



## **SAVE THE ENVIRONMENT? SAVE MONEY?**

### **Unit Overview**

In the past, decisions on how to provide a service to humankind were often based on what was fastest and least expensive to accomplish. After years of neglecting the environmental consequences of our actions, we now have to deal with pollution of our air, soil, and water. Toxins in our food are now causing us to be concerned about how we are managing our natural resources. Is using the most readily available energy sources the best for our planet in the long run? How can we take care of our planet and still provide for our needs and desires. How can we help the under developed nations avoid some of our mistakes? These and other questions are dealt with as you study this unit.

### **The Controversy**

A little over two hundred years ago when the United States was in its infancy, few people anywhere in the world worried about the environment. The global population was not nearly as large as now, and the Industrial Revolution was just beginning in Europe. Coal was being burned in large quantities, and, within several decades, would be used to make iron and steel, and also electricity. Coal produced dirty smoke and odors, but that was the price which was paid for a good source of heat and energy to power steam engines that ran many of the early factories. The Industrial Revolution emerged first in Great Britain. At the beginning of the 1800s, people began moving from the farms where wages were low, and machines were beginning to replace the hired hands. By 1851, half of the population of England lived in London. Houses built for the factory workers and their families were small and poorly constructed. There was no running water, and there were no toilets. Along the street there was one pump and two toilets for all the residents to use. There was no system to dispose of household waste, so it was thrown into the streets. Predictably, disease spread through the



crowded urban areas. In 1832, 31,000 people in England died of cholera. Typhus, dysentery, and small pox also killed many.

Coal mines were also very dangerous places to work with dust and cave-ins constantly threatening workers' lives. The chilly, damp atmosphere within the mines also led to respiratory illnesses. Children, often forced to work in mines or factories, worked long hours and were often mistreated. Many suffered injuries or death. In the cotton mills, hands could be crushed or hair could get caught in the machines, scalping the victims or killing them outright. In match factories, children were employed to dip matches in phosphorus. Exposure to this element could rot their teeth or harm their lungs.

Later in the nineteenth century, the United States endured similar problems. In 1860 there were only nine cities in the U.S. with populations over 100,000, but by 1900, there were 38 such cities. Children often suffered ill effects from factory work here, as well. Eventually, both countries enacted laws to protect workers from unsafe working conditions. Children under a certain age were completely barred from work in factories. As cities grew, forests were cut down to build houses and factories. This destroyed habitat for plants and animals. More roads were built and, with the invention of the steam engine, railroads became popular. Miles of railways were constructed to bring raw materials to the factories and take products to markets. Machines required an energy source, so coal mining increased, which also affected habitat and the quality of land, air, and water.

In the mid 1800s the first oil well was drilled, but it was not until the end of that century, when the automobile was introduced, that the use of petroleum dramatically increased. Early in the 1900s, Henry Ford's inexpensive automobiles greatly increased the use of petroleum since more people could afford cars. In addition to the increased mining of coal, large numbers of oil wells were being drilled. In early drilling operations, pressure under the ground would, at times, send the oil gushing into the air. These "gushers" created pollution in the area where the oil landed.

On the positive side, some improvements in people's lives resulted. Many had more money to buy goods, and more products were now available for sale. Health care was slowly improving, but there was now more exposure to harmful chemicals than ever before, which could harm one's health.

Where will all this lead? Can we produce new products and labor-saving devices and still maintain our health and the environment of our planet? Let's examine some modern day problems and their possible solutions.



## Protection or Destruction of Forests?



Deforestation by burning the rainforest increases global warming.

