

# What Is Environmental Science?

- **Environmental Science** is the study of the air, water, and land surrounding an organism or a community, which ranges from a small area to Earth's entire biosphere.
- It includes the study of the impact of humans on the environment.

# The Goals of Environmental Science

- A major goal of environmental science is to understand and solve environmental problems.
- To accomplish this goal, environmental scientists study two main types of interactions between humans and their environment:
  - 1) How our actions alter our environment.
  - 2) The use of natural resources.

# Many Fields of Study

- Environmental science is an interdisciplinary science, which means that it involves many fields of study.
- Important to the foundation of environmental science is ecology.
- **Ecology** is the study of interactions of living organisms with one another and with their environment.

# Many Fields of Study

## Major Fields of Study That Contribute to Environmental Science

**Biology** is the study of living organisms.

**Zoology** is the study of animals.

**Botany** is the study of plants.

**Microbiology** is the study of microorganisms.

**Ecology** is the study of how organisms interact with their environment and each other.

**Earth science** is the study of the Earth's nonliving systems and the planet as a whole.

**Geology** is the study of the Earth's surface, interior processes, and history.

**Paleontology** is the study of fossils and ancient life.

**Climatology** is the study of the Earth's atmosphere and climate.

**Hydrology** is the study of Earth's water resources.

**Physics** is the study of matter and energy.

**Engineering** is the science by which matter and energy are made useful to humans in structures, machines, and products.

**Chemistry** is the study of chemicals and their interactions.

**Biochemistry** is the study of the chemistry of living things.

**Geochemistry**, a branch of geology, is the study of the chemistry of materials such as rocks, soil, and water.

**Social sciences** are the study of human populations.

**Geography** is the study of the relationship between human populations and Earth's features.

**Anthropology** is the study of the interactions of the biological, cultural, geographical, and historical aspects of humankind.

**Sociology** is the study of human population dynamics and statistics.

# Scientists as Citizens, Citizens as Scientists

- Governments, businesses, and cities recognize that studying our environment is vital to maintaining a healthy and productive society.
- Thus, environmental scientists are often asked to share their research with the world.
- However the observations of nonscientists are the first steps toward addressing an environmental problem.

# Our Environment Through Time

- Wherever humans have hunted, grown food, or settled, they have changed the environment.
- For example, the environmental change that occurred on Manhattan Island over the last 300 years was immense, yet that period of time was just a “blink” in human history.

# Hunter-Gatherers

- Hunter-gatherers are people who obtain food by collecting plants and by hunting wild animals or scavenging their remains.
- Hunter-gatherers affect their environment in many ways:
  - 1) Native American tribes hunted buffalo.
  - 2) The tribes also set fires to burn prairies and prevent the grow of trees. This left the prairie as an open grassland ideal for hunting bison.

# Hunter-Gatherers

- In North America, a combination of rapid climate changes and overhunting by hunter-gatherers may have led to the disappearance of some large mammal species, including:
  - 1) giant sloths
  - 2) giant bison
  - 3) mastodons
  - 4) cave bears
  - 5) saber-toothed cats



# The Agricultural Revolution

- **Agriculture** is the raising of crops and livestock for food or for other products that are useful to humans.
- The practice of agriculture started in many different parts of the world over 10,000 years ago.
- The change had such a dramatic impact on human societies and their environment that it is often called the agricultural revolution.

# The Agricultural Revolution

- The agricultural revolution allowed human populations to grow at an unprecedented rate.
- As populations grew, they began to concentrate in smaller areas placing increased pressure on the local environments.

# The Agricultural Revolution

- The agricultural revolution changed the food we eat.
- The plants we grow and eat today are descended from wild plants.
- However, during harvest season farmers collected seeds from plants that exhibited the qualities they desired, such as large kernels.
- These seeds were then planted and harvested again. Overtime, the domesticated plants became very different from their wild ancestors.

# The Agricultural Revolution

- Many habitats were destroyed as grasslands, forests, and wetlands were replaced with farmland.
- Replacing forest with farmland on a large scale can cause soil loss, floods, and water shortages.

# The Agricultural Revolution

- The slash-and-burn technique was one of the earliest ways that land was converted to farmland.
- Much of this converted land was poorly farmed and is no longer fertile.

# The Industrial Revolution

- The Industrial Revolution involved a shift from energy sources such as animals and running water to fossil fuels such as coal and oil.
- This increased use of fossil fuels changed society and greatly increased the efficiency of agriculture, industry, and transportation.
- For example, motorized vehicles allowed food to be transported cheaply across greater distances.

# The Industrial Revolution

- In factories, the large-scale production of goods became less expensive than the local production of handmade goods.
- On the farm, machinery reduced the amount of land and human labor needed to produce food.
- With fewer people producing their own food, the populations in urban areas steadily grew.

# Improving the Quality of Life

- The industrial Revolution introduced many positive changes such as the light bulb.
- Agricultural productivity increased, and sanitation, nutrition, and medical care vastly improved.



