

sorted, uncontaminated and dry paper.

- **Plastic:** Different plastic types must not be mixed.
- **Glass:** Can be used repeatedly with no loss in quality and is 100 percent recyclable.
- **Aluminum:** Aluminum scrap is readily accepted for recycling, although other metals are rarely accepted.

Other Pollution by Reduction Strategies

In addition to recycling, two other basic strategies can reduce pollution:

- Reducing the amount of waste discharged into the environment.
- Expanding the capacity of the environment to accept discharges.

Reducing Discharges. Pollution can be prevented if the amount of waste being discharged into the environment is reduced to a level that the environment can assimilate.

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The mix of various inputs can be adjusted to produce a higher ratio of product to waste. The amount of waste can also be reduced if the production system produces less of the product — or if production ceases altogether — because of lower consumer demand. Emissions-trading systems can reduce discharges, especially into the atmosphere. To reduce sulfur dioxide discharges, the United States introduced a market through an amendment to the 1990 Clean Air Act. Power companies can buy and sell allowances to emit sulfur dioxide.

Increasing Environmental Capacity. The second way to handle pollution is to increase environmental capacity to accept waste discharges. The capacity of air, water, and land to accept waste is not fixed, but varies among places and at different times. A deep, fast-flowing river has a greater capacity to absorb wastewater than a shallow, slow-moving one. Wastewater can be stored when the river level is low and released when the river is high. Similarly, exhaust released into stagnant air irritates, whereas exhaust released in windy conditions is quickly dispersed. Environmental capacity can also be increased by transforming the waste so that it is discharged into a resource that has the capacity to assimilate it. For example, a coal-burning power plant discharges gases into the atmosphere, causing air pollution. To reduce air pollution, wet scrubbers are installed to wash particulates from the gas before it is released to the atmosphere. Wet scrubbers capture the particulates in water, which then can be discharged into a stream. If the stream is polluted by the discharge, then the wastewater can be cleaned in a settling basin where the particulates drop out. This transforms the residue into a solid waste for disposal on land.

Comparing Pollution Reduction Strategies

Relying on an increase in the capacity of the environment to accept discharges is risky. Recent history is filled with examples of wastes discharged in the environment with the belief that they would be dispersed or isolated safely: CFCs in the stratosphere, garbage offshore, and toxic chemicals beneath Love Canal. Tall smokestacks built to reduce sulfur dioxide discharges around coal-burning industries were successful at dispersing sulfur over a larger area. But the result of the dispersal was that acid precipitation fell hundreds of kilometers away. Reducing discharges into the environment (by either changing the production process or recycling) is usually the preferred alternative.

Key Issue 4. Why Should Resources Be Conserved?

- **Sustainable development**

- **Biodiversity**

Because it is one part natural science and one part social science, geography is especially sensitive to the importance of protecting the natural environment while meeting human needs. “Conservation” is a concept that reflects balance between nature and society.

Sustainable Development

Sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs,” according to the United Nations.

Conservation, Preservation, and Sustainability

Conservation is the sustainable use and management of natural resources such as wildlife, water, air, and Earth deposits to meet human needs, including food, medicine, and recreation.

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Conservation differs from **preservation**, which is maintenance of resources in their present condition, with as little human impact as possible. Preservation does not regard nature as a resource for human use. In contrast, conservation is compatible with development, but only if natural resources are utilized in a careful rather than a wasteful manner. An increasingly important approach to careful utilization of resources is sustainable development, based on promotion of biodiversity.

Sustainability and Economic Growth

The UN’s “sustainable development” definition originated in the 1987 Brundtland Report. The report argued that sustainable development had to recognize the importance of economic growth while conserving natural resources. Environmental protection, economic growth, and social equity are linked because economic development aimed at reducing poverty can at the same time threaten the environment. A rising level of economic development generates increased pollution, at least until a country reaches a GDP of about \$5,000 per person. Consequently, twentieth-century environmental improvements in the more developed countries of North America and Western Europe are likely to be offset by increased pollution in LDCs during the twenty-first century.

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Critical to world pollution in the twenty-first century is China. The rapid economic transformation of China has resulted in rapidly raising levels of pollution. The country has 16 of the 20 most polluted cities. Sulfur dioxide emissions from China are even crossing the Pacific Ocean and being deposited in the western U.S. The World Bank estimates that 10 percent of China’s GDP is being lost to direct damage from pollution, including destruction of crops, medical bills, and sick leave payments. The Brundtland Report was optimistic that environmental protection could be promoted at the same time as economic growth and social equity. In recent years the World Bank and other international development agencies have embraced the concept of sustainable development. Planning for development involves consideration of many more environmental and social issues today than was the case in the past.

Sustainability’s Critics

Some environmentally oriented critics have argued that it is too late to discuss sustainability.

The World Wildlife Federation (WWF) claims that the world surpassed its sustainable level around 1980. Others criticize sustainability from the opposite perspective: Human activities have not exceeded Earth's capacity because resource availability has no maximum, and Earth's resources have no absolute limit because the definition of resources changes drastically and unpredictably over time.