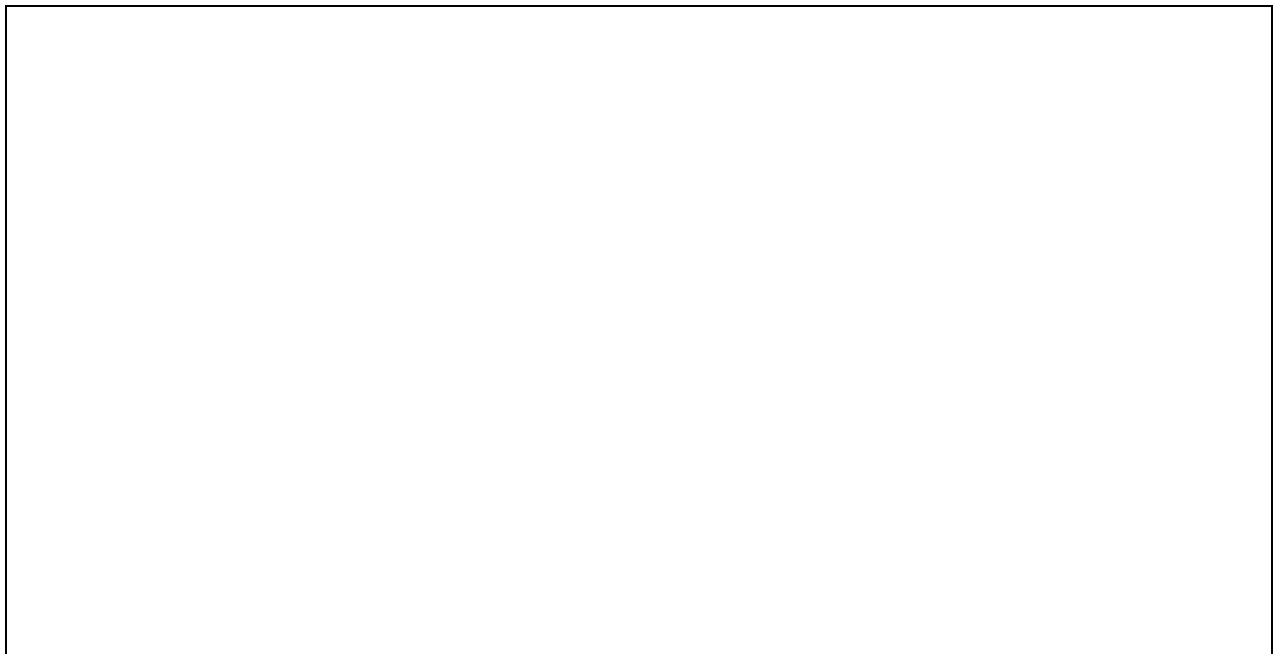
Forests serve important ecological purposes by serving as a habitat for plants and animals. Soil is conserved by plant and tree roots holding it so it is not washed away. Roots also help to regulate water supply by absorbing rainfall instead of having it run off into streams and lakes or evaporate into the atmosphere creating more rainfall. The trees themselves and other forest plants provide lumber, ingredients for drugs and medicines, and attract tourists who like to hike, hunt, and fish in these areas. There are over 5000 products made from trees, including toothpaste and clothing. Forests in Central Africa are home to 8000 species of plants. In addition, the forests provide the setting for the process of photosynthesis, which consumes carbon dioxide and creates oxygen. For this reason, some call rainforests the “lungs of the earth.” More than one-fifth of the oxygen produced in the world comes from the Amazon rainforest. As the carbon dioxide is used, the amount in the atmosphere is lowered and the greenhouse effect, which produces global warming, is slowed.



However, an area the size of a football field of rainforest is destroyed every second to supply timber and to create open land for agriculture and ranching. Clear-cutting is an easy method of lumbering since whole areas are stripped of trees rather than selectively cutting only the mature trees. This results in erosion of topsoil into the rivers, thus reducing the fertility of the soil. Increases in carbon dioxide and reduction of oxygen in the atmosphere result. Biodiversity, the number of different kinds of plants and animals, is reduced. Scientists estimate we are losing 137 species a day, and many of these organisms are not even known. They are becoming extinct, so we will never know if they might produce substances to fight disease or improve our society. Fifteen ton machines with eight-foot cutting discs chop up trees into bits smaller than a matchbox to be made into cardboard and chipboard.

## **Land Use Practices – Wise or Unwise?**

Careful use of land is important to provide food and resources for the world's population. Only about two and a half percent of the surface of the earth is available for crop production and only about six and one-half percent is usable as pasture land. This means we must take proper care of the farm land that is available to raise food for the entire planet. At times, land is cleared that is not the best for raising crops. This is true in the Amazon rainforest where the thin topsoil can quickly be eroded away after the trees are removed. Similarly, some areas become very dry even though the topsoil may be adequate. In the United States in the 1930s, the Dust Bowl was an area in the southern Great Plains where, after several years of drought, crops could not grow. When the wind blew, huge amounts of topsoil became airborne and darkened the sky. Families left areas of Kansas, Arkansas, Oklahoma, Texas, Nevada, and New Mexico to find work or land elsewhere, since they were starving and had no money. This plight lengthened the effects of the Great Depression in the United States. John Steinbeck's novel, *The Grapes of Wrath*, is a tale of families leaving the dust bowl to find a livelihood in California.





Dust Bowl scene in the 1930s – windblown topsoil creates air pollution and the loss of rich soil.

