obtain viable medicines. In addition, the natural proclivity of diseases, such as malaria, to build up resistance to drugs has accelerated the need for alternative forms of treatment.
Rain Forests May Offer Miracle Drugs

• Bioprospecting successes include the landmark Taxol, a treatment for advanced ovarian cancer found in the bark and needles of the Pacific yew, and Vinblastine, a drug used for treating cancers, including Hodgkin’s disease and leukemia, that is found in the rosy periwinkle, a Madagascan plant. Two other natural substances, Michellamine B from a Cameroon vine, and Prostratin, from a Samoan rubber tree help in the fight against AIDS.

• Plants are not the only source of potential life-saving drugs. On the French Guinea border, the Wayana people eat the heads of soldier ants to obtain a chemical that they believe will ward off malaria.
Rain Forests May Offer Miracle Drugs

• Researchers are also struggling with the dilemma of how to return part of the profits to the people and countries who provided the cure. In Suriname, bioprospectors set up a Forest People’s Fund, which received an initial $50,000 royalty from Bristol-Myers Squibb, and which will receive between 1 and 5 percent of any royalties from marketed drugs. This program is designed to encourage the local conservation of threatened ecosystems with financial incentives.

• Thus, while bioprospecting is showing increasing promise as a source of medicines and disease-fighting drugs, researchers are fighting environmental and cultural destruction in the race to discover the next wonder drug. While the search for traditional cures accelerates, no such acceleration in the process of bringing these cures to market seems imminent.
Rain Forests May Offer Miracle Drugs

RAIN FOREST DIVERSITY AND DESTRUCTION
As stated in the introduction, the rain forests of the world need protection because they significantly affect world climate by consuming large quantities of CO2, contributing a large percentage of the world’s oxygen, and slowing global warming. Also, rain forests guard most of the planet’s biodiversity (an umbrella term for the variety of ecosystems, species, and genes present).
Rain Forests May Offer Miracle Drugs

RAIN FOREST DIVERSITY AND DESTRUCTION
An example of this biological richness and abundance is demonstrated in a study that found that a single hectare (about 2.5 acres) of rain forest in Peru contained 300 tree species—almost half the number of tree species native to all of North America. In another study, scientists found more than 1,300 butterfly species and 600 bird species within one five-square-kilometer patch of Peruvian rain forest. (The entire United States harbors 400 butterfly species and about 700 bird species.) In the same Peruvian jungle, Harvard entomologist Edward O. Wilson determined 43 ant species in a single tree, about the same number as exists in all of the British Isles (Rice et al. 1997, 48).
Rain Forests May Offer Miracle Drugs

ECONOMIC VALUE

One reason why such plant and animal diversity is vital is because it is essential for creating food, medicines, and raw materials. Wild plants have the genetic resources to breed pest- and disease-resistant crops. An estimated 120 clinically useful prescription drugs originate from 95 species of plants, of which 39 grow in tropical forests. Botanists estimate that 35,000–70,000 plant species located primarily in tropical forests provide traditional remedies in countries throughout the world. Without the rain forest, these plant species and the vast array of existing and potential medicines derived from them would forever be lost (Rice et al. 1997, 48).
Rain Forests May Offer Miracle Drugs

Dr. Robert Balick of the New York Botanical Garden and Dr. Robert Mendelsohn of Yale University have studied the potential economic value that might result from medicines derived from the flora of the rain forest. Effective new drugs are valued at an average of $94 million each to drug companies. They concluded that at least 328 drugs await discovery with a projected value of some $147 billion (Medical Herpetology 1997).

