

## Environmental Problems, Their Causes, and Sustainability

### Chapter 1

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## Environmental Science

- **Environment**- a sum of all the conditions surrounding us that influence life.
- **Environmental science**- the field that looks at interactions among humans and nature.
- **System**- a set of interacting components that influence one another by exchanging energy or materials.
- **Ecosystem**- the living and non-living components of a particular place on earth.

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## Humans Alter Natural Systems

- Humans manipulate their environment more than any other species.



Figure 1.1  
Human Impact on the Environment  
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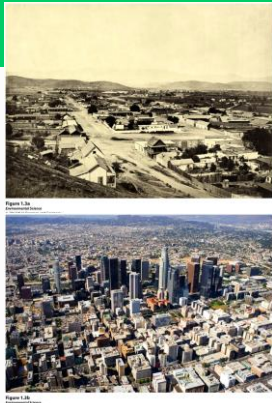
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In 1880, fewer than 6000 people lived in LA

In 2009 there were 3.8 million people in LA, and the greater LA area had 13 million people



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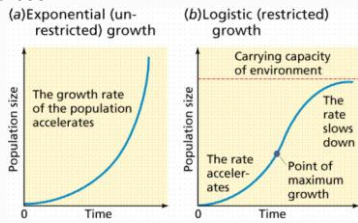
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### Core Case Study: Living in an Exponential Age

- Impact of human exponential growth on
  - Loss of animal and plant species
  - Loss of resources
  - Rule of 70



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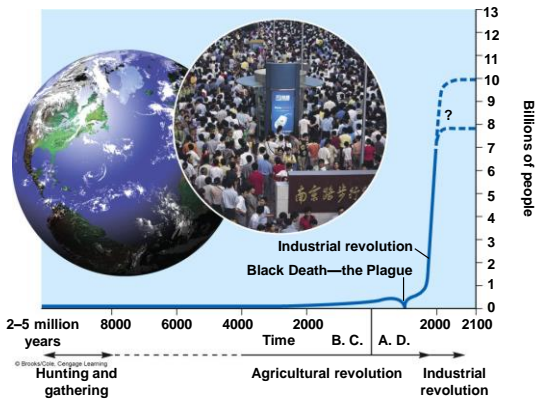


Fig. 1-1, p. 5

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## 1-1 What Is an Environmentally Sustainable Society?

- **Concept 1-1A** Our lives and economies depend on energy from the sun (solar capital) and on natural resources and natural services (natural capital) provided by the earth.
- **Concept 1-1B** Living sustainability means living off the earth's natural income without depleting or degrading the natural capital that supplies it.

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## Environmental Science Is a Study of Connections in Nature

- Interdisciplinary science connecting information and ideas from
  - Natural sciences, with an emphasis on ecology
  - Social sciences
  - Humanities
- How nature works
- How the environment affects us
- How we affect the environment
- How to deal with environmental problems
- How to live more sustainably

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## Major Fields of Study Related to Environmental Science

Table 1-1

| Major Fields of Study Related to Environmental Science   |  |
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| <b>Major Fields</b>  | <b>Subfields</b>   |
| <b>Biology:</b> study of living things (organisms)   | <b>Ecology:</b> study of how organisms interact with one another and with their nonliving environment<br><b>Botany:</b> study of plants<br><b>Zoology:</b> study of animals  |
| <b>Chemistry:</b> study of chemicals and their interactions  | <b>Biochemistry:</b> study of the chemistry of living things   |
| <b>Earth science:</b> study of the planet as a whole and its workings systems                                  | <b>Climatology:</b> study of the earth's atmosphere and climate<br><b>Geology:</b> study of the earth's origin, history, surface, and internal processes<br><b>Hydrology:</b> study of the earth's water resources<br><b>Paleontology:</b> study of fossils and ancient life   |
| <b>Social sciences:</b> studies of human society   | <b>Anthropology:</b> study of human culture<br><b>Demography:</b> study of the characteristics of human populations<br><b>Geography:</b> study of the relationships between human populations and the earth's surface features<br><b>Economics:</b> study of the production, distribution, and consumption of goods and services<br><b>Political Science:</b> study of the principles, processes, and structure of government and political institutions |
| <b>Humanities:</b> study of the aspects of the human condition not covered by the physical and social sciences | <b>History:</b> study of information and ideas about humanity's past<br><b>Ethics:</b> study of moral values and concepts concerning right and wrong human behavior and responsibilities<br><b>Philosophy:</b> study of knowledge and wisdom about the nature of reality, values, and human conduct  |