After the wind dies down, soil is piled in drifts

The process which gradually destroys land by over cultivation and overgrazing and depletes the soil, leading to wind and water erosion, is known as **desertification**. If not corrected, the land can be useless. This is a growing problem throughout the world. It usually occurs on semi-arid land and is aided by drought. Over cultivation destroys the nutrients in the soil, and overgrazing can destroy the vegetation. With the vegetation gone, water and wind wash and blow the topsoil away, and, in a few seasons, centuries of build-up of soil can be lost.



In the winter of 1995-96, South Dakota soil from fall plowing blows into 2 to 3 feet drifts.(above left)

An area that has suffered devastating famine and starvation in the early 1970s was sub-Saharan Africa. This is the region south of the Sahara Desert and north of the moist savannahs or plains of Africa. Depletion of the soil, caused by rapid population growth and six years of drought, led to the death of 200,000 people and millions of cattle. Deforestation, the removal of trees, and poorly controlled irrigation can also lead to desertification. Over half of all dry lands in the world have suffered some damage. Many of these are in North America.

Thirty percent of the U.S. lands west of the Mississippi River and three of the provinces in Canada have experienced desertification. Other areas in Asia, China, Latin America, and even Iceland are facing problems. The loss of soil creates silting in rivers and air pollution. In April of 2001, a yellowish cloud of soil from China was tracked by satellite across the United States to the Atlantic Ocean.

When the soil is depleted, it leads to social unrest and poverty, forcing people to move or starve. There are ways to combat this process, but it requires action on the part of local groups and governments. When some of the productive soil is removed from the agricultural resources, people must be given other means of earning a living. Rotating crops and terracing the soil into steps on sloped areas can help maintain the soil. Rotating crops includes growing row crops one year and then a crop which holds soil better, like hay or wheat, the next year. In 1992, the United Nations held an "Earth Summit" to address the desertification throughout the world. One of the outcomes was to encourage the developed nations to support the developing nations in combating the land devastation problems. Local peoples and governments must also get involved, especially women in the less-developed countries who are in charge of the growing of crops for their families. Educating them in ways to avoid soil destruction and/or providing jobs so they no longer have to farm can help solve the problem. Secretary General Kofi Annan of the United Nations stated on the World Day to Combat Desertification that "fighting desertification must be an integral part of our wider efforts to eradicate poverty and ensure long-term food security." We must work towards "achieving sustainable development for all, including the dry land rural areas where the world's poorest people live." In the United States, individual states are responsible for tackling the problem. But, as a nation, we must assume responsibility to help those nations that are less wealthy than ours to combat the problem within their borders.

Urbanization, the development of cities as people move from rural areas to towns, creates problems. If growth is too rapid, problems in providing sanitation, utilities, and proper housing result. Today, instead of London, England, it is the cities of Africa, Asia, Latin America, and the Caribbean that have these problems. In the slums of Nairobi, Kenya, there is only one toilet for every 150 people. Waste water runs into the streets creating water-borne disease problems. Carbon dioxide and nitrogen oxide produced from factories and vehicles pollute the air causing respiratory problems, such as bronchitis and asthma. Crime and poverty are often the end results of rapid urbanization. The growth of cities also causes valuable irreplaceable farmland to be used as sites for factories and homes. This lowers the ability of the country to produce food for its people. Those people who have moved to the city own no land and cannot produce food for them anymore.

As stated in earlier units, extracting our natural resources from the soil can also harm the environment if not done wisely. In the past when coal was removed by strip mining, the dirt and rocks that were blasted away to reach the coal seam was simply left in piles and the high wall or tall cliff that resulted was left after the coal seam was depleted. This left the land permanently scarred and very dangerous. Little could be done with the land which had been stripped of its topsoil and large depressions carved out of it. These frequently filled with water and became strip pits that were often overly acidic due to the presence of minerals deep in the soil that dissolved into the water. This was also the cause of acid mine drainage from shaft mines that had been dug deep into the earth and polluted local streams. Fortunately, the Environmental Protection Agency now requires all operators of stripped areas, including those who practice mountaintop removal, to return the land to close to its original condition. This requires the saving of topsoil so that it can be replaced back over the less fertile subsoil. Bulldozers must move the dirt to fill in the depressions and remove the dangerous high walls. Grasses are planted and cattle can graze in this area soon after the mining operation stops. After a number of years the land can be used for other purposes. Deep mines now must be sealed to prevent the seepage of mine acid into local waterways. Even though these methods increase the cost of mining, they are protecting our land and making it more valuable for future generations.