About half of the earth’s 250,000 flowering plants exist in tropical forests, but less than 1 percent has been thoroughly tested for medicinal uses. Nearly one-half of all drugs prescribed in the United States have originated from plant life, with 47 medications currently on the market that are derived from the tropical forest including codeine, quinine, and curare (see Table 34.1) (Science 1995).
Rain Forests May Offer Miracle Drugs

BOX 34-1 Biological Diversity
With an estimated 13 million species on Earth (UNEP 1995:118), few people take notice of an extinction of a variety of wheat, a breed of sheep, or an insect. Yet it is the very abundance of species on Earth that helps ecosystems work at their maximum potential. Each species makes a unique contribution to life. Species diversity influences ecosystem stability and undergirds essential ecological services. From water purification to the cycling of carbon, a variety of plant species is essential to achieving maximum efficiency of these processes. Diversity also bolsters resilience—an ecosystem’s ability to respond to pressures—offering “insurance” against climate change, drought, and other stresses.
Rain Forests May Offer Miracle Drugs

BOX 34-1 Biological Diversity

The genetic diversity of plants, animals, insects, and microorganisms determines agroecosystems’ productivity, resistance to pests and disease, and, ultimately, food security for humans. Extractions from the genetic library are credited with annual increases in crop productivity worth about $1 billion per year (WCMC 1992:433); yet the trend in agroecosystems is toward the replacement of polycultures with monocultures and diverse plant seed varieties with uniform seed varieties (Thrupp 1998:23–24). For example, more than 2,000 rice varieties were found in Sri Lanka in 1959, but just five major varieties in the 1980s (WCMC 1992:427).

Genetic diversity is fundamental to human health. From high cholesterol to bacteria fighters, 42 percent of the world’s 25 top-selling drugs in 1997 were derived from natural sources. The global market value of pharmaceuticals derived from genetic resources is estimated at $75–$150 billion. Botanical medicines like ginseng and echinacea represent an annual market of another $20–$40 billion, with about 440,000 tons of plant material in trade, much of it originating in the developing world. Not fully captured by this commercial data is the value of plant diversity to the 75 percent of the world’s population that relies on traditional medicine for primary health care (ten Kate and Laird 1999:1–2, 34, 101, 334–335).
Rain Forests May Offer Miracle Drugs

The threat to biodiversity is growing. Among birds and mammals, rates may be 100–1,000 times what they would be without human-induced pressures—overexploitation, invasive species, pollution, global warming, habitat loss, fragmentation, and conversion (Reid and Miller 1989). Regional extinctions, particularly the loss of populations of some species in tropical forests, may be occurring 3–8 times faster than global species extinctions (Hughes et al. 1997:691). Of the estimated 250,000–270,000 species of plants in the world, only 751 are known or suspected to be extinct. But an enormous number—33,047, or 12.5 percent—are threatened on a global scale. Even that grim statistic may be an underestimate because much information about plants is incomplete, particularly in the tropics (WCMC/IUCN 1998).
Rain Forests May Offer Miracle Drugs

Such localized extinctions may be just as significant as the extinction of an entire species worldwide. Most of the benefits and services provided by species working together in an ecosystem are local and regional. If a keystone species is lost in an area, a dramatic reorganization of the ecosystem can occur. For example, elephants disperse seeds, create water holes, and trample vegetation through their movements and foraging. The extinction of elephants in a piece of savanna can cause the habitat to become less diverse and open and cause water holes to silt up, which would have dramatic repercussions on other species in the region (Goudie 2000:67).
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

• This is the story of perhaps the country’s most notorious waste site battle. It ignited people’s emotions, grabbed headlines, and brought together homemakers, scientists, corporations, politicians, government officials, and activists to the environmental nightmare and corruption of industrial wastes that literally lay underneath the feet of families and growing children. It brought to the fray the nexus of environmental responsibility, the technological age, and neighborhoods of children caught between unseen consequences and ignored responsibility.

• Love Canal was the dream community of William T. Love. He imagined a village nestled in the rolling hills and orchards near the Niagara River in upstate New York. The success of the venture, begun back in 1894, depended on the construction of a canal that would connect the two branches of the Niagara River. The canal would tap the power of the rapids just before Niagara Falls and produce hydroelectric power, which would attract business and industry to the area.
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

• But Love’s dream was not to be. Economic difficulties caused many of his backers to pull out of the scheme. The only trace of Love’s plan was a three thousand 3,000-foot long, sixty 60-foot wide canal. In 1927, the area was annexed to the city of Niagara Falls. Around 1946, the city was approached by the Hooker Chemical Company, which was looking for a place to dump chemical wastes.

