Ecosystem The ecosystem is the structural and functional unit of ecology where the living organisms interact with each other and the surrounding environment. In other words, an ecosystem is a chain of interaction between organisms and their environment.

Types of Ecosystem An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles.

There are two types of ecosystem:

- Terrestrial Ecosystem
- Aquatic Ecosystem

1). Terrestrial Ecosystems Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones.

They are as follows:

1. Forest Ecosystems
2. Grassland Ecosystems
3. Tundra Ecosystems
4. Desert Ecosystem

Forest Ecosystem A forest ecosystem consists of several plants, 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, savanna grasslands are some of the 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. The ecosystem in the Arctic or mountain tops is tundra type.

Desert Ecosystem Deserts are found throughout the world. These are regions with very little rainfall. The days are hot and the nights are cold.

2). Aquatic Ecosystem Aquatic ecosystems are ecosystems present in a body of water.

These can be further divided into two types, namely:

1. Freshwater Ecosystem
2. 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.

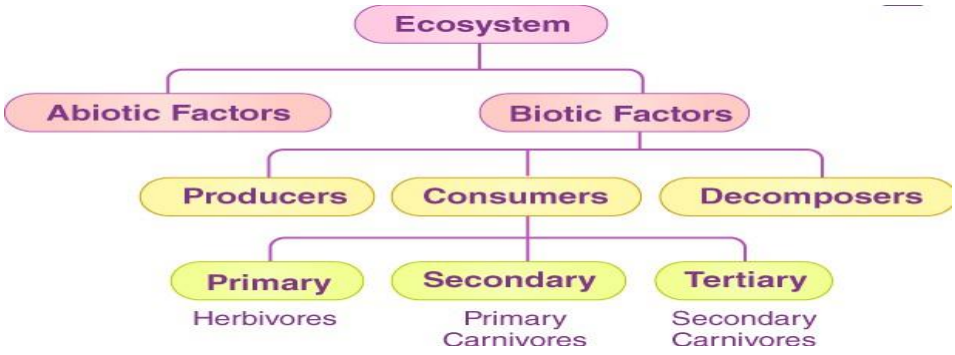
Structure of the Ecosystem

The structure of an ecosystem is characterised by the organisation of both biotic and abiotic components. This includes the distribution of energy in our environment. It also includes the climatic conditions prevailing in that particular environment.

The structure of an ecosystem can be split into two main components, namely:

- Biotic Components
- Abiotic Components

The biotic and abiotic components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries.



Biotic Components Biotic components refer to all life in an ecosystem. Based on nutrition, biotic components can be categorised into autotrophs, heterotrophs and saprotrophs (or decomposers).

- **Producers** Producers include all autotrophs such as plants. They are called autotrophs as they can produce food through the process of photosynthesis. Consequently, all other organisms higher up on the food chain rely on producers for food.
- **Consumers** Consumers or heterotrophs are organisms that depend on other organisms for food. Consumers are further classified into primary consumers, secondary consumers and tertiary consumers.
  - Primary consumers are always herbivores that they rely on producers for food.
  - Secondary consumers depend on primary consumers for energy. They can either be a carnivore or an omnivore.
  - Tertiary consumers are organisms that depend on secondary consumers for food. Tertiary consumers can also be an omnivore.
  - Quaternary consumers are present in some food chains. These organisms prey on tertiary consumers for energy. Furthermore, they are usually at the top of a food chain as they have no natural predators.

Decomposers Decomposers include saprophytes such as fungi and bacteria. They directly thrive on the dead and decaying organic matter. Decomposers are essential for the ecosystem as they help in recycling nutrients to be reused by plants.

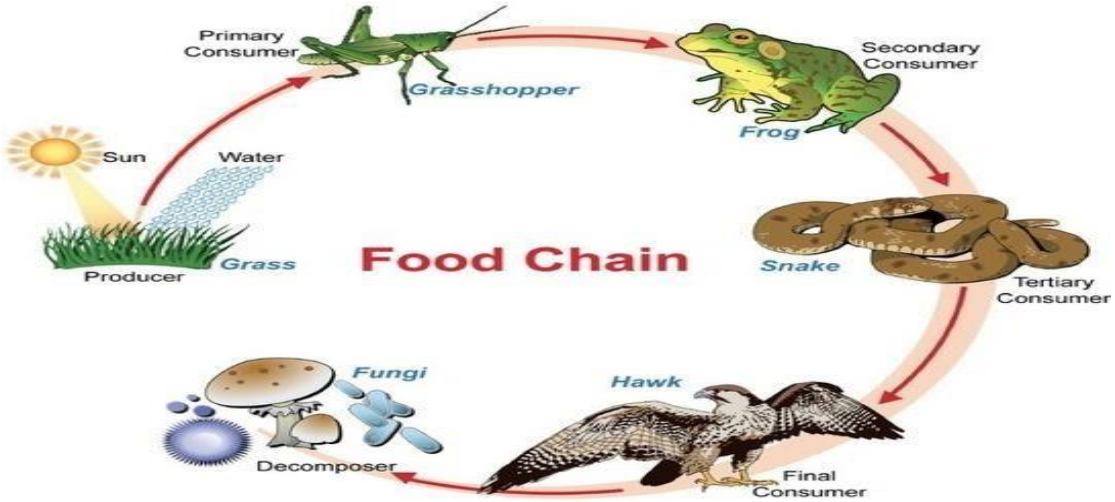
Abiotic Components Abiotic components are the non-living component of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity, etc.