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The study of environmental science uses knowledge from many disciplines

Figure 1.1  
Fundamental Science  
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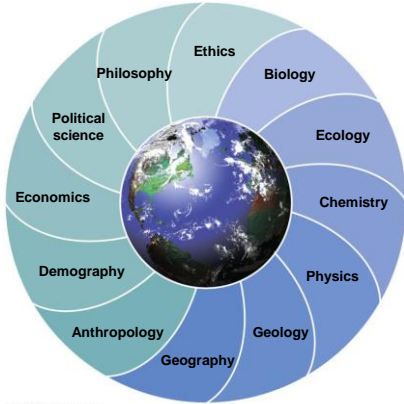
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Fig. 1-2, p. 7

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### Sustainability Is the Central Theme of This Book

- Natural capital: supported by solar capital
  - Natural **resources** (examples?)
  - Natural services
    - E.g., nutrient cycling
  
- Degradation of natural capital through human activities
  - Examples?
  
- Scientific solutions
  - Don't confuse environmental science with environmentalism! Examples?

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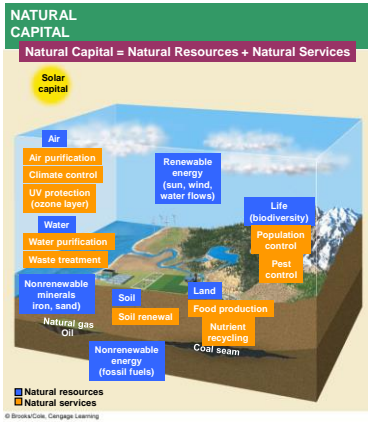


Fig. 1-3, p. 8

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## 1-2 How Can Environmentally Sustainable Societies Grow Economically?

- **Concept 1-2** *Societies can become more environmentally sustainable through economic development dedicated to improving the quality of life for everyone without degrading the earth's life support systems.*
- *Does economic growth necessarily degrade earth's natural capital?*

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## There Is a Wide Economic Gap between Rich and Poor Countries – Key concept!

- Country's economic growth: measured by **gross domestic product (GDP)**
- Changes in economic growth: measured by **per capita GDP**
- Purchasing power parity (PPP) plus GDP are combined for **per capita GDP PPP**
- Compare developed with developing countries (Fig. 1-5)

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2008 Developed and Developing Countries

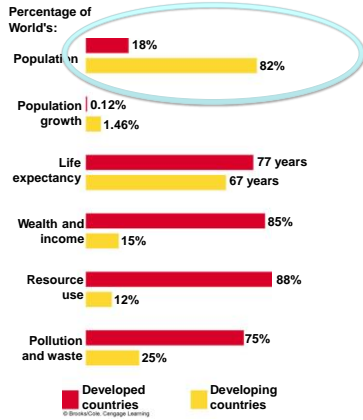


Fig. 1-5, p. 11

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Extreme Poverty in a Developing Country




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1-3 How Are Our Ecological Footprints Affecting the Earth?

- **Concept 1-3** As our ecological footprints grow, we are depleting and degrading more of the earth's natural capital.
- What is an **ecological footprint**?
  - The amount of the environment necessary to produce the goods and services necessary to support a particular lifestyle.