• Love Canal seemed like the perfect spot, sparsely populated, and the thick, clay-like soil provided protection against any possible leakage. Hooker began dumping chemical wastes into the canal that year and for every year until 1952. At least 150 chemicals were placed into Love Canal, including dioxin, the most toxic man-made chemical known. There was little public awareness at the time about the dangers of these chemicals and their connection with nervous system disorders, kidney problems, respiratory distress, deafness, and birth defects.
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

The potential for a technological disaster at Love Canal mounted during the 1950s. The post-war baby boom had created a pressing need for housing and schools. Officials in Niagara Falls began looking at Love Canal as a place to expand. In 1953, the Niagara Falls Board of Education announced its intention to acquire Love Canal for the purpose of building an elementary school in the area. Hooker, aware the land could be taken from them via eminent domain, sold the land to the city for $1, but made city officials sign a deed acknowledging that the area had been used as a chemical dump site, and absolving Hooker of any deaths, loss, or damage to property once construction began.

The 99th Street School was built on the central part of the canal, and the city sold the southern part to developers. As the bulldozers began tearing away the top soil, the rain and snow gradually began to seep into the drums and containers holding the chemical wastes, and in time, a chemical mixture, leachate, began to flow out of Love Canal.
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

The leachate which began to appear in the late 1950s produced skin burns on a few children who were playing in the area. But that was nothing compared to the complaints that began surfacing in the 1970s as the danger of Love Canal became apparent. Heavy rains during that decade forced the buried chemicals to the surface, and with them came increased reports of miscarriages, birth defects, liver abnormalities, and cancer. In 1978, over 200 families were forced from their homes after toxic fumes were detected in their basements.

Two years later, the Federal Government and the state of New York, reacting to an Environmental Protection Agency (EPA) report, moved an additional 800 families out of the Love Canal area. Love Canal remained a near ghost town throughout the 1980’s as the E.P.A., Hooker Chemical, the School Board and City of Niagara Falls, as well as numerous insurance companies thrashed out the legal and possibly criminal costs of this disaster. In 1988, Love Canal residents received a $20 million settlement, in addition to the $30–$40,000 each family received for their homes. Individual claims were in the $2-$4,000 range. By 1990, 1,000 cases were still pending.
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

ONE PERSON MAKES A DIFFERENCE

Lois Gibbs was a housewife living in Love Canal in 1978. She discovered an epidemic of miscarriages, birth defects, nervous system problems, and respiratory disorders across the neighborhood; she also learned that the neighborhood had been built next to a huge toxic waste dump. She became a neighborhood organizer and ultimately became responsible, as much as anyone, for bringing this toxic disaster into the public forum and causing responsible parties to pay for victim relocation. She continued to become one of the most prominent grassroots environmental activists in the United States. She founded the Citizens Clearinghouse on Hazardous Waste (CCHW) and has written extensively on toxic hazards, the prevention of new ones, and approaches for communities with existing toxic dumps.
Ms. Gibbs has also written on the effects of dioxin as both a potent carcinogen as well as a cause of illness affecting almost every major system of the body such as diabetes, chronic bronchitis, irregular heartbeat, nervous disorders, thyroid and immune system disorders, and a variety of reproductive system disorders including birth defects, miscarriages, and lowered fertility. Gibbs recommends a strong dose of democracy as a cure for toxic environmental problems. She concludes, “The job is too big for some national organization or remote coalition to achieve on our behalf . . . Our country’s power is vested in the people, and the people must act.” (Mazza 1996).
Case Study 1: Buried Displeasure: Love Canal and One Person Who Made Such a Difference

ONE PERSON MAKES A DIFFERENCE
SOME INFORMATION TO CONSIDER

Manufacturing wastes are being created at an accelerating pace of 6 percent per year, which means that total waste production is doubling every 12 years. In the first 12 years since the problems at Love Canal were discovered, American industry pumped out a total amount of toxic waste equal to all of the toxic waste created prior to Love Canal (from the years 1880–1978).

