Chapter 6
6.2 Using Resources Wisely: Soil, Freshwater, & Atmospheric Resources

Key Questions:
1) Why is soil important and how do we protect it?
2) What are the primary sources of water pollution?
3) What are the major forms of air pollution
Soil Resources

– The mineral- and nutrient-rich portion of soil is called **topsoil**.

– Good topsoil
  – *absorbs and retains* moisture yet allows water to drain.
  – Is rich in **organic** matter and nutrients, but low in salts
  – Produced by long-term interactions between soil and the plants growing in it.

– Topsoil can be a **renewable** resource if it is managed properly, but it can be damaged or lost if it is mismanaged.
Soil Erosion

– Soil erosion is the **removal** of soil by **water** or **wind**.

– Soil erosion is often worse when land is plowed and left barren between plantings. When no roots are left to **hold** soil in place, it is easily washed away.

– When soil is badly eroded, **organic matter** and **minerals** that make it fertile are often carried away with the soil.
Soil Erosion

- In parts of the world with dry climates, a combination of farming, overgrazing, seasonal drought, and climate change can turn farmland into desert. This process is called *desertification*.

- Roughly **40** percent of Earth’s land is considered at risk for desertification. This map shows vulnerable areas in North and South America.
Soil Erosion

- **Deforestation**, or the loss of forests, can have a negative effect on soil quality and lead to severe erosion.

- **Healthy** forests hold soil in place, protect the quality of fresh water supplies, absorb **carbon dioxide**, and help moderate local climate.

- In some areas, forests can regrow after cutting, but it takes **centuries for succession** to produce mature, old-growth forests. In some places, forests don’t grow back at all after logging.
Soil Use and Sustainability

- Leaving **stems and roots** of the previous year’s crop in the soil can help hold soil in place between plantings.

- **Crop rotation**—planting different crops at different seasons or in different years—can help prevent both erosion and nutrient loss.

- **Terracing**—shaping the land to create level “steps”—also helps hold water and soil
Freshwater Resources

– Humans depend on fresh water and freshwater ecosystems for goods and services, including drinking water, industry, transportation, energy, and waste disposal.

– Only 3 percent of Earth’s water is fresh water—and most of that is locked in ice at the poles.
Water Pollution

- Freshwater sources can be affected by different kinds of pollution. A pollutant is a harmful material that can enter the biosphere.

- Pollutants that enter water supplies from a single source—a factory or an oil spill, for example—are called point source pollution.

- Pollutants that enter water supplies from many smaller sources—the grease and oil washed off streets by rain or chemicals released into the air by factories and automobiles, for example—are called nonpoint source pollution.

- The primary sources of water pollution are industrial and agricultural chemicals, residential sewage, and nonpoint sources.
Industrial and Agricultural Chemicals

– One industrial pollutant is a class of organic chemicals called PCBs that were widely used in industry until the 1970s. After several large-scale contamination events, PCBs were banned.

– Because PCBs often enter mud and sand beneath bodies of water, they can be difficult, if not impossible, to eliminate.

– Other harmful industrial pollutants are heavy metals like cadmium, lead, mercury, and zinc.
Industrial and Agricultural Chemicals

– Large-scale monoculture has increased the use of pesticides and insecticides. These chemicals can enter the water supply in the form of runoff after heavy rains, or they can seep directly into groundwater.

– **Pesticides** can be very dangerous pollutants. **DDT** effectively controls agricultural pests and disease-causing mosquitoes. But, Some pesticides, such as the insecticide DDT, are potential pollutants. when DDT gets into the water supply, a phenomenon known as biological magnification can occur.

– **Biological magnification** occurs if a pollutant, such as DDT, mercury, or a PCB, is picked up by an organism and is not broken down or eliminated from its body. Instead, the pollutant collects in body tissues.
Industrial and Agricultural Chemicals

- In the process of biological magnification, **primary producers** pick up a pollutant from the environment.
- **Herbivores** that eat those producers concentrate and store the compound. Pollutant concentrations in herbivores may be more than **ten times** the levels in producers.
- When **carnivores** eat the herbivores, the compound is still **further concentrated**.
- In the highest trophic levels, pollutant concentrations may reach **10 million** times their original concentration in the environment.
Industrial and Agricultural Chemicals

- These high concentrations can cause serious problems for wildlife and humans. Widespread DDT use in the 1950s threatened fish-eating birds like pelicans, osprey, falcons, and bald eagles. It caused females to lay eggs with thin, fragile shells, reducing hatching rates and causing a drop in birth populations. Since DDT was banned in the 1970s, bird populations are recovering.

- Still a concern is mercury, which accumulates in the bodies of certain marine fish such as tuna and swordfish.
Residential Sewage

– Sewage contains lots of **nitrogen** and **phosphorus**. Large amounts of sewage can stimulate blooms of **bacteria and algae** that rob water of oxygen. **Oxygen-poor** areas called “dead zones” can appear in both fresh and salt water.

– Raw sewage also contains microorganisms that can spread **disease**.
Water Quality and Sustainability

- One key to sustainable water use is to protect the natural systems involved in the water cycle. Protecting these ecosystems is a critical part of watershed conservation.

- **Sewage treatment** can lower levels of sewage-associated bacteria and help prevent dead zones in bodies of water receiving the runoff.

- **Conserving water** is also important. One example of water conservation in agriculture is drip irrigation, which delivers water drop by drop directly to the roots of plants. Tiny holes in water hoses allow farmers to deliver water only where it’s needed.
Atmospheric Resources

– The atmosphere, which provides the oxygen we breathe, is a common resource whose quality has direct effects on health.

– **Ozone**, a form of oxygen that is found naturally in the upper atmosphere, absorbs harmful ultraviolet radiation from sunlight before it reaches Earth’s surface. The ozone layer protects our skin from damage that can cause cancer.

– The atmosphere’s greenhouse gases, including carbon dioxide, methane, and water vapor, regulate global temperature. Without the greenhouse effect, Earth’s average temperature would be about 30° Celsius cooler than it is today.
Air Pollution

– When the quality of Earth’s atmosphere is reduced, respiratory illnesses such as **asthma** are made worse and **skin** diseases tend to increase.

– Industrial processes and the burning of **fossil fuels** can release pollutants of several kinds. Common forms of air pollution include **smog**, **acid rain**, and greenhouse gases.
Smog

- **Smog** is a gray-brown haze formed by chemical reactions among pollutants released into the air by industrial processes and automobile exhaust. Ozone is one product of these reactions.

- At **ground level**, ozone and other pollutants threaten the health of people, especially those with respiratory conditions.

- Many athletes participating in the 2008 Summer Olympics in Beijing, China, expressed concern over how the intense smog would affect their performance and health.
Acid Rain

– Burning fossil fuels releases nitrogen and sulfur compounds. When those compounds combine with water vapor in the air, they form nitric and sulfuric acids. These airborne acids can drift for many kilometers before they fall as acid rain.

– In some areas, acid rain kills plants by damaging their leaves and changing the chemistry of soils and surface water.
Greenhouse Gases

– **Burning** fossil fuels and forests releases stored **carbon** into the atmosphere as **carbon dioxide**, a greenhouse gas.

– Agricultural practices release **methane**, another greenhouse gas.

– Although some greenhouse gases are necessary, when excess greenhouse gases accumulate in the atmosphere, they contribute to **global warming** and climate change.