## **Water, Water Everywhere, But How Much Of It Can We Drink?**

Our planet is unique in that so much of it is covered by water, nearly three-fourths of the earth's surface. Yet, only 2.5% is fresh water and 87.5% of the fresh water is in the form of ice. Only .008% of the water on our planet is available for human use. We cannot change the amount and if we continue to pollute it, the amount will decrease. An increasing population requires more, not less, water. Of the 6 billion people on earth now, it is estimated that about 1.3 billion do not have access to clean water. Water pollution from sewage leads to water-borne disease outbreaks. It is estimated that seven children die per minute worldwide due to water pollution and 25 million people per year die from water pollution.

Other causes of water pollution include the use of fossil fuels which place sulfur and nitrogen oxide into the air as well as mercury vapor. The oxides cause acid rain which can severely disrupt the health of our lakes. Mercury can enter the food chain by contaminating water. Fish ingest a

form of mercury that dissolves in water and pass it on to other animals that eat them. Improper application of fertilizers can cause **eutrophication**, when waterways become over-fertilized from run-off from fields, and water plants grow wildly, choking waterways and diminishing the oxygen in the water available for fish. This happens because, as the plants die, their decomposition removes oxygen from the water. Until it was banned, DDT, used as a pesticide, was entering the water and causing detriment to fish and particularly to birds of prey that ate them. This included osprey, eagles, condors, and falcons.



Waste from a pulp mill pollutes the Columbia River in Washington State in September of 1972. (above left)

Irrigation, which is the use of underground water to water crops, can waste as much as 50 to 70% of the water by not directing it properly or using too much or watering at the wrong time when most of it evaporates instead of soaking into the soil. This depletes our sources of underground water. Urbanization can add to this depletion problem by requiring vast amounts of water from wells or from reservoirs. If rainfall diminishes, water supplies are in trouble. Water is not only used for drinking and cooking, but also to wash clothes and cars, to water lawns, for cooling processes in industry and to serve as a solvent in industrial processes. In our country, Las Vegas, Nevada, which lies in an arid part of our country, is one of the fastest growing urban areas. Satellite data show less green than average on the earth's surface in Las Vegas, except where there are golf courses or cemeteries. This urban area is taking more water from an already water-starved area of the United States.

As discussed in earlier units, chemicals used in our society often find their way into waterways and sometimes cause problems. Not only do fertilizers from farmland over-fertilize water

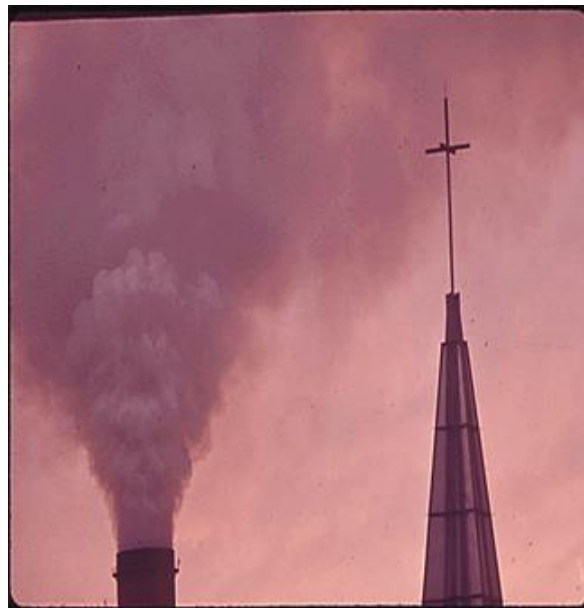


creating too much plant growth, but pesticides, such as DDT, and industrial chemicals, like PCBs, can enter the food chain through the fish and other organisms that live in our waters.

## **This is the Air We Breathe**

Air pollution, like water pollution, is also the result of technological developments. Beginning with the Industrial Revolution, which dramatically increased the use of fossil fuels, vast amounts of carbon dioxide, methane, mercury, and nitrogen oxides have been released into the air. This causes an increase in the average temperature of the earth. Without greenhouse gases, the earth's temperature would plummet from an average of 15 degrees Celsius (59 degrees Fahrenheit) to -18 degrees Celsius (-4 degrees Fahrenheit). This would severely limit the amount of food that we could grow. However, the last 100 years has seen an increase in carbon dioxide of more than 25%.

It is predicted that in the next 50 years temperatures will increase an average of 3 to 5 degrees and melt more of the polar ice caps. This could cause ocean levels to increase by as much as 14 feet.



