Our Environment

Environment refers to everything that surrounds us, including both living and non-living components. It encompasses our physical surroundings like air, water, soil, and all organisms such as plants, animals, humans, and microorganisms.

Ecosystem

Definition

An **ecosystem** is a self-sustaining structural and functional unit where living organisms interact with each other and with their physical environment. The term ecosystem was coined by Sir Arthur Tansley.

Components of Ecosystem

1. Abiotic Components (Non-living)

Physical factors:

- **Climatic factors:** Temperature, rainfall, humidity, wind, sunlight
- **Edaphic factors:** Soil texture, pH, minerals, topography
- **Chemical factors:** Water, oxygen, carbon dioxide, nitrogen

2. Biotic Components (Living)

Based on nutrition, organisms are classified as:

A. Producers (Autotrophs)

- Organisms that can make their own food
- Use sunlight, water, and carbon dioxide for photosynthesis
- Examples: Green plants, algae, some bacteria
- Form the first trophic level

B. Consumers (Heterotrophs)

- Organisms that depend on other organisms for food
- Cannot make their own food

Types of Consumers:

1. **Primary Consumers (Herbivores)**
    - Feed directly on producers
    - Examples: Rabbit, deer, cow, goat

2. **Secondary Consumers (Primary Carnivores)**
    - Feed on primary consumers
    - Examples: Frog, small fish, snakes
3. **Tertiary Consumers (Secondary Carnivores)**
    - Feed on secondary consumers
    - Examples: Hawk, large fish, tiger
4. **Omnivores**
    - Feed on both plants and animals
    - Examples: Humans, bears, pigs
5. **Parasites**
    - Live on or inside other organisms and obtain food
    - Examples: Tapeworm, lice, ticks

C. Decomposers (Saprophytes)

- Break down dead organic matter
- Recycle nutrients back to the ecosystem
- Examples: Bacteria, fungi
- Essential for maintaining ecosystem balance

Types of Ecosystems

1. Natural Ecosystems

- Occur naturally without human intervention
- Examples: Forests, grasslands, deserts, ponds, lakes, rivers, oceans

2. Artificial Ecosystems

- Created and maintained by humans
- Examples: Gardens, parks, aquariums, agricultural fields, fish ponds

Food Chains and Food Webs

Food Chain

A **food chain** is a sequence of organisms where each organism feeds on the previous one and is food for the next organism.

Components:

- Each step in the food chain is called a **trophic level**
- Energy flows in one direction (unidirectional)
- Matter is recycled

Example of Food Chain:
Grass → Grasshopper → Frog → Snake → Hawk

Trophic Levels:

- **T1:** Producers (Grass)
- **T2:** Primary consumers (Grasshopper)
- **T3:** Secondary consumers (Frog)
- **T4:** Tertiary consumers (Snake)
- **T5:** Top consumers (Hawk)

Food Web

A **food web** is an interconnected network of food chains. It shows the complex feeding relationships in an ecosystem where organisms may feed at different trophic levels.

Energy Flow in Ecosystem

Ten Percent Law (Lindeman's Law)

- Only **10% of energy** is transferred from one trophic level to the next
- **90% of energy** is lost as heat, used in metabolism, or remains unused
- This limits the number of trophic levels in a food chain
- Energy flow is **unidirectional** and cannot be recycled

Example:
If plants capture 10,000 J energy:

- Primary consumers get 1,000 J (10%)
- Secondary consumers get 100 J (1%)
- Tertiary consumers get 10 J (0.1%)

Biological Magnification

Definition

Biological magnification is the increase in concentration of harmful chemicals at successive trophic levels in a food chain.