The Niagara River has the greatest concentration of toxic dumps anywhere on the North American continent with 65 huge chemical dumps along the banks of the river. Love Canal, at 20,000 tons of toxins, is not the largest of these dumps: the Hyde Park dump contains 80,000 tons of toxins, the “S” site contains 70,000 tons, and the 102 Street Site contains 80,000 tons. All of these sites are within a few hundred yards of the river (Montague 1990).
ONE PERSON MAKES A DIFFERENCE

SOME INFORMATION TO CONSIDER

When Lois Gibbs founded the CCHW) in 1981, its main focus was to help community groups who were suffering from the effects of toxic dump sites, such as Love Canal. It has since expanded its programs to address a broad range of environmental issues including toxic waste, solid waste, air pollution, incinerators, medical waste, radioactive waste, pesticides, sewage, and industrial pollution. The CCHW is a now a more than 20-year-old nonprofit environmental organization and remains the only national organization started and led by grassroots organizers. As of 1996, the CCHW had worked with over 8,000 community-based groups nationwide (Gibbs 1996).
ONE PERSON MAKES A DIFFERENCE

SOME INFORMATION TO CONSIDER

The CCHW has changed its name to the Center for Health, Environment and Justice, where Ms. Gibbs remains the executive director. It continues to grow into an effective, broad-based information, referral, and support resource organization to help individuals, organizations, and communities eliminate exposure to hazardous chemicals. It specializes in dioxin as well as other toxic, chemical, and hazardous wastes and provides various publications and resources for communities, community leaders, and strategists devoted to hazardous waste information and elimination.
Who says environmentalism is nothing but bad news?
For two days it has been cold and pouring continually, but each morning the caravan of scientists rolls out from the inn on the square in the small northwestern Czech village of Horni Blatna and heads an hour north into the mountains. At the group’s study site, just a few miles from the German border, the forest is full-grown Norway spruce about a hundred years old. The trees survive on the western edge of the notorious Black Triangle, the heavily industrialized region where Poland, Germany, and the Czech Republic meet. During the Communist era, this 12,000-square-mile area was one of the most polluted industrial landscapes on the face of the globe.
The group unpacks its gear—from pruners that can reach branches 30 feet off the ground to small glass lab dishes in which a single spruce needle can be cut up and preserved—and hikes into the woods. Barrett Rock, a professor of natural resources at the University of New Hampshire, a tall, ruddy-faced, white-haired Vermonter, briefs the researchers on their procedures and they set to work, some at branches, some at trunks, some at roots, like a Lilliputian surgical team operating on a giant.
The lignite strip mines expanded and deepened. As industries moved in—chemical plants, refineries, steam heating and power plants—so did workers. To provide heat and electricity for the growing population, more coal was burned. When still more coal was needed, the government had no compunction about bulldozing entire villages so the strip mines could devour more of the landscape. North of the basin, where the three national borders converge, the mountains formed an angular barrier that contained the increasingly polluted air, enveloping the Most basin in ash and ozone. When the wind blew, plumes of pollution swept up into the spruce forests.

Writing in 1987, electrical engineer Eduard Vacka described life in the Black Triangle town of Teplice:

It was one of those miserable fall days, when you wake up in the morning with a throbbing headache. Out the window, it looks like a dark sack has been thrown over the whole town, just as it had all week. “Back into this s***,” you mutter under your breath as you close the door. “God, what a stench! What the hell are they putting in the air? It’s unbelievable: they’re waging chemical warfare against their own people.”

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Technology and Society: Issues for the 21st Century and Beyond

Case Study 2: Europe’s “Black” Triangle Turns Green

If you say you can’t breathe, there are two meanings. The first is symbolic, that the mental environment is stifling, choked with lies and hypocrisy: there is no breathing room. The second meaning is more immediate, that the air itself is corrupted and you are literally choking to death. The first is a sigh of despair; the second a cry for help.