May 1973, Kaiser aluminum plant belching fumes over a residential area in New Orleans, Louisiana. (above left)

To combat this on a global scale, the Kyoto Protocol, an agreement written by 160 industrialized nations to lower their emissions of greenhouse gases to 1990 levels, was written. These gases

include carbon dioxide, methane, and nitrogen oxides plus three others. To take effect, 55 of the nations that produce 55% of the gases must ratify it. The United States has not ratified it because we feel it would create economic problems for our industries. The United States produces 36% of these greenhouse gases due to our great reliance on fossil fuels to run our factories, power plants, and transportation systems. Instead, President Bush has vowed to reduce greenhouse gases by 18% by 2012. In order to accomplish this, we need to find more fuel efficient methods so less fuel is burned to accomplish the same amount of work. For example, more fuel efficient cars could reduce the amount of gasoline used. Technologies have already been developed to clean the air (scrubbers and electrostatic precipitators) but even more efficient methods may be developed. The use of renewable sources of energy must be increased, especially wind and biomass. Even though biomass does release carbon dioxide, it is used up by other plants to produce more biomass. More use of natural gas and nuclear energy to produce electricity will also help. Although natural gas is a fossil fuel, it produces less carbon dioxide than either petroleum or coal.

Other more natural ways to combat global warming are to reforest areas and use the ocean. Forests can absorb huge amounts of carbon dioxide in a relatively short period of time by photosynthesis. However, when trees are burned during forest fires or to clear forests and when plants decompose, the carbon dioxide is released. Oceans, on the other hand, can absorb as much as one-half of the carbon dioxide produced by fossil fuels. Coral reefs use a large amount to produce their skeletons which are composed of carbonates. Phytoplankton in the top 50 meters of ocean water use carbon dioxide through photosynthesis. When ocean plants die and sink to the bottom, they release carbon dioxide as they decompose but this can dissolve in ocean water, especially in colder areas, and be held in solution for as long as a thousand years. Research is being done on the possibility of pumping carbon dioxide into the ocean to dissolve it. Adding nutrients to the ocean to increase the growth of phytoplankton is also being studied.

Ozone is another gas in the atmosphere that affects the health of our planet. The pungent smell after a thunderstorm is the result of the production of ozone. In larger concentrations, it can irritate lungs and eyes. Ozone is also created by automobile exhausts and can lead to respiratory problems in the young, the elderly, and others suffering from respiratory diseases. This is especially noticeable in areas like Los Angeles that have a high population density and an abundance of cars. When smoke and fog along with other contaminants mix, the condition is known as smog, a form of air pollution.



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Above: Hollywood-freeway in Los Angeles, California, May 1972 Right: Smog evident over Los Angeles, California, May 1972

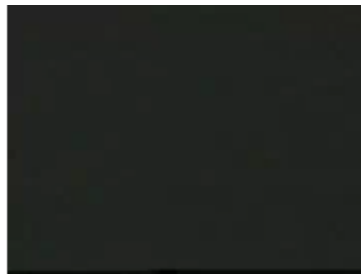
However, the ozone layer in our stratosphere (35 to 58 miles high) protects against the ultraviolet rays from outer space, mainly from the sun. These rays when can cause skin cancers and cataracts. Over a period of years, it appears that this ozone layer is becoming thinner, especially over Antarctica. As a result we have seen an increase in skin cancer and cataracts. People are being warned to limit exposure to sunlight and to use sunscreen as a preventive. In the 1980s the United States banned the use of CFCs (chlorofluorocarbons) which are chemicals used as refrigerants, solvents, cleaning fluids, propellants in aerosol cans, and foaming agents in the production of foam plastics such as Styrofoam. Other chemicals have had to be found to replace them. Some of these are more expensive and/or less efficient but more **environmentally friendly**. To be environmentally friendly, a product must cause little harm to the environment during its production. By 1996, many other nations agreed to limit production of these chemicals. Why? They are thought to destroy the ozone in the stratosphere. It is hoped that the ozone layer will now begin to be restored.

