

Chapter 1: Environmental Problems, Their Causes, and Sustainability



What is Environmental Science?

- Interdisciplinary science connecting information and ideas from natural sciences, physical sciences, social sciences, and humanities
- Goals are to learn:
 - how nature works
 - how the environment affects us
 - how we affect the environment
 - how we can live more sustainably without degrading our life-support system
- Environmental Science is interdisciplinary
- Not a social movement

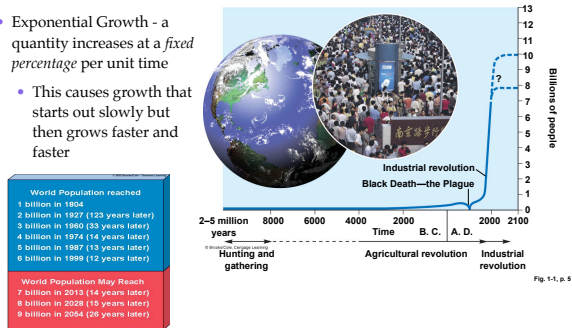
Table 1-1
Major Fields of Study Related to Environmental Science

Major fields	Subfields
Biology: study of living things (organisms)	Ecology: study of how organisms interact with one another and with their evolving environment Botany: study of plants Zoology: study of animals
Chemistry: study of chemicals and their interactions	Biochemistry: study of the chemistry of living things
Earth science: study of the planet as a whole and its functioning systems	Climatology: study of the earth's atmosphere and climate Geology: study of the earth's origin, history, surface, and interior processes Hydrology: study of the earth's water resources Paleontology: study of fossils and ancient life
Social sciences: studies of human society	Anthropology: study of human cultures Demography: study of the characteristics of human populations Geography: study of the relationships between human populations and the earth's surface features Economics: study of the production, distribution, and consumption of goods and services Political science: study of the principles, processes, and structure of government and political institutions History: study of information and ideas about humanity's past Ethics: study of moral values and concepts concerning right and wrong human behavior and responsibilities Philosophy: study of knowledge and wisdom about the nature of reality, values, and human conduct

© Brooks/Cole, Cengage Learning

Exponential Age

- Exponential Growth - a quantity increases at a fixed percentage per unit time
- This causes growth that starts out slowly but then grows faster and faster



Natural Capital

- Natural Capital - the natural resources and natural services that keep us and other forms of life alive and support our economies
- Natural Capital = Natural Resources + Natural Services
 - Natural Resources
 - Renewable - air, water, soil (kind of), plants
 - Non Renewable - copper, oil, coal
 - Natural Services
- Human activities degrade natural capital

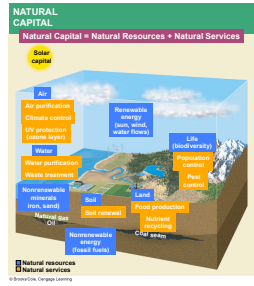


Fig. 1-3

Nutrient Cycling

- Nutrient Cycling - the circulation of chemicals necessary for life, from the environment through organisms and back into the environment
- Example:
 - Topsoil (the upper layer of the earth's crust) - provides nutrients that support plants, animals, and microorganisms that live on the land; when they die, they decay and resupply the soil with nutrients
 - Without this service, life would not exist.

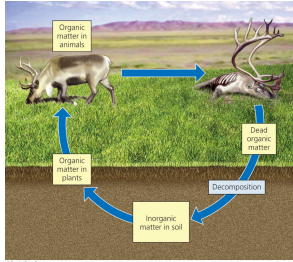


Fig. 1-4

Solar Capital

- Solar capital - energy from the sun
- Supports natural capital
- Without solar capital, all natural capital would collapse
- Why?



Goal = Environmentally Sustainable Society

- Meet the current and future basic resource needs of its people
- Natural income - living off of renewable resources
- BIG QUESTION: How do we help the economies of developing countries while doing so in an environmentally sustainable way?



Economics of Sustainability

- Gross Domestic Product (GDP) - annual market value of all goods and services produced by all organizations operating within a country
- Per Capita GDP - GDP divided by the total population at midyear
- Purchasing Power Parity (PPP) - ability to buy a particular thing
- Per Capita GDP PPP - measure of the amount of goods and services a country's average citizen could buy
- Economic Development - using economic growth to improve living standards
- Developed Countries - highly industrialized and high per capita GDP PPP
- Developing Countries - some are middle-income, moderately industrialized, and some are low-income, least industrialized. Per capita GDP PPP is steadily declining.

Economics of Sustainability

- Population increases are greatest in developing countries. These countries are least able to handle these increases
- More than half of the world lives on less than \$2 a day. One in six lives on less than \$1 per day.