For many Czechs the Black Triangle became a symbol of Soviet callousness toward both nature and their culture. Josef Richter, a physician who heads the department of immunology at the Institute of Public Health in Usti, witnessed the region’s decline. Now a stout, barrel-chested man with white hair, Richter has lived all his 70 years in the Most basin. During the Soviet years his father, for the offense of being half-Gypsy, or Roma, had been forced to work in the infamous uranium mines in nearby Jakimov. For him, as for many others, work in the mines with no protective gear was a sentence to a slow but certain death. When the younger Richter had the temerity to express a desire to attend medical school, Communist authorities told him that he, too, had to first serve a year in the mines. Before I can ask him what it was like, he stands, lifts his shirt, and points to a scar on the right side of his chest.
“Bronchogenic carcinoma. All of us had tumors removed,” he says, lowering his shirt and sitting. “I would have to walk with a uranium stone for five kilometers.” After earning his degree Richter came to the Usti hospital.

“The main chemical plant was built here during the time of Hitler,” he tells me. “In the Communist era they began building energy plants. Eighty percent of Czechoslovakia’s electricity was produced here, and all of it from brown coal.” The population was also changing. Following the war, Richter explains, the Czechs, with clearly justified grievances but with sometimes savage zeal, drove the German population out of Bohemia, the area known by the Germans as Sudetenland. Much of the textile and glass industries went with them. “What we got in exchange were people with little education and with no roots in the region—many Gypsies, very few with a high school education.”
Case Study 2: Europe’s “Black” Triangle Turns Green

The EPA requires that over the course of a year, particulate emission densities not average more than 40 micrograms per cubic meter. In 1980, densities in the Black Triangle averaged more than three times that, reaching nearly 200 micrograms per cubic meter during the winter months.

In a single generation, the average Czech life expectancy had fallen to seven years lower than that of Western Europe. The infant mortality rate was 40 percent higher than the European norm. The incidence of respiratory infections was five times greater. Those who could moved away, a migration caused not by war or natural disaster but by an environment made uninhabitable.
Case Study 2: Europe’s “Black” Triangle Turns Green

Once released into the air, sulfur dioxide and nitrogen dioxide, which do so much damage to the human respiratory system, undergo a chemical change. With sunlight as a catalyst, they combine with atmospheric water vapor and oxygen to form sulfuric and nitric acids. In a high mountain forest such as the Krušné hory, leaves soak in the acidic moisture from low clouds and mist. When it rains or snows, the acidic precipitation acidifies the soil. Nutrients in the soil get broken down and washed away. In their place substances toxic to trees, such as aluminum, are released and the trees, being the efficient hydraulic systems that they are, suck them up. Between 1972 and 1989 about half of the Krušné hory forests died, 115 square miles’ worth, and had to be clearcut.
Ducking into my car to find some refuge from the day’s rain, Rock explains that his studies of the effects of acid rain in the northeastern United States were what brought him to the Czech Republic. As a research scientist at the government’s Jet Propulsion Laboratory in Pasadena, California, Rock had considered using satellites for environmental monitoring. When he came to the University of New Hampshire in 1987, Rock began trying to assess the decline of New England forests. What he concluded immediately was that airborne pollution appeared to hang in a layer at 3,000 feet, the altitude at which the bottoms of clouds flatten out.
“What I was seeing was that the bottom of a cloud could have a pH of 2.5 while the top of the cloud could be 4 to 4.5.” This is not a trivial difference. Each unit increment on the pH scale indicates a tenfold difference in the concentration of hydrogen ions. The lower the pH, the higher the acidity. What Rock was recording was a pH 100 times lower at the base of the clouds than at their top. Pure water has a neutral pH of 7. Normal rain, because of dissolved carbon dioxide, has a pH of 5.5. Rain is considered acidic when the pH level drops to 4. At 3,000 feet Rock was measuring vinegar. He tells me that in one Vermont forest, on September 20, 1988, scientists measured a single cloud with a pH of 2.6. “For three hours it hung there and just toasted the needles.”
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• Rock concluded that pollution damage hits first and hardest at 3,000 feet, though other researchers questioned this. “I was asked whether this 3,000-foot acid rain damage applied only in a specific location in Vermont where the pollution input was constant. I had to find a place where, at 3,000 feet, they had a range of pollution levels,” depending on proximity to industrial sources and wind direction.
• “So I came to the Krušné hory. When I looked at the Landsat images I couldn’t believe what I saw. The damage was appalling.”
• This was in 1989. What Rock found on the ground when he arrived in May of that year confirmed the worst.
• “Retention of needles is a key indicator of health in these trees. A healthy tree may have 12 or more years of needles on its limbs. These had only two or three. The trees were skeletons with tufts of needles. When I looked at the cells of these needles I saw they were suffering plasmolysis, the inability to retain water. The cell content pulls away from the cell wall. The cells become physiologically crippled.”
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• When Rock takes out photographs of damaged needle cells they recall for me comparisons between normal lungs and smokers’ lungs. The cells’ chloroplasts, which are responsible for photosynthesis, disintegrate. Acidic tannins, looking like tar, accumulate inside the cell. The cell’s walls go flaccid and the needles’ normally orderly interior structure disintegrates. Says Rock, “Sulfur dioxide and ozone are the only things that do this.”

