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ENVIRONMENTAL SCIENCES

UNIT 2

TOPIC :

- **Ecosystems**

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

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Ecosystems

- An ecosystem is a natural, self-sustaining unit where living organisms (plants, animals, microbes) interact with non-living components (air, water, soil, sunlight) of their environment in a balanced and cyclic manner. It represents a functional unit of nature.
- In simple terms, an ecosystem includes everything that lives in a particular environment and how those living things interact with each other and with their environment.



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Concepts of Ecosystem

1. Biotic and Abiotic Interactions

- Biotic components: Living organisms like plants, animals, and microorganisms.
- Abiotic components: Non-living physical and chemical factors like sunlight, temperature, water, soil, and air.
- These components are interdependent, creating a system that supports life.

2. Energy Flow

- Energy from the sun is captured by green plants (producers) through photosynthesis.
- This energy flows through the food chain to herbivores, carnivores, and finally decomposers.
- The flow of energy is unidirectional and follows the 10% law (only 10% of energy is passed to the next level).

3. Nutrient Cycling

- Nutrients like carbon, nitrogen, phosphorus, and water are recycled in the ecosystem.
- This recycling is done by decomposers and other organisms through biogeochemical cycles.

4. Food Chains and Food Webs

- Organisms are linked through feeding relationships, forming food chains.
- Multiple interconnected food chains form a food web, which provides stability to the ecosystem.

5. Trophic Levels

- Organisms are classified into levels based on what they eat:
- Producers (plants)
- Primary consumers (herbivores)
- Secondary consumers (carnivores)
- Tertiary consumers (top predators)
- Decomposers (fungi and bacteria)

6. Ecological Balance

- An ecosystem maintains a balance between production and consumption.

Structure and Function of an Ecosystem



1. Structure of an Ecosystem

The **structure** of an ecosystem refers to the **physical components** (both living and non-living) that make up the ecosystem and how they are organized.

A. Biotic Components (*Living*)

These are the organisms present in the ecosystem. They are categorized into:

1. Producers (Autotrophs)

- Green plants and algae that produce food using **photosynthesis**.
- Example: Grass, phytoplankton

2. Consumers (Heterotrophs)

- Depend on producers or other organisms for food.
- Divided into:
 - **Primary consumers** (herbivores): eat plants (e.g., deer, rabbit)

- **Secondary consumers** (carnivores): eat herbivores (e.g., snake, frog)
- **Tertiary consumers**: eat other carnivores (e.g., eagle, tiger)
- **Omnivores**: eat both plants and animals (e.g., humans, bears)

3. **Decomposers (Saprotrophs)**

- Break down dead plants and animals into nutrients.
- Example: Bacteria, fungi, earthworms

B. Abiotic Components (Non-Living)

These are **physical and chemical factors** essential for sustaining life.

- **Sunlight** – Primary source of energy
- **Water** – Essential for all life forms
- **Air (O₂, CO₂, N₂)** – For respiration and photosynthesis
- **Temperature** – Influences metabolic activities
- **Soil** – Source of minerals and nutrients

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Function of an Ecosystem

The function of an ecosystem refers to the dynamic processes that allow the ecosystem to maintain balance, sustain life, and recycle nutrients.

A. Energy Flow

- Energy enters via sunlight and is captured by producers.
- It flows in a one-way direction through various trophic levels via food chains and food webs.
- At each trophic level, only 10% of energy is passed on to the next level (known as the 10% Law).

B. Nutrient Cycling (Biogeochemical Cycles)

- Nutrients like carbon, nitrogen, phosphorus, and water cycle between biotic and abiotic components.
- These cycles maintain ecosystem stability.
- Example: Nitrogen cycle, carbon cycle, water cycle

C. Food Chains and Food Webs

- A food chain is a linear sequence showing “who eats whom”.
- A food web is a network of interconnected food chains, providing more stability to the ecosystem.

D. Ecological Succession

- A gradual and natural change in the types of species in an ecosystem over time.
- It helps an ecosystem recover from disturbances and reach climax communities.

E. Homeostasis (Ecological Balance)

- Ecosystems can self-regulate to maintain a balance between organisms and resources.
- Helps resist and recover from environmental changes.

Types of Ecosystems

Ecosystems can be broadly categorized into:

1. Natural Ecosystems
2. Artificial (Man-made) Ecosystems

1. Natural Ecosystems

These ecosystems occur naturally without human intervention and are self-regulating.

A. Terrestrial Ecosystems

These are land-based ecosystems.

a) Forest Ecosystem

- **Characteristics:**

Dense tree cover, high biodiversity, multi-layered vegetation, rich in fauna.

- **Structure:**

- *Biotic*: Trees (producers), herbivores (deer), carnivores (tiger), decomposers (fungi).
- *Abiotic*: Soil, water, air, sunlight.

- **Functions:**

- Oxygen production
- Carbon dioxide absorption (carbon sink)
- Biodiversity habitat
- Rainfall regulation

b) Grassland Ecosystem

- **Characteristics:**

Dominated by grasses with few trees; supports grazing animals.