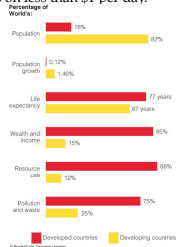


Fig. 1-5

Resources

- Resource - anything obtained from the environment to meet our needs and wants
- Conservation - management of natural resources minimizing waste and sustaining supplies for future generations
- Perpetual Resources - the sun is considered a perpetual resource because it is renewed continuously and is expected to last at least 6 billion years
- Renewable Resources - can be replaced fairly quickly through natural processes (from hours to hundreds of years)
- Sustainable yield - highest rate renewable resources can be used indefinitely without reducing supply

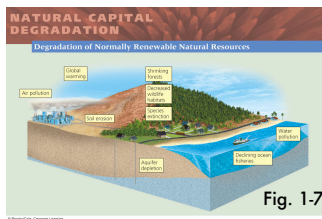
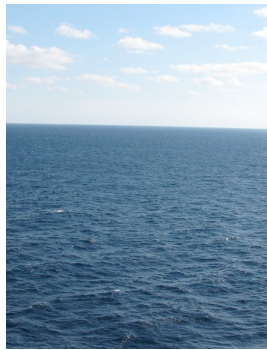


Fig. 1-7

- Environmental degradation - exceeding the resources replacement rate (supply begins to shrink)
- Non-renewable resources - exist in a fixed quantity and can only be renewed on a time scale of millions to billions of years

Property/Resource Rights

- Private property - resources owned by individuals or firms
- Common property - resources held by a large group of individuals
- Open access - owned by no one



Tragedy of the Commons

- Term used by biologist Garrett Hardin (1915-2003)
- Relates to common property and open access areas
- Users think that their personal pollution is too small to matter. Is this true?
- Solutions
 - Use shared resources at rates well below the estimated sustainable yields
 - laws and regulations
 - Convert open access resources to private ownership
 - ownership causes users to protect investment
- Are these solutions practical?

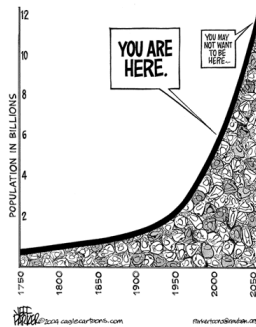
Ecological Footprint

- People in developing countries are poor and use fewer resources
- People in developed countries consume large amounts of resources (far beyond basic needs)
- Ecological Footprint - amount of biologically productive land and water needed to supply the people in a particular area with resources and to absorb and recycle the wastes and pollution produced
- Per Capita Ecological Footprint - ecological footprint per person in a given area
- Biological Capacity - ability to replenish renewable resources
- Ecological Deficit - if ecological footprint is larger than biological capacity



Ecological Footprint

- 2003 - World's ecological footprint exceeded biological capacity by 25%
- If current trends continue, by 2050 the ecological footprint will be twice the biological capacity.
- If all countries were brought to the per capita consumption level of the United States, it would take five planet Earths to supply the renewable resources.
- In other words, if everyone consumed as much as Americans, the Earth could only support 1.3 billion people. The Earth currently contains 6.7 billion people.



Culture

- Culture (a society's knowledge, beliefs, technology, and practices) changes ecological footprint.
- How?
 - 12,000 years ago humans were hunters/gatherers
 - Three cultural events changed this:
 - Agricultural revolution
 - Industrial-medical revolution
 - Information-globalization revolution

Pollution

- Pollution - any substance in the environment that is harmful to health, survival of humans or other organisms
 - Can enter the environment naturally
 - Can enter the environment through human activities
- Sources of pollution
 - Point Sources - single, identifiable
 - Nonpoint sources - dispersed, difficult to identify
- Types of pollutants
 - Biodegradable pollutants - harmful materials that can be broken down by natural processes
 - Nondegradable pollutants - harmful materials that natural processes cannot break down



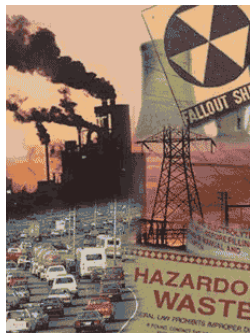
Dealing with Pollutants

- Output pollution control (pollution cleanup) - cleaning up or diluting pollutants after they are produced
- Input pollution control (pollution prevention) - reduces or eliminates the production of pollutants



Five Major Causes of Environmental Problems

- Population Growth
- Wasteful and Unsustainable Resource Use
- Poverty
- Not including environmental costs of goods and services in market prices
- Insufficient knowledge of how nature works



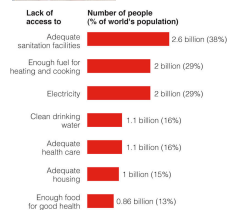
Poverty

- Short-term need for survival overshadows long-term environmental concerns
- Increases population because families need more individuals to support the family and the parents in old age
- Environmental hazards also increase poverty and health concerns
- Polluted water
- Little sanitation
- Respiratory diseases from air pollutants because of burning wood and coal
- Cause premature death of about 19,200 people a day



Fig. 1-14

Fig. 1-13



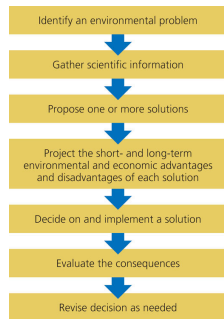
Affluence

- High levels of consumption
 - Takes 27 tractor-trailer loads of resources to support one American for one year
 - An American consumes more than 30 times the resources of those in developing countries and 100 times more than those in the poorest countries
- Can help if those with the money are concerned about the environment and their level of consumption
- Scientific research
- Environmental cleanup



Solving Environmental Problems

- Social Capital - getting people with different views to discuss, listen, and find common ground
- Research shows that it only takes 5-10% of a community to cause major change
- "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has."
-Margaret Mead



© Brookfield, Cengage Learning

Fig. 1-15

Principals of Sustainability

- Reliance on solar energy (solar capital)
- Biodiversity - variety of organisms
- Population control
- Nutrient cycling - natural processes recycle chemicals