• As it turned out, the most damaged Czech forests were those located at 3,000 feet.

• In November 1989, a few months after Rock’s first trip to the Krušné hory, the great change came. In what would become known as the Velvet Revolution, the shaky Communist regime fell and gave way to a new Czech democracy. The right to clean air was among the first demands of the revolution’s leaders, and very quickly the new republic set out to clean up the Most basin. What was required was clear. Smokestacks needed scrubbers to remove sulfur from emissions. Inefficient energy plants had to be shut down or switched to low-sulfur, low-nitrogen fuels, such as hard coal or natural gas. The loss of these plants would also require the development of new sources of low-polluting energy. All of these changes would take money.
Case Study 2: Europe’s “Black” Triangle Turns Green

• In 1990, the Czech Republic received financial aid from the European Union’s Phare plan, under which grants were given to nations intending to join the E.U. From 1990 to 2003, the country received some 1.1 billion euros ($1.42 billion) in aid. To this was added $626 million from the World Bank. Combining these funds with technical assistance from Europe and the United States, the Czechs began dismantling the wasteful and damaging energy complex that had been imposed by the Soviet central committee four decades earlier.

• At the same time the Czechs began gradually to diversify their sources of power, adding natural gas, hydropower, and a new nuclear power plant. They ended price controls on energy costs. They passed new standards limiting sulfur dioxide emissions that mirrored the EPA standard of “best available technology.” The legislation also enabled them to levy fines on polluters. And they began to share energy resources with three neighboring countries—Germany, Hungary, and Poland—which were also receiving assistance from the E.U. to implement similar changes. Since 75 percent of the pollution produced in the Black Triangle areas of Germany and the Czech Republic ended up in Poland, that country immediately benefited from the changes that were made by its neighbors.
Case Study 2: Europe’s “Black” Triangle Turns Green

• Poland began treating its own emissions as well, especially those from its huge Turow power plant. Germany, meanwhile, began to retrofit its massive power plant in Boxburg, adding desulfurization technology, as well as decommissioning smaller, lignite-powered plants. To complement these efforts, the three Black Triangle states set up a joint air-monitoring system, which continuously measures major air pollutants at 42 stations.