## What Is Being Done?

On a national level, the United States established the Environmental Protection Agency (EPA) to protect the national public health and the environment in December of 1970. Its purpose was to find ways to clean up and prevent pollution, to see that environmental laws are followed, to help the states develop new air quality standards, to use scientific research to educate the nation about environmental issues, and to set national health-based standards for air pollution and for auto emissions. Some of the activities of the EPA are:

- the limiting of exposure to lead, especially children, including the phasing out of lead in gasoline
- placing limits on industrial water pollution
- requiring cars to have catalytic converters to reduce emissions
- phasing out PCBs, DDT, and CFCs – harmful chemicals to the environment and human health
- creating a Superfund to finance the cleanup of toxic waste dumps from industry
- encouraging efforts to stop the depletion of ozone worldwide
- requiring industry to keep records of the location, quantity, use, and disposal of toxic material and make these records available to the public
- fining industries who pollute the environment (example: fining Exxon over 950 million to clean up the Exxon *Valdez* oil spill)
- requiring the U.S. government to use recycled products and to recycle
- alerting the public to the dangers of second-hand smoke

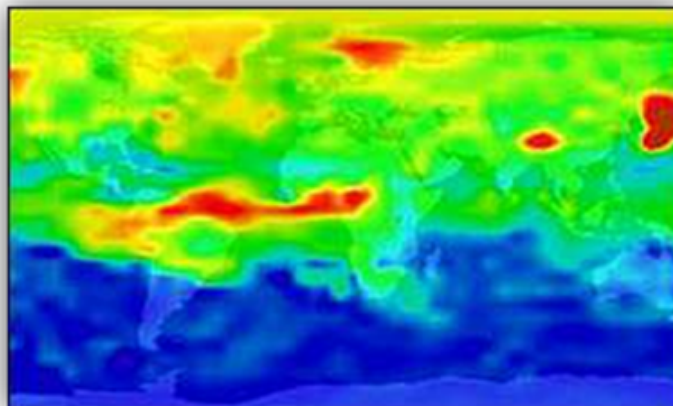
These efforts are making the United States a safer place to live and are protecting our nation's resources.





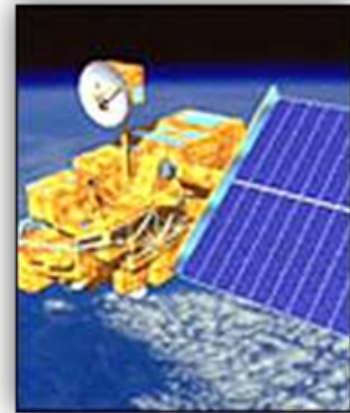
A young osprey on its nest in the Chesapeake Bay region after the DDT ban. DDT caused shell-thinning in birds of prey that fed on fish. Often eggs never hatched.

The National Aeronautics and Space Administration (NASA) have launched several satellites that monitor environments around the globe. The newest is the TERRA earth-observing satellite. It was launched in December of 1999 and began sending data in March of 2000. It has 5 different monitoring devices. One monitors the amount of moisture in the soil and can sense minerals and land surfaces as small as 50 feet across. Another attempts to understand Earth as a balanced energy system by measuring the warming and cooling caused by clouds, how much sunlight is reflected by water, the atmosphere, and land, and how much energy is absorbed and then emitted as heat. A third takes 3-dimensional pictures of clouds and monitors nine different aerosols. **Aerosols** are airborne particles. TERRA, for example, can identify dust from a desert, smoke from a forest fire, pollution from a factory, and volcanic ash. About 10% of aerosols are from human sources. They can cool the planet by blocking sunlight or changing cloud formation. The fourth device can detect 36 different wavelengths of light to determine ocean temperature, the movement of phytoplankton in the ocean, and whether plants on land have been destroyed or replenished. The fifth device tracks the production and paths of methane and carbon monoxide. These are products of fossil fuel burning, livestock, landfills, forest fires, and rice farming.



**Above:** The red spots indicate carbon monoxide, CO. Sources of this are: air pollution from US forest fires in summer, emissions from the burning of fossil fuels in the Northern Hemisphere during winter, and from forest and grassland fires in Africa and South America during the dry season.

The United States Geological Survey has the world's largest data base of earth science information. It is known as EROS (Earth Resources Observation System). Earlier NASA satellites, called Landsat, were also remote sensing satellites that could detect earth surface changes such as deforestation or crop disease. Many of them have since been sold to private companies. Other satellites can detect ozone levels or provide weather information.



