APES—Water Pollution

Water Pollution—any chemical, biological, or physical change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses

- Infectious agents—
  - Examples include bacteria, viruses, protozoa, & parasitic worms
  - Major human sources—human & animal wastes
  - Effects—diseases (Typhoid fever, Cholera, Dysentary, Giardiasis, Hepatitis)
  - Good indicator of water quality in terms of infectious agents is the number of colonies of coliform bacteria present in a 100-mL sample of water
    - WHO & EPA recommend 0 colonies/100-mL for drinking water & maximum level of 200 colonies for swimming
- Oxygen-demanding wastes—
  - Examples include decomposition of animal & plant matter by aerobic bacteria
  - Major human sources—sewage, animal feed lots, paper mills
  - Effects—depletion of dissolved oxygen leading to death of aquatic organisms
  - Biological Oxygen Demand (BOD)—amount of dissolved oxygen needed by aerobic decomposers to break down the organic matter in a certain volume of water in a 5-day incubation period at $20^{o}C$
- Inorganic chemicals—
  - Examples include acids, toxic metals (Pb, As, Se), & salts (NaCl, Fl^{-})
  - Major human sources—surface runoff, industrial effluents, household cleansers
  - Effects—damage human systems (cancers), harm aquatic life, lower crop yields, accelerate corrosion, make water non-potable
  - Chemical water analysis is used to determine presence of inorganics in water
- Organic chemicals—
  - Examples—gasoline, oil, plastics, pesticides, detergents
  - Major human sources—industrial effluents, household cleansers, surface runoff from farms & yards
  - Effects—threaten human health & harm wildlife
  - Chemical water analysis & use of indicator species used to determine presence & concentration
    - Filter-feeding mollusks
- Sediment—
  - Examples—soil & silt
  - Major human sources—land erosion
  - Harmful effects—reduce photosynthesis, disrupt aquatic food webs, destroy spawning grounds of benthic species, clog harbors & lakes
- Heat (Thermal pollution)
  - Examples include excessive heat
  - Major sources—water cooling of electric power plants
  - Lowers DO levels & causes thermal shock in species

Forms of water pollution—

- Point sources—discharge pollutants at specific locations through pipes, ditches, or sewers into bodies of surface water
  - Easily identified, monitored, & regulated
- Nonpoint sources—sources that cannot be traced to a single site of discharge
  - Large areas of land that pollute water by runoff or atmospheric deposition

    - Agricultural runoff includes sediments, inorganic fertilizers, manure, salts from irrigation waters, & pesticides
        - Responsible for an estimated 64% of all water pollution in US

Pollution of Streams & Lakes

- Streams & rivers have potential to rapidly recover from degradable wastes & excess heat
    - Depends on volume, flow rate, temperature, & pH
    - Developing nations deploy about 95% of all sewage directly into rivers & streams
- Lakes are more vulnerable to pollution
    - Often stratified with little vertical mixing
    - Have little flow
- Eutrophication—natural nutrient enrichment of lakes leading to excessive algal growth
    - Human activities accelerate eutrophication (sewage treatment plants, runoff of fertilizers, & accelerated erosion of topsoil)—cultural eutrophication
    - Accumulation of nitrates can lead to nitrate poisoning as nitrates bind to hemoglobin reducing the capacity for oxygen transport (amphibians)
    - Leads to a potential algal bloom
        - Decreases light penetration
        - Decreases DO levels due to the action of decomposers
        - Disrupts nitrogen & phosphorus cycles
    - Methods to control eutrophication
        - Planting vegetation along streambeds to slow erosion
        - Controlling application & timing of fertilizer
        - Controlling runoff from feedlots, golf courses, & fields
        - Use of biological control agents such as denitrification

Pollution of Groundwater

- Groundwater supplies 75% of drinking water in Europe & 51% in US
- Pollution sources include storage lagoons, septic tanks, landfills, hazardous waste dumps, deep injection wells, and underground storage tanks filled with gasoline, oil, & solvents
- EPA estimates that 4.5 trillion liters of contaminated water seep into US groundwater each day
- Easily polluted because water in aquifers is renewed very slowly (recycling time is 1400 years compared to 16 days for rivers)
    - Degradable wastes do not break down due to slow flow of water, cold temperatures, & smaller populations of bacteria
- Excessive pumping of groundwater leads to saltwater intrusion of an aquifer
- Impossible to clean contamination so prevention is the only effective way to protect groundwater resources
    - Require leak detection devices for underground tanks
    - Banning disposal of hazardous wastes in deep injection wells & landfills
    - Storing hazardous wastes above ground

Ocean Pollution

- Coastal areas (wetlands, estuaries, coral reefs, etc.)
    - 40% of world's population lives within 160 miles of the coast
    - 14 of the 15 largest metropolitan cities are coastal

- Dumping of untreated sewage directly into the ocean along SE Asia
- Algal blooms (Red tides)—
    - Release toxins that kill marine life
    - Poison seafood
- Effects of oil on ocean ecosystems
    - Operation of offshore wells, washing tankers, pipeline & storage tank leaks
        - 50% of oil pollution comes from oil dumped on land making its way to sewers
    - VOCs in oil kill aquatic organisms immediately (especially larvae)
    - Accumulation of tars on feathers & fur of marine birds & mammals—reduce natural insulation
    - Cleaning up oil spills
        - Floating booms to contain coil spill
        - Absorbent pads to soak up oil on beaches
        - Coagulating agents that cause oil to clump for easier pickup
        - Dispersing agents to break up oil slicks
        - Biological cleanup—oil degrading microbes