• Henry Manczyk, an energy expert who has studied the efforts of the Czech Republic, Poland, and Germany to reduce pollution, says the success of the program sets up a paradigm for other former Soviet states, with Bulgaria, Ukraine, and Belarus all likely to follow as their political circumstances change.
Case Study 2: Europe’s “Black” Triangle Turns Green

- Mining output in the region dropped from 80 million tons of lignite in 1984 to 56 million tons in 1993 and then to 50 million tons in 1999. By 1996 the Czechs could measure a decline in sulfur dioxide emissions, from 2.5 metric tons in 1982 to less than 1.4. Rock, working by then with Czech scientists, most closely with Jana Albrechtova, a plant physiologist at Charles University in Prague, began seeing changes in the forest: The acute damage appeared to have come to a halt.
- Landsat imagery of the Krušné hory in 1997 showed Rock that the areas whose appearance had shocked him when he first came to the region were now experiencing the beginning of a remarkable reversal of fortunes.
Case Study 2: Europe’s “Black” Triangle Turns Green

• During Rock’s tenure at the Jet Propulsion Laboratory, NASA satellites had begun measuring the reflected infrared light from the forests below. Light in the infrared spectrum is invisible to the human eye. (“A good thing,” he says, “or we’d be blinded by a walk in the woods.”) Each plant’s leaves reflect a specific range of infrared light. By using a spectrometer, the satellites showed what trees made up a forest and, to a lesser degree, how healthy those trees were.

• Rock, however, was dissatisfied with the resolution of the satellite imagery. He believed that by doing close-up spectrometry he’d be able to tell what was going on inside the leaves. If he could see that, he might also be able to recognize when a forest was in danger of dying.
Case Study 2: Europe’s “Black” Triangle Turns Green

• So he took his students out into the Krušné hory with a spectrometer. And what the spectrometer did in fact see was what was happening at the cellular level. It was like going from photograph to CAT scan. They could measure the leaves’ chlorophyll concentrations, water content, and cellular development—essentially, the health of the leaf, the tree, and the forest.
• Outside in the chilling rain, Rock, Albrechtova, and other researchers and students are hustling from tree to tree, pruning branches, taking cuttings, digging soil samples, and collecting needles.
Case Study 2: Europe’s “Black” Triangle Turns Green

brechtova is an intense woman with an athlete’s lithe build. In the forest she’s all business. She points out that some of the trees now have seven or eight years of needles on them. The needles are dark and plump. In the young forests, planted only five or six years ago, the trees are healthy and reproducing on their own. A once-denuded hillside is damp and redolent of young pines. It’s possible once again to appreciate the rain.

The environmental indicators—sulfur dioxide emissions, particulate densities—have continued to improve steadily. On graphing paper the slope of pollution decline is a slide into a ravine. Nearly as rapid has been the improving health data coming from the Most basin. While it still lags behind the rest of the country, life expectancy there has increased and deaths from respiratory illnesses have declined.
QUESTIONS
1. Provide three reasons why the Most Basin in the “Black Triangle” became so toxic. Discuss the political, economic, and cultural reasons why this occurred.
2. Provide three reasons why the Most Basin is on its way to recovery. Discuss the political, economic, and cultural reasons why this is occurring.
3. Discuss what this case study teaches us about environmental destruction and environmental recovery.
4. What are two special challenges that lay ahead for the Most Basin in the Czech Republic for recovery to continue and become permanent?
Scenarios

SCENARIO I
California Leads the Nation in Driving a Solution to Global Warming
California has passed legislation that approved the nation’s first rule to cut global warming pollution from cars. The new standard, which takes effect for new cars and light trucks beginning in 2009, will require automakers to reduce tailpipe emissions of CO2 and other pollutants by 30 percent with 2016 models. “With the Bush Administration and Congress refusing to take action on global warming, California is leading the way to show that Americans can help solve this problem,” says Natural Resources Defense Council Policy Director Roland Hwang (California Drives, Natural Resources Defense Council 2005, p.1).
Scenarios

SCENARIO I
California Leads the Nation in Driving a Solution to Global Warming

The new rule is highly supported in California, which has the largest auto market in the U.S. and buys about 1.7 million new cars and light trucks each year. But this new standard could also reach across the country. California was regulating tailpipe pollution (with stricter standards than the Clean Air Act) before the federal government passed the Clean Air Act, therefore, it has the authority to adopt its own motor vehicle standards. Seven states (including New York, New Jersey, and Massachusetts) use California’s stricter standards than those of the federal government’s.
Technology and Society: Issues for the 21st Century and Beyond