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## Some Resources Are Renewable

- **Perpetual resource:** inexhaustible on human scale
  - Solar energy
- **Renewable resource:** resource that can be replenished rapidly through rapid processes as long as it is not used up faster than it can be replenished.
  - E.g., forests, grasslands, fresh air, fertile soil
- **Sustainable yield:** the highest rate at which a renewable resource can be used indefinitely without reducing its available supply.
- **Environmental degradation** – exceeds sustainable yield

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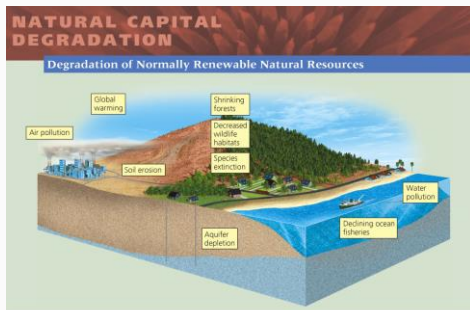
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## Degradation of Normally Renewable Natural Resources and Services




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## Overexploiting Shared Renewable Resources: Tragedy of the Commons

- Three types of property or resource rights
  - **Private property**
  - **Common property**
  - **Open access renewable resources**
- Tragedy of the commons - when open access resources shared by all (held in common), e.g., air we breathe, water we drink, or fish we eat, are used at a rate that exceeds the resources' **sustainable limit**
  - Solutions???

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## Some Resources Are Not Renewable

- **Nonrenewable resources – exist in fixed amounts**
  - Energy resources
  - Metallic mineral resources
  - Nonmetallic mineral resources

**Three R's...**

- Reduce**
- Reuse**
- Recycle**

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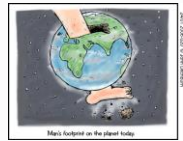
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## Our Ecological Footprints Are Growing

- **Ecological footprint concept**
  - Biological capacity
  - Ecological footprint – the amount of biologically productive land and water needed to supply the people in a country or area with resources and to absorb or recycle their wastes and pollution
    - See earlier definition.




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### Natural Capital Use and Degradation

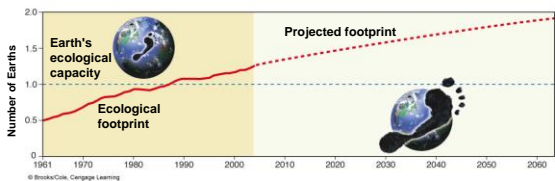
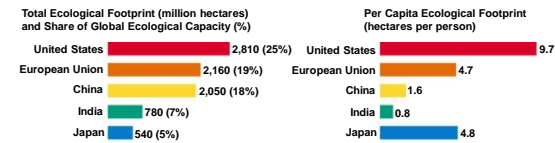


Fig. 1-10, p. 15

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### Cultural Changes Have Increased Our Ecological Footprints

- 12,000 years ago: hunters and gatherers
  
- Three major cultural events
  - Agricultural revolution
  - Industrial-medical revolution
  - Information-globalization revolution

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### 1-4 What Is Pollution and What Can We Do about It?

- **Concept 1-4** Preventing pollution is more effective and less costly than cleaning up pollution.



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### Pollution Comes from a Number of Sources

- Sources of pollution
  - **Point**
    - E.g., smokestack
  - **Nonpoint**
    - E.g., pesticides blown into the air
  
- Main type of pollutants
  - **Biodegradable**
  - **Nondegradable**
  
- Unwanted effects of pollution

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## Point-Source Air Pollution



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## We Can Clean Up Pollution or Prevent It

- Pollution cleanup (**output pollution control**)
- Pollution prevention (**input pollution control**)

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## 1-5 Why Do We Have Environmental Problems? (1)

- **Concept 1-5A** Major causes of environmental problems are population growth, wasteful and unsustainable resource use, poverty, exclusion of environmental costs of resource use from the market prices of goods and services, and attempts to manage nature with insufficient knowledge.

