Chapter 6: Humans in the Biosphere

6-1 A Changing Landscape

- Human Activities
  - Ecosystems provide goods and services
    - Breathable air, drinkable water, fertile soil
    - Storage and recycling of nutrients
  - Global human activities use as much energy, and transport almost as much material, as all Earth's other multicellular species combined
  - We have become the most important source of environmental change on the planet
    - *Hunting & gathering*
    - *Agriculture*
    - *Industry*
    - *Urban development*

- ***Hunting and Gathering***
  - Hunted birds and mammals
  - Fished in rivers and oceans
  - Gathered wild seeds, fruits, and nuts
  - Caused a major mass extinction of animals
    - Wooly mammoths, giant ground sloths, saber-toothed cats

- ***Agriculture***
  - The practice of farming
  - Early hunter-gatherers learned how plants grew & ripened and raised their own animals (cows, sheep, pigs, horses)
  - Humans began to gather in large settlements
  - In the 1800s and 1900s, advances in science & technology led to
    - Irrigation
    - Use of machinery for plowing, planting & harvesting
    - Development of new varieties of crops, producing higher yields
      - Often grown using **monoculture** (large fields are planted with a single variety year after year)

        - Chemical fertilizers and pesticides
    - *Green revolution*
        - The development of highly productive crop strains and the use of modern agricultural techniques to increase yields of food crops
        - To solve food shortages in many parts of the world
    - Challenges for the Future
        - Large-scale monoculture can lead to problems with insect pests & diseases
        - Finding enough water for irrigation

- ***Industrial Growth and Urban Development***
    - Industrial Revolution in the 1800s
        - Led to the combination of industrial productivity and scientific know-how that provides most of the conveniences of modern life
    - Effects of human activity on environments
        - Requires energy (mostly from burning fossil fuels)
        - Wastes from manufacturing, energy production & other sources discarded into air, water & soil
        - Land use changes
        - Habitat destruction

6-2 Renewable & Nonrenewable Resources

- **Tragedy of the Commons**
  - Any resource that is free and accessible to everyone may eventually be destroyed
    - If no one is responsible for protecting it, and if no one benefits from preserving it, people will use it up
- Classifying Resources
  - Environmental goods and services may be classified as either renewable or nonrenewable
    - ***Renewable resource***
      - Resource that can regenerate quickly and that is replaceable
      - Ex: trees, fresh water
    - ***Nonrenewable resource***
      - Resource that cannot be replenished by natural processes
      - Ex: fossil fuels (coal, oil, natural gas)
  - **Sustainable Development**
    - A way of using natural resources without depleting them and of providing for human needs without causing long-term environmental harm
    - Human activities can affect the quality and supply of renewable resources such as land, forests, fisheries, air, and fresh water.
    - Must take into account both the functioning of ecosystems and the ways that human economic systems operate.
  - **Land Resources**
    - Provides space for human communities, raw materials for industry, soils for growing crops
    - Soil is renewable if managed properly.
    - Fertile topsoil produced by long-term interactions between soil & plants growing in it
    - Plowing removes roots & increases rate of **soil erosion** (wearing away of surface soil by water & wind)
    - ***Desertification***: process caused by a combination of poor farming practices, overgrazing, and drought that turns productive land into desert
  - **Forest Resources**
    - Important for the products they provide & for the ecological functions they perform
      - Wood to make products and burn as fuel for cooking and heating
      - ***"lungs of the Earth"***: remove carbon dioxide and produce oxygen

        - Provide habitats, food, moderate climate, limit erosion
    - **Deforestation**: loss of forests
        - Can lead to severe erosion, washing away nutrients, and preventing future tree regrowth
    - Forest Management
        - Selective harvesting of mature trees
        - Replant and manage tree farms
        - Genetically modified faster-growing varieties
- **Fishery Resources**
    - Valuable source of food
    - Declining fish populations (Tragedy of the Commons)
    - Sustainable development
        - Guidelines for commercial fishing
        - Caused short term loss of jobs
    - ***Aquaculture***
        - The raising of aquatic animals for human consumption
- **Air Resources**
    - *Pollutant*
        - Harmful material that can enter the biosphere through the land, air, or water
    - Burning of fossil fuels from automobiles & industry releases nitrates, sulfates & particulates into the atmosphere
    - Can cause respiratory & other health problems
    - Can lead to acid rain when they combine with water vapor in the air
- **Freshwater Resources**
    - Pollution threatens water supplies
        - Chemicals, wastes discarded on land, domestic sewage
    - Sustainable use involves protecting the natural systems involved in the water cycle.
        - Wetlands help purify water passing through them
        - Forests & vegetation help purify water
    - Water conservation is becoming increasingly important as the demand for water grows rapidly.