- **Structure:**



- *Biotic*: Grasses, herbivores (buffalo), carnivores (lion), decomposers.
- *Abiotic*: Soil, sunlight, temperature.

- **Functions:**

- Supports livestock
- Maintains soil fertility
- Prevents erosion



c) Desert Ecosystem

- **Characteristics:**

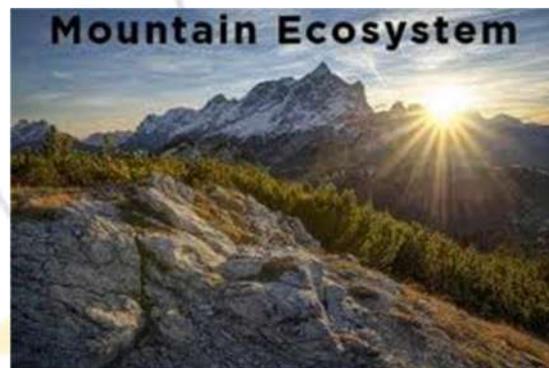
Arid, very low rainfall, extreme temperatures, sparse vegetation.

- **Structure:**

- *Biotic*: Cactus, camels, snakes, scorpions.
- *Abiotic*: Sandy soil, high temperature, low humidity.

- **Functions:**

- Adaptation and survival
- Water conservation
- Specialized flora and fauna



d) Mountain Ecosystem

- **Characteristics:**

High altitude, cold climate, snow cover, diverse flora and fauna.

- **Structure:**

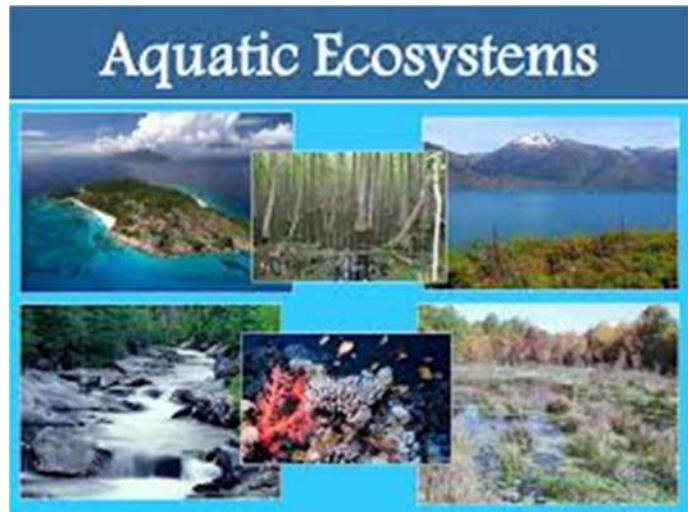
- *Biotic*: Alpine plants, snow leopard, birds, mosses.
- *Abiotic*: Snow, rocks, thin air, low temperature.

- **Functions:**

- Source of rivers
- Biodiversity conservation
- Regulates regional climate

B. Aquatic Ecosystems

These are water-based ecosystems.



a) Freshwater Ecosystem

- **Types:** Ponds, lakes, rivers, streams.
- **Characteristics:** Low salt concentration, flowing or standing water.
- **Structure:**
 - *Biotic:* Algae, fishes, amphibians, bacteria.
 - *Abiotic:* Water, dissolved oxygen, sunlight.
- **Functions:**
 - Drinking water supply
 - Irrigation
 - Aquatic biodiversity

b) Marine Ecosystem

- **Types:** Oceans, seas, coral reefs, estuaries.
- **Characteristics:** High salt concentration, large size, deep zones.
- **Structure:**
 - *Biotic:* Phytoplankton, fish, whales, dolphins.
 - *Abiotic:* Salt water, waves, ocean currents.
- **Functions:**
 - Major oxygen producer (via phytoplankton)
 - Seafood source
 - Climate regulation

2. Artificial or Man-Made Ecosystems

These ecosystems are created and maintained by human beings.

a) Agroecosystem (Agricultural Land)

- **Characteristics:** Planned growth of crops and livestock.
- **Structure:**
 - *Biotic:* Crops, pests, cattle, humans.
 - *Abiotic:* Fertilizers, irrigation, tools.
- **Functions:**
 - Food and fiber production
 - Economic development
 - Employment source



b) Urban Ecosystem

- **Characteristics:** High human density, buildings, less greenery.
- **Structure:**
 - *Biotic:* Humans, domestic animals, birds.
 - *Abiotic:* Roads, buildings, pollutants.
- **Functions:**
 - Social and economic centers
 - Services and trade
 - High energy and resource use



c) Aquaculture Ecosystem

- **Characteristics:** Artificial water bodies for fish and aquatic plant farming.
- **Structure:**
 - *Biotic:* Fish, aquatic plants, plankton.
 - *Abiotic:* Tank or pond water, artificial nutrients.
- **Functions:**
 - Fish and seafood production
 - Commercial farming