Ecosystem

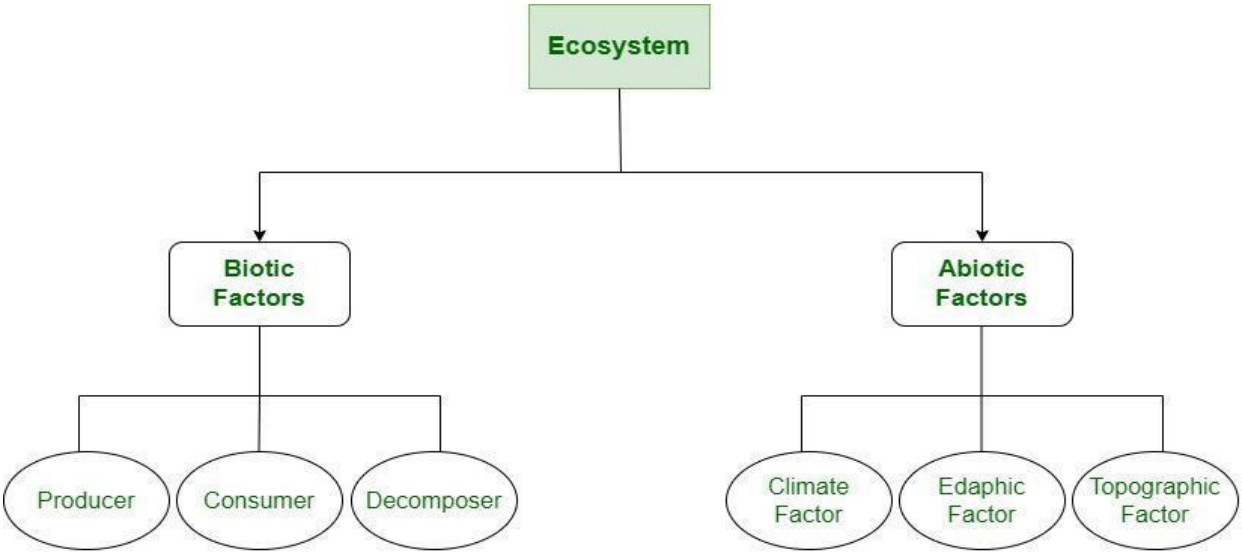
❖ Concept of Ecosystem

. In the word "ecosystem", "eco" means environment, and "system," refers to connected processes or elements. **Ecosystems are made up of both biotic (and alive) and abiotic (or nonliving) components.** It is a biological community where living and non-living components of the planet interact with each other. Ecosystem varies in the size and number of organisms they consist of. When the ecosystem is land-based it is called a terrestrial ecosystem and when it is water-based it is called an aquatic ecosystem.

Definition:

- An ecosystem is a chain of interactions between organisms and their environment
- An ecosystem can be defined as a unit of ecological studies that includes all the interactions between living organisms with their surrounding non-living environment.

Structure of Ecosystem



Biotic Components

- Plants, animals, microorganisms, aquatic plants, and all other living creatures are the biotic components of the ecosystem. These biotic components can be classified into:
- **Producers:** All autotrophs like plants, phytoplankton, etc. that can produce their food using sources like sun, water, carbon dioxide, or any other chemical elements belong to this category.
- **Consumers:** All heterotrophs, primarily animals, that are dependent on the producers or other organisms are called consumers. These consumers are subdivided into the following groups:

- **Primary consumers: All herbivores t**hat directly depend on plants, such as cows, goats, rabbits, and sheep, are considered primary consumers.
- **Secondary consumers:** All that depend on primary consumers for food are considered secondary consumers. The secondary consumer can be omnivores or carnivores.
- **Tertiary consumers:** All animals that depend on secondary-level organisms for their food are known as tertiary consumers.
- **Quaternary consumer**: Those animals that depend on the tertiary level organism for their food and are known as the quaternary consumer. This level is present in some food chains only.
- **Decomposers:** All microorganisms, such as bacteria and fungi, that depend on decaying and dead matter for food fall under this category. It contributes to environmental cleanup and ecosystem nutrient recycling. These nutrients support plant development and subsequently ecosystem maintenance.

Abiotic components

- It involves all the non-living things present in the environment. Some of the abiotic components are sun, soil, water, minerals, climate, rocks, temperature, and humidity. These components' functioning together enables the ecosystem's energy and nutrition cycles. The sun's rays are the primary energy source. An ecosystem's temperature changes have an impact on the types of plants that may flourish there. The availability of nutrients and soil nature determines the type and abundance of vegetation in an area. All the abiotic factors are essential factors that determine the number and type of organisms present in a region.

Ecosystem Process

Ecosystem is basically developed by two factors:

- **External factors (state factors):** External factors basically controls over all structure of ecosystem, e.g., climate.
- **Internal factors:** Internal factors in ecosystem not only control ecosystem processes, but are also controlled by them.
- Non-living
- Process
- Energy flow
- Cycling of matter
- Change
- Dynamic
- Succession

Ways to Maintain Ecological Balance

- Control population
- Recycle
- Reduction in pollution
- Prevent deforestation
- Manage natural resources carefully

- Protect water.