6-3 Biodiversity

- **Biodiversity**
  - The sum total of the genetically based variety of all organisms in the biosphere
    - Ecosystem diversity: includes the variety of habitats, communities, and ecological process in the world
    - Species diversity: the number of different species in the biosphere (about 1.5million species identified and named so far)
    - Genetic diversity: the sum total of all the different forms of genetic information carried by all organisms living on Earth today
  - One of Earth's greatest natural resources
    - Provide us with foods, industrial products, and medicines

- **Threats to Biodiversity**
  - Human activities
    - Altering habitats
    - Hunting species to extinction
    - Introducing toxic compounds into food webs
    - Introducing foreign species to new environments
  - Can lead to ***extinction*** (when a species disappears from all or part of its range)
  - **Endangered species:** a species whose population size is declining in a way that places it in danger of extinction

  - **Habitat Alteration**
    - As habitats disappear, species vanish.
    - Development can split ecosystems into pieces
      - Habitat fragmentation
      - Remaining pieces of habitat become biological "islands"
        - New York's Central Park
      - The smaller the "island", the fewer species can live their, the smaller their population can be, and the more vulnerable they are to further disturbances or climate change.

  - **Demand for Wildlife Products**

        - Humans have pushed some animal species to extinction by hunting them for food or other products.
        - In the U.S., endangered species are protected, but in parts of Africa, South America, and Southeast Asia hunting still threatens rare animals.
            - For meat, fur, hides, body parts for medicinal properties
    - **Pollution**
        - Toxic compounds can accumulate in the tissues of organisms
        - DDT
            - One of the first widely used pesticides
            - Remains active for a long time & kills many different insects
            - Nonbiodegradable and, when it is picked up by organisms, they do not eliminate it from their bodies.
            - ***Biological magnification***
                - Concentrations of a harmful substance increase in organisms at higher trophic levels in a food chain or food web
    - **Introduced Species**
        - Apparently harmless plants or animals that humans transport around the world either accidentally or intentionally
        - Often become *invasive* species
            - Not native
            - Reproduce rapidly (new habitats lack the parasites & predators that control their population)

- **Conserving Biodiversity**
    - ***Conservation***
        - The wise management of natural resources
    - Efforts focus on protecting entire ecosystems as well as single species
    - Must be informed by solid research
    - Try to maximize benefits while minimizing economic costs

6-4 Charting a Course for the Future

- Researchers are gathering data to monitor and evaluate the effects of human activities on important systems in the biosphere
    - The ozone layer high in the atmosphere
    - The global climate system

- **Ozone Depletion**
    - Ozone layer
        - High concentrations of ozone gas (O_3) 20-50 kilometers above Earth's surface
        - Absorbs harmful UV (ultraviolet radiation) from the sun
            - Increased exposure to UV radiation can cause cancer, damage eyes, decrease resistance to disease, damage tissue in plants & phytoplankton
        - "hole" or gap in ozone layer
            - Caused by ***chloroflurocarbons*** (CFCs)
                - Originally used as a propellant or coolant
        - Today most uses of CFCs are banned, but molecules can linger for as long as a century

- **Global Climate Change**
    - Since the late 19th century, average atmospheric temperatures have risen about 0.6 Celsius degrees
    - Since about 1980, average temperatures have risen between 0.2 and 0.3 Celsius degrees.
    - **Global warming**: increase in the average temperatures of the biosphere
        - *Evidence*
            - Is the current trend part of a larger, natural cycle of climate change or is it caused by human activity?
            - Human activities (burning fossil fuels, cutting & burning forests) are adding CO_2 to the atmosphere faster than the carbon cycle can remove it.
        - *Possible Effects*
            - Sea levels may rise, causing coastal flooding
            - More droughts
            - Habitat alterations, leading to more threatened or endangered species