Process

1. Toxic substances enter producers from environment
2. Consumers accumulate these toxins from their food
3. Concentration increases at higher trophic levels
4. Top consumers have highest toxin concentration

Examples

- **DDT accumulation:** Plants → Small fish → Large fish → Birds
- **Mercury accumulation** in aquatic food chains
- **Pesticides** in agricultural food chains

Effects

- Reduced reproduction in birds
- Eggshell thinning
- Death of top consumers
- Disruption of ecosystem balance

Environmental Problems

1. Ozone Layer Depletion

Ozone Formation

- **Ozone (O_3)** formed in stratosphere (15-50 km altitude)
- Process: $O_2 + O \rightarrow O_3$ (in presence of UV radiation)
- Forms protective layer around Earth

Importance of Ozone Layer

- Absorbs harmful **UV-B radiation** from sun
- Protects life on Earth from UV damage
- Prevents skin cancer, cataracts, genetic damage

Ozone Depletion

Causes:

- **Chlorofluorocarbons (CFCs)** from refrigerators, air conditioners
- **Halons** from fire extinguishers
- **Nitrous oxide** from fertilizers
- **Methyl bromide** from pesticides

Effects:

- Increased UV radiation reaching Earth
- Skin cancer, cataracts in humans
- Damage to plants and marine life
- Climate change

Prevention:

- Montreal Protocol (1987) - international agreement
- Ban on CFC production
- Use of ozone-friendly alternatives
- Public awareness

2. Waste Management

Types of Waste

A. Biodegradable Waste

- **Definition:** Materials that can be broken down by natural biological processes
- Decomposed by bacteria, fungi, and other decomposers
- **Examples:** Food waste, paper, wood, cloth, sewage, animal waste

Advantages:

- Keep environment clean
- Recycled naturally
- Provide nutrients to soil
- No long-term environmental impact

B. Non-biodegradable Waste

- **Definition:** Materials that cannot be broken down by biological processes
- Persist in environment for long periods

- **Examples:** Plastics, glass, metals, synthetic fibers, pesticides, radioactive waste

Disadvantages:

- Cause pollution
- Accumulate in environment
- Harmful to organisms
- Require special disposal methods

Waste Disposal Methods

1. Composting

- Biodegradable organic waste converted to manure
- Natural decomposition by microorganisms
- Improves soil fertility
- Reduces waste volume

2. Landfills

- Waste buried in designated areas
- Lined to prevent groundwater contamination
- Used for both biodegradable and non-biodegradable waste
- Requires large land areas

3. Incineration

- Burning waste at high temperatures
- Reduces waste volume significantly
- Can generate energy
- May produce harmful gases

4. Recycling

- Converting waste materials into new products
- Examples: Paper, plastic, metal recycling
- Conserves resources
- Reduces environmental impact

5. Reuse

- Using materials again for same or different purpose
- Examples: Glass bottles, paper bags
- Most environmentally friendly option
- Reduces need for new materials

6. Sewage Treatment

- Treatment of liquid waste
- Physical, chemical, and biological processes
- Produces clean water and biogas
- Prevents water pollution

7. Biogas Plants

- Anaerobic decomposition of organic waste
- Produces methane and carbon dioxide
- Used as fuel for cooking and heating
- Produces slurry as fertilizer

Conservation Strategies

3 R's of Waste Management

1. Reduce

- Minimize consumption
- Use only what is necessary
- Choose products with less packaging
- Use energy-efficient appliances

2. Reuse

- Use items multiple times
- Find new purposes for old items
- Examples: Using glass jars for storage, old clothes as cleaning rags

3. Recycle

- Convert waste into new products
- Separate recyclable materials

- Examples: Paper, plastic, metal recycling

Sustainable Development

- Meeting present needs without compromising future generations
- Balance between economic development and environmental protection
- Includes renewable energy, conservation, pollution control

Important Points for Exams

1. **Ecosystem** consists of biotic and abiotic components interacting with each other
2. **Energy flow** is unidirectional and follows 10% law
3. **Biological magnification** increases toxin concentration at higher trophic levels
4. **Ozone layer** protects Earth from harmful UV radiation
5. **CFCs** are main cause of ozone depletion
6. **Biodegradable waste** is decomposed naturally, **non-biodegradable** persists
7. **3 R's** (Reduce, Reuse, Recycle) help in waste management
8. **Decomposers** are essential for nutrient recycling

Summary

Our environment is a complex system where living and non-living components interact to maintain ecological balance. Understanding ecosystems, food chains, and energy flow helps us appreciate the interconnectedness of life. Human activities have created environmental problems like ozone depletion and waste accumulation, but through proper waste management and conservation strategies, we can work toward sustainable development and environmental protection.