Functions of Ecosystem

1. **Nutrient Cycling**:

- This process involves the movement of essential nutrients (e.g., carbon, nitrogen, phosphorus) between biotic and abiotic components.
- Decomposers play a key role by breaking down dead organisms and releasing nutrients back into the soil, which are then taken up by plants and passed through the food chain.

2. **Energy Flow**:

- Energy enters the ecosystem through sunlight and is captured by producers via photosynthesis.
- This energy flows through the food chain, with each trophic level losing energy due to metabolic processes.
- Eventually, decomposers release the remaining energy back into the ecosystem as heat.

3. **Ecological Succession**:

- This refers to the gradual change in the composition of an ecosystem over time due to interactions between biotic and abiotic factors.
- Primary succession occurs in previously uninhabited areas, while secondary succession follows disturbances in existing ecosystems.

4. Ecosystem Services:

- Ecosystems provide essential services such as air and water purification, climate regulation, and resources like food, fiber, and fuel.
- These services are critical for human well-being but are threatened by activities like habitat destruction and pollution.

❖ Types of Ecosystem

➢ Terrestrial Ecosystem

- Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:
- Forest Ecosystem
- Grassland Ecosystem
- Tundra Ecosystem
- Desert Ecosystem

- **Aquatic Ecosystem**

Aquatic Ecosystem are ecosystems present in a body of water.

- Freshwater Ecosystem
- Marine Ecosystem
  - **Freshwater Ecosystem**
- The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.
  - **Marine Ecosystem**
- The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

- **Terrestrial Ecosystem**

- **Forest Ecosystem:**
- A forest ecosystem consists of several plants, particularly trees, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink.
- **Grassland Ecosystem:**
- In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands and tropical or savanna grasslands are examples of grassland ecosystems.
- **Tundra Ecosystem:**
- Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce. These are covered with snow for most of the year. Tundra type of ecosystem is found in the Arctic or mountain tops.
- **Desert Ecosystem:**
- Deserts are found throughout the world. These are regions with little rainfall and scarce vegetation. The days are hot, and the nights are cold.

ENERGY FLOW IN ECOSYSTEM:

Introduction: Energy flow is a fundamental process in ecosystems, describing how energy moves from one organism to another. This flow of energy is unidirectional, beginning with the sun and ultimately being released as heat. Understanding how energy flows through ecosystems is essential for grasping their structure and function

Primary Source of Energy: The sun is the primary energy source for most ecosystems. Plants, algae, and other photosynthetic organisms, known as producers, capture solar energy through photosynthesis. During photosynthesis, sunlight is converted into chemical energy stored in

organic compounds like glucose. These compounds form the base of the food chain, providing energy for all other organisms in the ecosystem

Terminology of trophic levels:

- We can further separate the TROPHIC LEVELS, particularly the Consumers:
- Producers (Plants, algae, cyanobacteria; some chemotrophs)--capture energy, produce complex organic compounds
- Primary consumers--feed on producers
- Secondary consumers--feed on primary consumers
- Tertiary consumers--feed on secondary consumers

Alternate Terminology:

- Producers = plants etc. that capture energy from the sun
- Herbivores = plant-eaters
- Carnivores = animal-eaters
- Omnivores=eat both animals and plants
- Specialized herbivores:
- Granivores=seed-eaters
- Frugivores=fruit-eaters

Trophic Levels and Ecological Pyramids:

- Energy transfer in ecosystems is represented by ecological pyramids, which illustrate the relative amount of energy at different trophic levels. The base of the pyramid consists of producers, which are then consumed by primary consumers (herbivores), secondary consumers (carnivores), and tertiary consumers (top carnivores). Each step up the pyramid represents a transfer of energy from one trophic level to the next. However, energy decreases as it moves up the pyramid because of metabolic processes like respiration and digestion.

Laws of Thermodynamics:

- The flow of energy in ecosystems is governed by the laws of thermodynamics. The first law of thermodynamics states that energy cannot be created or destroyed but only transformed from one form to another. For example, solar energy is transformed into chemical energy by producers and then into kinetic and thermal energy by consumers.
- The second law of thermodynamics highlights that energy transfer is inefficient. At each trophic level, a significant portion of energy is lost as heat. This inefficiency results in

only a small fraction of the energy being passed on to higher trophic levels, limiting the number of trophic levels an ecosystem can support.

Energy Loss and Ecosystem Function:

- The energy loss as heat is crucial in determining the structure and sustainability of ecosystems. Because of this energy loss, there are fewer organisms at higher trophic levels. This loss also emphasizes the importance of conserving producers, as they form the base of the food chain and support the entire ecosystem's energy flow.

Human Impact:

- Human activities, such as deforestation and pollution, disrupt energy flow in ecosystems. These disruptions can lead to a loss of biodiversity and degrade ecosystem services. Understanding energy flow is critical for promoting sustainable management and conservation of natural resources.