Chapter 13: Our Environment - Detailed Notes

1. Ecosystem and its Components

- **Environment:** Everything that surrounds an organism. It includes living (biotic) and non-living (abiotic) components.
- **Ecosystem:** A self-sustaining structural and functional unit of the biosphere, comprising living organisms (biotic components) and their non-living physical environment (abiotic components), interacting with each other.
    - **Examples:** A forest, a pond, a grassland, an aquarium, a garden.
    - **Types:**
        - **Natural Ecosystems:** Forests, deserts, grasslands, ponds, lakes, rivers, oceans.
        - **Artificial (Man-made) Ecosystems:** Gardens, crop fields, aquariums.
- **Components of an Ecosystem:**
    1. **Abiotic Components (Non-living):**
        - **Physical Factors:** Sunlight, temperature, rainfall, humidity, wind.
        - **Chemical Factors:** Water, soil (minerals, pH), air (gases like O2, CO2, N2).
        - These factors influence the type of organisms that can live in an ecosystem.
    2. **Biotic Components (Living):**
        - **Producers (Autotrophs):** Organisms that produce their own food using simple inorganic substances (like CO2 and water) and energy (usually sunlight).
            - **Examples:** All green plants, blue-green algae (cyanobacteria). They convert solar energy into chemical energy.
        - **Consumers (Heterotrophs):** Organisms that depend on other organisms for their food. They cannot synthesize their own food.
            - **Primary Consumers (Herbivores):** Feed directly on producers (plants). Examples: Deer, cow, rabbit, grasshopper.
            - **Secondary Consumers (Carnivores/Omnivores):** Feed on primary consumers. Examples: Frog, snake, small fish, lion (carnivore), human (omnivore).
            - **Tertiary Consumers (Top Carnivores):** Feed on secondary consumers. Examples: Eagle, tiger.
        - **Decomposers (Saprotrophs):** Microorganisms (bacteria and fungi) that break down complex organic matter from dead producers and consumers into simpler inorganic substances.
            - **Role:** Essential for recycling nutrients back into the environment (soil, air, water) for reuse by producers. They clean up the environment.
            - **Examples:** Bacteria, Fungi.

2. Food Chains and Food Webs

- **Food Chain:** A sequence of organisms in an ecosystem through which energy is transferred from one trophic level to the next by eating and being eaten. It shows a linear flow of energy.

    - **Examples:**
        - Grass → Deer → Tiger
        - Algae → Fish → Eagle
        - Grass → Insect → Frog → Snake → Eagle
    - **Each step in a food chain is called a Trophic Level.**
- **Trophic Levels:**
    - **First Trophic Level:** Producers (e.g., plants).
    - **Second Trophic Level:** Primary consumers (herbivores).
    - **Third Trophic Level:** Secondary consumers (small carnivores).
    - **Fourth Trophic Level:** Tertiary consumers (top carnivores).
    - **Note:** Not all food chains have four or more trophic levels; most food chains are short (3-4 steps) due to energy loss at each step.
- **Energy Flow in a Food Chain:**
    - Energy flows in a **unidirectional** manner.
    - **10% Law (Lindeman's Law):** Only about 10% of the energy from one trophic level is transferred to the next trophic level. The remaining 90% is lost as heat to the environment during metabolic processes (respiration, digestion, growth, reproduction) or used for life processes.
    - This means that the amount of energy available progressively decreases at higher trophic levels.
    - Consequently, the number of individuals generally decreases at higher trophic levels (though there can be exceptions, e.g., a large tree supporting many insects).
    - The total biomass also decreases at higher trophic levels.
- **Food Web:** A network of interconnected food chains in an ecosystem. It represents more realistic feeding relationships because most organisms consume more than one type of food, and are in turn eaten by multiple types of organisms.
    - **Significance:** Provides alternative pathways for energy flow, making the ecosystem more stable and resilient to disturbances. If one food source disappears, consumers can switch to another.

3. How Do Our Activities Affect the Environment?

Human activities have a significant and often detrimental impact on the environment.