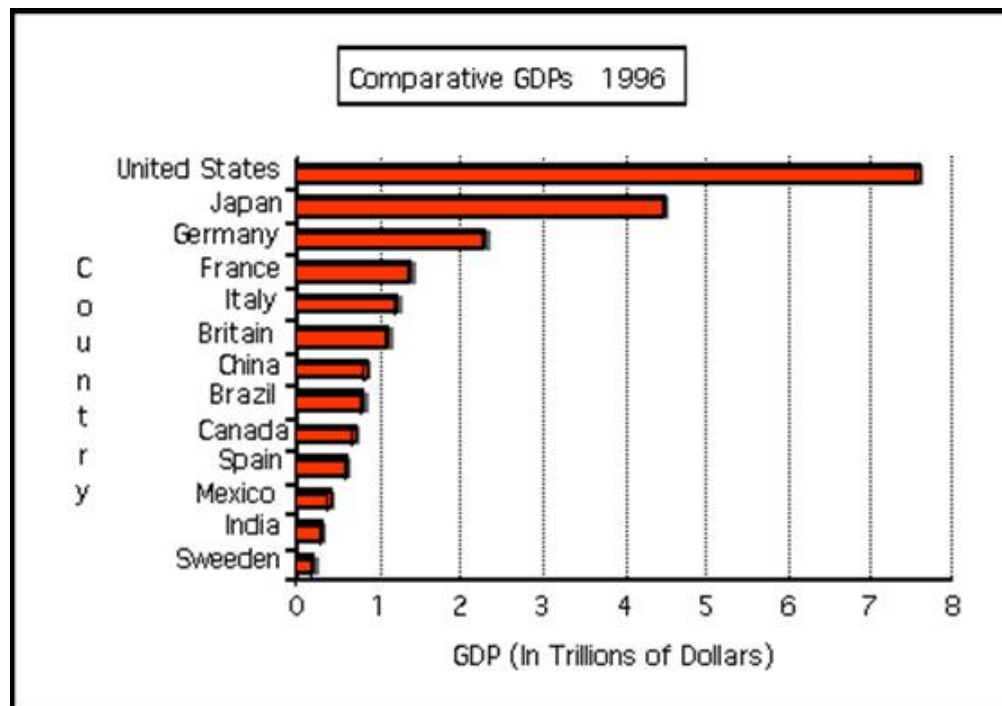
Another method of protecting the global environment is through trade agreements with other nations. The World Trade Organization (WTO) regulates international trade law and some feel that it will lower environmental standards since American companies can produce products more cheaply if they do not have to meet environmental standards. This would make them more competitive worldwide. In addition, the General Agreement on Tariffs and Trade (GATT) does not allow a country to refuse to accept a product based upon whether environmentally friendly methods were used in its production. People opposed to this said that US companies would try to get environmental standards lowered or move their plants to countries where environmental standards were lower. However, this turned out not to be the case at least in one instance.

In 1991 the Tuna-Dolphin Dispute broke out between Mexico and the United States. U.S. fishermen were limited to how many dolphins could be killed in the nets that were set to catch tuna whereas Mexico had no such limitation. The U.S. protested but it was not upheld. In response U.S. tuna canners labeled their tuna as “dolphin safe” meaning that they did not kill excessive amounts of dolphins. U.S. consumers who wanted the dolphins protected would only buy cans labeled “dolphin safe”. The next year the United States and nine other countries including Mexico signed an agreement that set a limit on the amount of dolphins that could be killed while fishing for tuna. Worldwide dolphin deaths decreased from 100,000 in 1989 to 3600 in 1993. Public concern had made the difference.

