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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)

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.

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 (O_2, CO_2, N_2)** – For respiration and photosynthesis
- **Temperature** – Influences metabolic activities
- **Soil** – Source of minerals and nutrients

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

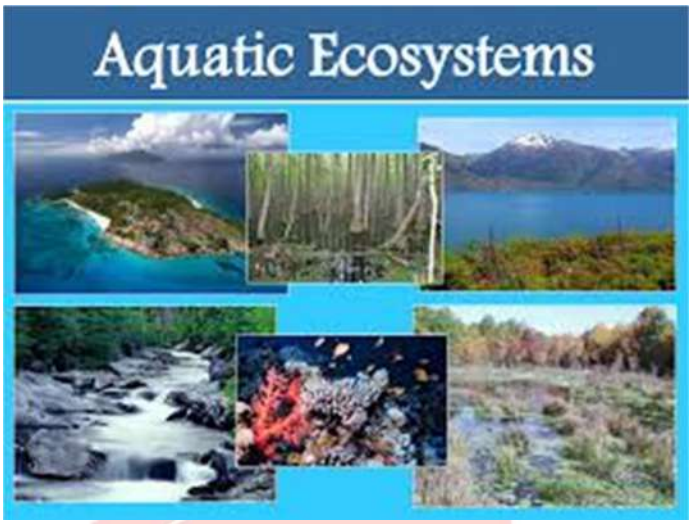
c) **Desert Ecosystem**

- **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