Environmental improvements can be achieved through careful assessment of the outer limits of Earth's capacity. Critics and defenders of sustainable development agree that one important recommendation of the UN report has not been implemented — increased international cooperation to reduce the gap between more developed and less developed countries.

Biodiversity

Biological diversity, or **biodiversity** for short, refers to the variety of species across Earth as a whole or in a specific place. (470) Sustainable development is promoted when biodiversity of a particular place or Earth as a whole is protected.

Biological and Geographic Biodiversity

Species variety can be understood from several perspectives. Geographers are especially concerned with biogeographic diversity, whereas biologists are especially concerned with genetic diversity. Estimates of Earth's total number of species range from 3 to 100 million, with 10 million as a median "guess," meaning that humans have not yet "discovered," classified, and named most of Earth's species. For geographers, biodiversity is a measurement of the number of species within a specific region or habitat. A community containing a large number of species is said to be species-rich, whereas an area with few species is species-poor. Two communities may have the same number of species and the same total population of individuals, yet one may be more diverse than the other, depending on the distribution of the total population among the various species. Strategies to protect genetic diversity have been established on a global scale. Strategies to protect biogeographic diversity vary among countries. Frustrated by the inability to precisely measure environmental impacts, Millennium Ecosystem Assessment has undertaken a multiyear effort to establish systematic data sets.

Biodiversity in the Tropics

The characteristics of the tropical forest biome contribute to the presence of more species than in temperate or polar biomes. Thus, reduction of biodiversity through species extinction is especially important in tropical forests, where six species per hour are extinguished in the tropics, and more than 5,000 species are considered in danger of extinction. Although tropical forests occupy only 6 percent of Earth's land area, they contain more than one-half of the world's species, including two-thirds of vascular plant species and one-third of avian species. The principal cause of the high rate of extinction is cutting down forests, which is the result of changing economic activities in the tropics, especially a decline in shifting cultivation (see Chapter 10). Governments in LDCs support the destruction of rain forests, because they view activities such as selling timber to builders or raising cattle for fast-food restaurants as more effective strategies for promoting economic development than shifting cultivation. Until recently, the World Bank has provided loans to finance development proposals that require clearing forests.

Key Terms:

Acid deposition (p. 452)

Acid precipitation (p. 452)

Active solar energy systems (p. 463)

- Air pollution (p. 451)
- Animate power (p. 441)
- Biochemical oxygen demand (BOD) (p. 456)
- Biodiversity (p. 469)
- Biomass fuel (p. 441)
- Breeder reactor (p. 460)
- Chlorofluorocarbon (CFC) (p. 452)
- Conservation (p. 467)
- Ferrous (p. 449)
- Fission (p. 459)
- Fossil fuel (p. 441)
- Fusion (p. 461)
- Geothermal energy (p. 462)
- Greenhouse effect (p. 451)
- Hydroelectric power (p. 461)
- Inanimate power (p. 441)
- Nonferrous (p. 450)
- Nonrenewable energy (p. 441)
- Ozone (p. 452)
- Passive solar energy systems (p. 463)
- Photochemical smog (p. 454)
- Photovoltaic cell (p. 463)
- Pollution (p. 451)
- Potential reserve (p. 442)
- Preservation (p. 468)
- Proven reserve (p. 441)
- Radioactive waste (p. 459)
- Recycling (p. 465)
- Renewable energy (p. 441)
- Resource (p. 440)
- Sanitary landfill (p. 458)
- Sustainable development (p. 467)

Test Prep Questions

- 1) What country has the world's largest proven reserves of coal by a large margin?
 - A) China
 - B) The United States
 - C) Russia
 - D) Canada

- 2) Which of the following is a nonferrous metal?
 - A) copper
 - B) titanium
 - C) molybdenum
 - D) tungsten

- 3) Which of the following is an example of air pollution at the local level?
 - A) the greenhouse effect
 - B) ozone depletion
 - C) acid precipitation
 - D) photochemical smog

- 4) Which of the following is NOT an industry that generates large amounts of waste water?
 - A) food processing
 - B) paper products
 - C) automotive assembly
 - D) steel

- 5) Which of the following is NOT a renewable energy source?

- A) biomass
- B) nuclear fission
- C) geothermal
- D) nuclear fusion

6) What is the world's second most widespread energy source for generating electricity, after coal?

- A) natural gas
- B) biomass
- C) wind
- D) hydroelectric

7) Which of the following is NOT presently an alternative source of fuel for automobiles that is becoming commercially available?

- A) solar power
- B) batteries
- C) hydrogen fuel cells
- D) biofuel

8) Which of the following is least commonly recycled in the U.S.?

- A) glass
- B) ferrous metals
- C) paper
- D) aluminum

9) Which of the following is NOT a primary recycling collection method?

- A) buyback centers
- B) dropoff centers
- C) incineration
- D) curbside

10) While tropical forests occupy only 6 percent of Earth's land area, they contain _____ of the world's species.

- A) two-thirds
- B) over half
- C) 30 percent
- D) one-fourth

Short Essay

1) Identify the two main groups of mineral resources important to human activities, and describe their relative importance, and, in particular, how they are used.

2) Explain how air pollution occurs at three different scales.

3) Describe the problems associated with nuclear power that impede its adoption as an alternative to fossil fuels.