- **a) Ozone Layer Depletion:**
    - **Ozone (O3):** A molecule made up of three atoms of oxygen.
    - **Ozone Layer:** A protective layer in the stratosphere (15-50 km above Earth's surface) that absorbs harmful ultraviolet (UV) radiation from the sun.
    - **Importance:** UV radiation can cause skin cancer, cataracts, damage to the immune system, and harm to plants and aquatic life.
    - **Depletion Cause:** Primarily caused by human-made chemicals called **Chlorofluorocarbons (CFCs)**, which were widely used as refrigerants, in fire extinguishers, and in aerosol sprays. CFCs release chlorine atoms in the stratosphere, which catalytically destroy ozone molecules.
    - **Effects of Depletion:** Increased UV radiation reaching Earth's surface.
    - **International Efforts:** The Montreal Protocol (1987) was an international treaty to phase out the production of CFCs. Efforts have led to a gradual recovery of the ozone layer.
- **b) Managing the Waste We Produce:**

- **Waste (Garbage):** Unwanted and discarded materials.
- **Types of Waste:**
  - **Biodegradable Waste:** Substances that can be broken down by biological processes (action of decomposers like bacteria and fungi) into simpler, harmless substances.
    - **Examples:** Food waste, paper, cotton, wood, sewage, animal dung.
  - **Non-biodegradable Waste:** Substances that cannot be broken down by biological processes. They persist in the environment for a long time, causing pollution.
    - **Examples:** Plastics, polythene, glass, metals, DDT, radioactive waste.
- **Impact of Waste Accumulation:**
  - Land pollution (landfills).
  - Water pollution (leaching into water bodies).
  - Air pollution (burning of waste).
  - Aesthetic degradation.
  - Harm to wildlife.
  - Health hazards (breeding ground for pests, release of toxic chemicals).
- **Waste Management Strategies (3 R's):**
  1. **Reduce:** Minimise the generation of waste at the source. (e.g., carry your own shopping bag, buy products with less packaging).
  2. **Reuse:** Use items again for the same or a different purpose instead of discarding them. (e.g., reuse plastic bottles, old clothes as cleaning rags).
  3. **Recycle:** Collect discarded materials and process them to make new products. Requires sorting of waste. (e.g., recycling paper, plastic, glass, metals).
- **Other Waste Management Methods:**
  - **Composting:** Biodegradable waste is allowed to decompose naturally to form nutrient-rich manure (compost).
  - **Biogas Plants:** Organic waste (animal dung, agricultural waste) is anaerobically decomposed to produce biogas (fuel) and bio-manure.
  - **Incineration:** Burning waste at high temperatures. Reduces volume but can cause air pollution if not properly managed.
  - **Landfilling:** Burying waste in designated areas. Can lead to leachate formation and methane gas release.
  - **Sewage Treatment:** Treating wastewater to remove pollutants before discharging it into water bodies.

4. Important Environmental Issues

- **Pollution:** The introduction of contaminants into the natural environment that cause adverse change.
  - **Air Pollution:** Caused by gases (CO, SO2, NOx), particulate matter. Leads to respiratory problems, acid rain.
  - **Water Pollution:** Contamination of water bodies by industrial effluents, sewage, agricultural runoff. Affects aquatic life, human health.
  - **Soil Pollution:** Contamination of soil by pesticides, fertilizers, industrial waste, non-biodegradable waste. Affects soil fertility, food safety.

    - **Noise Pollution:** Excessive and unpleasant sound. Causes stress, hearing loss.
- **Deforestation:** Large-scale cutting down of forests.
    - **Impact:** Loss of biodiversity, soil erosion, climate change (reduced CO2 absorption, increased greenhouse effect).
- **Biodiversity Loss:** Reduction in the variety of life forms on Earth.
    - **Causes:** Habitat destruction, pollution, climate change, overexploitation, invasive species.
    - **Impact:** Ecosystem instability, loss of potential resources (medicines, food).
- **Climate Change & Global Warming:**
    - **Greenhouse Effect:** Natural process where certain gases in the atmosphere (CO2, methane, water vapor) trap some of the sun's heat, keeping Earth warm enough for life.
    - **Global Warming:** The gradual increase in Earth's average surface temperature due to an enhanced greenhouse effect, primarily caused by increased emissions of greenhouse gases from human activities (burning fossil fuels, deforestation).
    - **Climate Change:** Long-term shifts in temperatures and weather patterns.
    - **Impact:** Rising sea levels, extreme weather events, disruption of ecosystems, food and water insecurity.

5. Role of Individuals in Environmental Conservation

- **Sustainable Development:** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- **Individual Actions:**
    - **Responsible Consumption:** Reduce, Reuse, Recycle.
    - **Energy Conservation:** Switch off lights/fans when not in use, use energy-efficient appliances, promote renewable energy.
    - **Water Conservation:** Fix leaks, use water-efficient fixtures, rainwater harvesting.
    - **Reduce Pollution:** Use public transport, walk/cycle, avoid single-use plastics, dispose of waste properly.
    - **Plant Trees:** Contribute to afforestation efforts.
    - **Support Eco-friendly Initiatives:** Buy sustainable products, support environmental organizations.
    - **Educate Others:** Spread awareness about environmental issues.