# Improving the Quality of Life

- However, the Industrial Revolution also introduced many new environmental problems such as pollution and habitat loss.
- In the 1900s, modern societies began to use artificial substances in place of raw animals and plant products.
- As a result, we now have materials such as plastics, artificial pesticides, and fertilizers.

# Improving the Quality of Life

- Many of these products make life easier, but we are now beginning to understand some of the environmental problems they present.
- In fact, much of environmental science is concerned with the problems associated with the Industrial Revolution.

# Spaceship Earth

- Earth can be compared to a spaceship traveling through space as it cannot dispose of its waste or take on new supplies.
- Earth is essentially a closed system.
- This means that the only thing that enters the Earth's atmosphere in large amounts is energy from the sun, and the only thing that leaves in large amounts is heat.

# Spaceship Earth

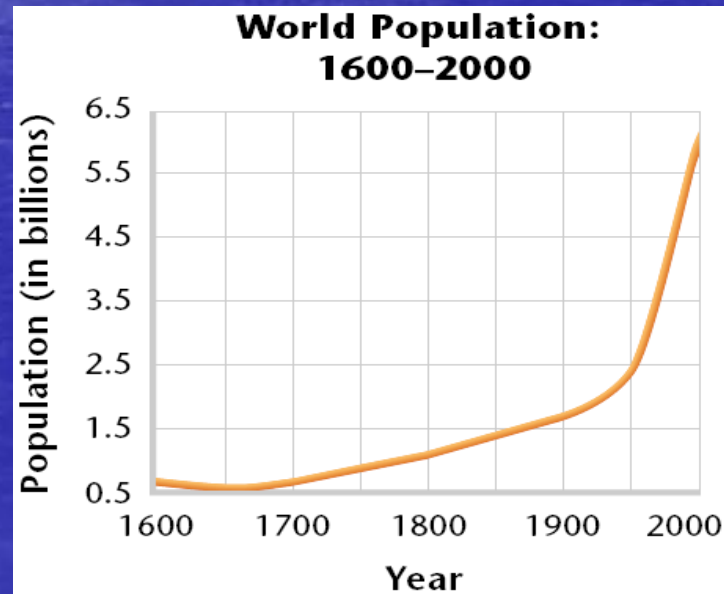
- This type of closed system has some potential problems.
- Some resources are limited and as the population grows the resources will be used more rapidly.
- There is also the possibility that we will produce wastes more quickly than we can dispose of them.

# Spaceship Earth

- Environmental problems can occur on different scales: local, regional, or global.
  - A local example would be your community discussing where to build a new landfill.
  - A regional example would be a polluted river 1000 miles away affecting the region's water.
  - A global example would be the depletion of the ozone layer.

# Population Growth

- The Industrial Revolution, modern medicine, and sanitation all allowed the human population to grow faster than it ever had before.



# Population Growth

- In the past 50 years, nations have used vast amounts of resources to meet the world's need for food.
- Producing enough food for large populations has environmental consequences such as habitat destruction and pesticide pollution.

# Population Growth

- Most scientists think that the human population will almost double in the 21st century before it begins to stabilize.
- Because of these predictions, we can expect the pressure on the environment will continue to increase and the human population and its need for food and resources grow.



# What are our Main Environmental Problems?

- Environmental problems can generally be grouped into three categories:
  - 1) Resource Depletion
  - 2) Pollution
  - 3) Loss of Biodiversity

# Resource Depletion

- **Natural Resources** are any natural materials that are used by humans, such as, water, petroleum, minerals, forests, and animals.
- Natural resources are classified as either a renewable resources or a nonrenewable resource.

# Resource Depletion

- Renewable resources can be replaced relatively quickly by natural process.
- Nonrenewable resources form at a much slower rate than they are consumed.

Renewable and Nonrenewable Resources	
Renewable	Nonrenewable
energy from the sun	metals such as iron, aluminum, and copper
water	nonmetallic materials such as salt, sand, and clay
wood	
soil	
air	fossil fuels

# Resource Depletion

- Resources are said to be depleted when a large fraction of the resource has been used up.
- Once the supply of a nonrenewable resource has been used up, it may take millions of years to replenish it.
- Renewable resources, such as trees, may also be depleted causing deforestation in some areas.

# Pollution

- **Pollution** is an undesirable change in the natural environment that is caused by the introduction of substances that are harmful to living organisms or by excessive wastes, heat, noise, or radiation
- Much of the pollution that troubles us today is produced by human activities and the accumulation of wastes.

# Pollution

- There are two main types of pollutants:
  - Biodegradable pollutants, which can be broken down by natural processes and include materials such as newspaper.
  - Nondegradable pollutants, which cannot be broken down by natural processes and include materials such as mercury.

# Pollution

- Degradable pollutants are a problem only when they accumulate faster than they can be broken down.
- However, because nondegradable pollutants do not break down easily, they can build up to dangerous levels in the environment.

# Loss of Biodiversity

- Biodiversity is the variety of organisms in a given area, the genetic variation within a population, the variety of species in a community, or the variety of communities in an ecosystem.
- The organisms that share the world with us can be considered natural resources.
- We depend on them for food, the oxygen we breathe, and for many other things.