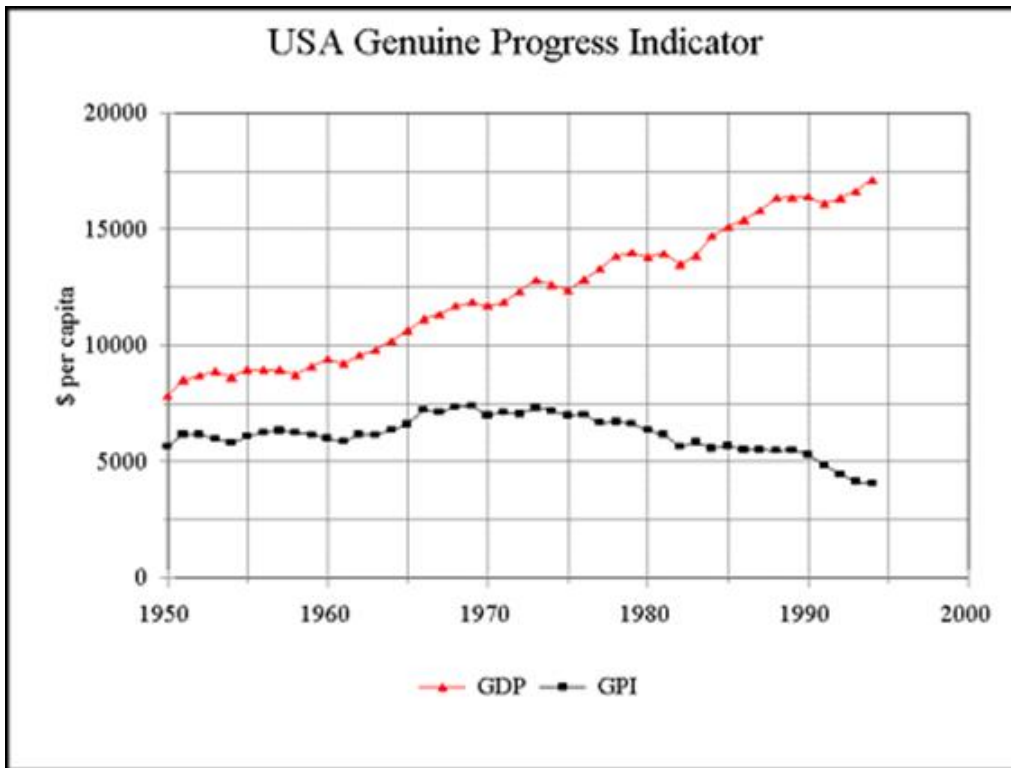
About this time, the North American Free Trade Agreement or NAFTA was signed. This was a **green** free trade agreement, meaning it made environmental concerns part of the agreement. The U.S. or any country could deny entry of any product from another country that did not meet national standards. Individual states could even enact tougher restrictions than the federal government if they so desired. Therefore, if a country manufactured an item using methods that polluted the environment, a country could refuse to import it based on that fact.

This brings us to a question: How do we measure the well-being of a country? Until recently this was done by using a number called the Gross Domestic Product (GDP) which was the market value (selling totals) of all the goods and services produced in a country in a given year. An increase in the GDP is either a reflection of population growth or the consumption of more goods per person. It is also an indication that more resources, both materials and energy sources, are being consumed. If we look at the following graph, we will see that, in the U.S., the GDP has steadily increased. Does this mean the U.S. is increasing the quality of life for its citizens? Perhaps not, because it does not include the effects of using these natural resources or the health effects from this production. It also underestimates the positive effects on society of using energy efficient methods which may not be the cheapest way to produce goods. Nor does it take note of foods individuals produce themselves or of volunteer work they may do. Nor does it indicate if the production of these products changes the spread of income and harmful effects over the population as a whole. That is, do some parts of the society benefit from this production while others are made poorer in money or in health than the others?

A better indicator is the Index of Sustainable Economic Welfare (ISEW) or Genuine Progress Indicator which includes environmentally important topics, such as dependence on nonrenewable energy sources, loss of wetlands or farmlands, and the cost of air and water pollution, the effect on ozone depletion and global warming, and whether it causes incomes of the population to be unequally varied. That is, do the poor get poorer and the rich get richer? If we look at the graph below, we can see that, since 1976, the United States has shown a decline in economic health if we consider quality of life.



The graph at the above left shows the production of goods in the United States in 1996 was far greater than many other countries. But does this have anything to do with the quality of our lives, our health, and our environment?



This graph charts the Gross Domestic Product for the United States from 1950 to 1994 in red. As you can see, it steadily raises showing that the value of our products per person has steadily increased. The Genuine Progress Indicator shown in black takes into effect the negative aspects of production – the pollution created, the use of resources, the negative health and economic effects on the citizens. Since 1969 this has shown a decrease. Does this mean we need to pay more attention to the negative effects of production?

### **Is our quality of life really improving?**





## Unit Conclusions

When the Industrial Revolution began, many people thought that everyone's standard of living would improve. Wages were higher and more products were available to make our lives easier. But the costs of this production in the areas of use of resources and health were not being measured. As pollution of water, air, and land increased due to the use of fossil fuels and the shift and growth in population, some parts of the population were made to live in poor housing and work in unsafe conditions, causing their health to suffer. Poor agricultural practices led to desertification in many areas with people starving or forced to move elsewhere. After a couple of hundred years the negative effects of industrialization and population growth are taking their toll. Americans and others around the globe are awakening to the fact that the planet must be protected from pollution of air, water, and soil. Methods that protect the environment must be used even if they make a product or crop cost more. The public must be educated to recycle, reuse, and reduce the amount of materials they use. Governments must agree to set limits on the amount they add to global warming and must use their knowledge and resources to help other less developed countries avoid some of the mistakes those developed nations have made. If we are to lower poverty and starvation, we must take good care of our water, land, and atmosphere. Even in America, it is time to wake up and improve.