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Fig. 1-12, p. 18

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### Experts Have Identified Five Basic Causes of Environmental Problems

- Population growth (exponential growth)
- Wasteful and unsustainable resource use
- Poverty (Fig. 1-13)
- Failure to include the harmful environmental costs of goods and services in their market prices (profit vs. health?)
- Insufficient knowledge of how nature works

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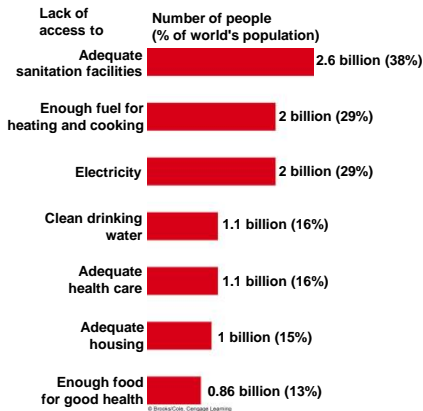


Fig. 1-13, p. 18

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### Poverty Has Harmful Environmental and Health Effects

- Population growth affected
- Malnutrition
- Premature death
- Limited access to adequate sanitation facilities and clean water

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### Global Outlook on Malnutrition



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### Affluence Has Harmful and Beneficial Environmental Effects

- Harmful environmental impact due to
  - High levels of consumption
  - Unnecessary waste of resources
- Affluence can provide funding for
  - Developing technologies to reduce
    - Pollution
    - Environmental degradation
    - Resource waste

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**Prices Do Not Include the Value of Natural Capital**

- Companies do not pay the environmental cost of resource use
  
- Goods and services do not include the harmful environmental costs
  
- Companies receive tax breaks and subsidies
  
- Economy may be stimulated but there may be a degradation of natural capital

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**1-5 Why Do We Have Environmental Problems? (2)**

- **Concept 1-5B** *People with different environmental worldviews often disagree about the seriousness of environmental problems and what we should do about them.*

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**Different Views about Environmental Problems and Their Solutions**

- Environmental Worldview including environmental ethics
  - Planetary management worldview
  - Stewardship worldview
  - Environmental wisdom worldview

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## We Can Learn to Make Informed Environmental Decisions

- Scientific research
- Identify problem and multiple solutions
- Consider human values

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Steps involved in making intelligent decisions...

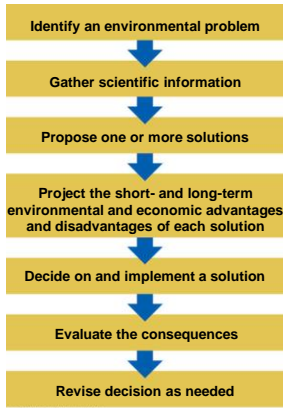


Fig. 1-15, p. 21

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## Individuals Matter: Aldo Leopold

- 5–10% of the population can bring about major social change
- Anthropologist Margaret Mead
- Aldo Leopold: environmental ethics
  - A leader of the *conservation and environmental movements* of the 20<sup>th</sup> century
    - By the 1930s, Leopold was the nation's foremost expert on wildlife management.
    - Leopold viewed wildlife management as a technique for restoring and maintaining diversity in the environment rather than primarily as a means of producing a surplus for sport hunting.

*"One person can make a difference, and everyone should try"* John F. Kennedy

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### 1-6 What Are Four Scientific Principles of Sustainability?

- **Concept 1- 6** Nature has sustained itself for billions of years by using solar energy, biodiversity, population control, and nutrient cycling—lessons from nature that we can apply to our lifestyles and economies.

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### Studying Nature Reveals Four Scientific Principles of Sustainability

- Reliance on solar energy
- Biodiversity
- Population control
- Nutrient cycling

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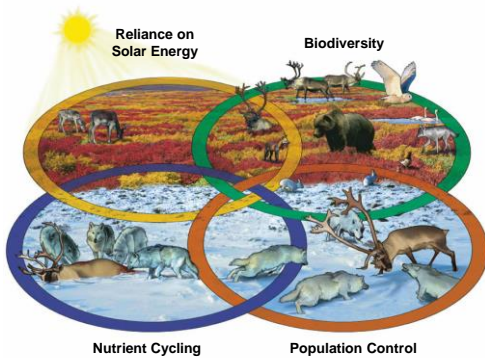
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Fig. 1-17, p. 23

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Fig. 1-18, p. 24

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