Scenarios

SCENARIO I
California Leads the Nation in Driving a Solution to Global Warming

• Therefore these same states and others are likely to also adopt California’s new global warming pollution standards. This could triple the number of cars required to cut global warming emissions and make a difference in U.S. emissions.
• The technology exists to make less-polluting cars, SUV’s, mini-vans, and pickups, but many automakers are attempting to block the new standard in courts, while the public is expressing its preference for cleaner cars with their high demand for the advanced hybrid cars from Toyota, Honda and Ford.
Scenarios

SCENARIO I
California Leads the Nation in Driving a Solution to Global Warming
“Automakers have fought every health and safety requirement from catalytic converters to seat belts,” says Hwang. “California’s plan is sensible, feasible, and legally sound. It’s time for automakers to innovate, not litigate.” (Natural Resources Defense Council California Drives, 2005, p.1).
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Scenarios

SCENARIO I
California Leads the Nation in Driving a Solution to Global Warming

Questions:

1. Research your state’s emissions and emission standards by using an almanac or other source. Calculate how much CO2 would be saved in your state from these emissions standards.

2. Considering the U.S. emits ¼ of the world’s CO2, research and calculate how much the U.S. would lessen its emissions from these standards.

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Scenarios

SCENARIO II

Earth Day 2000: A 30-Year Report Card

• On the first Earth Day in 1970, experts warned that the planet’s natural systems were being dangerously destabilized by human industry. Here is how we have fared on some key fronts since then:
  - Energy and the climate.
  - As our growing population increased its burning of coal and oil to produce power, the carbon locked in millions of years’ worth of ancient plant growth was released into the air, laying a heat-retaining blanket of carbon dioxide over the planet. Earth’s temperature increased significantly. Climate scientists had predicted that this increase would disrupt weather. And indeed, annual damages from weather disasters have increased over 40-fold.

Solution: A faster shift to nonpolluting, renewable solar, wind, and hydrogen energy systems.
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Scenarios

SCENARIO II
Earth Day 2000: A 30-Year Report Card

• Our consumption of chemicals has exploded, with about three new synthetic chemicals introduced each day. Almost nothing is known about the long-term health and environmental effects of new synthetics, so we have been ambushed again and again by belated discoveries. One of the most ominous chronic effects is that, as pesticide use has increased, so has the evolution of pesticide-resistant pests.

Solution: A large-scale shift to organic farming, a shift away from excessive consumption of synthetic chemical products, and application of the precautionary principle to the chemical industry.
Scenarios

SCENARIO II
Earth Day 2000: A 30-Year Report Card
• Population has increased as much in the past 30 years as it did in the 100,000 years prior to the mid-twentieth century. As the number of people has grown, the amount of land used by each person—either directly or through economic demand—has also expanded. As a result of this double expansion, incursions of human activity into agricultural and forested land have accelerated.
Solution: Stabilize population, especially by improving the economic and social status of women; design cities in ways that reduce distances traveled between home, work, shopping, and school; and in urban transit systems, shift emphasis from cars to public transportation, bicycling, and walking.
Technology and Society: Issues for the 21st Century and Beyond

Scenarios

SCENARIO II
Earth Day 2000: A 30-Year Report Card
• The global economy has more than doubled in the past 30 years, putting pressure on most countries to increase export income. Many have tried to increase revenues by selling more ocean fish—for which there is growing demand, since the increase in crop yields no longer keeps pace with population growth. The result is that overfishing is decimating one stock after another, and the catch is getting thinner and thinner.

Solution: Stabilize population growth, stop subsidizing fishing fleets, and end the practice of feeding ocean-caught fish to farmed fish (it takes five pounds of ocean catch to produce one pound of farmed fish), which is still a very profitable and common practice.
Technology and Society: Issues for the 21st Century and Beyond

“Earth is a Closed System...”