Functions of Ecosystem The functions of the ecosystem are as follows:

1. It regulates the essential ecological processes, supports life systems and renders stability.
2. It is also responsible for the cycling of nutrients between biotic and abiotic components.
3. It maintains a balance among the various trophic levels in the ecosystem.
4. It cycles the minerals through the biosphere.
5. The abiotic components help in the synthesis of organic components that involves the exchange of energy.

Food Chain

The order of living organisms in a community in which one organism consumes other and is itself consumed by another organism to transfer energy is called a food chain. Food chain is also defined as “a chain of organisms, existing in any natural community, through which energy is transferred”. Every living being irrespective of their size and habitat, from the tiniest algae to giant blue whales, need food to survive. Food chain is structured differently for different species in different ecosystems. Each food chain is the vital pathway for energy and nutrients to follow through the ecosystem.



Food chains were first introduced by the African-Arab scientist and philosopher Al-Jahiz in the 9 th century and later popularized in a book published in 1927 by Charles Elton.

A food chain starts with a producer such as plants. Producers form the basis of the food chains. Then there are consumers of many orders. Consumers are organisms that eat other organisms. All organisms in a food chain, except the first organism, are consumers.

Plants are called producers because they produce their own food through photosynthesis. Animals are called consumers because they depend on plants or other animals for food to get energy they need.

In a certain food chain, each organism gets energy from the one at the level below. In a food chain, there is reliable energy transfer through each stage. All the energy at one stage of the chain is not absorbed by the organism at the next stage

Trophic Levels in a Food Chain Trophic levels are different stages of feeding position in a food chain such as primary producers and consumers of different types.

Organisms in a food chain are categorized under different groups called trophic levels. They are as follows.

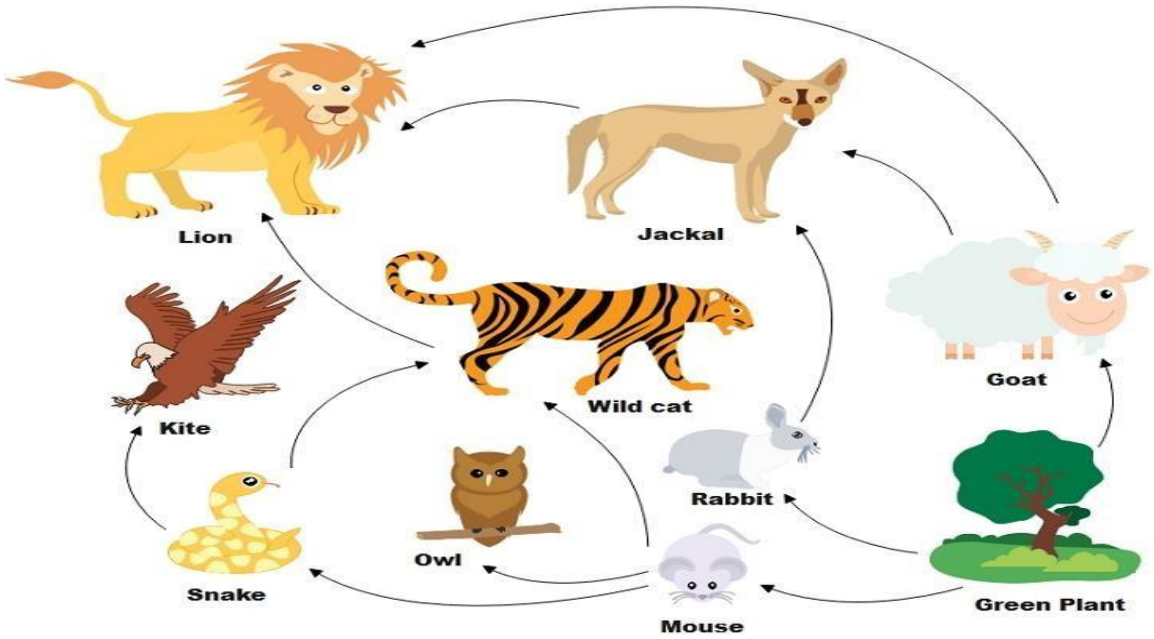
Consumers − At the second trophic level, there are consumers who depend upon others for food.

- **Primary Consumers (Second Trophic Level)** − Primary consumers eat the producers. They are called herbivores. Deer, turtle, and many types of birds are herbivores.
- **Secondary Consumers (Third Trophic Level)** − Secondary consumers based at the third trophic level eat plants and herbivores. They are both carnivores (meat-eaters) and omnivores (animals that eat both animals and plants). In a desert ecosystem, a secondary consumer may be a snake that eats a mouse. Secondary consumers may eat animals bigger than they are. Some lions, for example, kill and eat buffalo. The buffalo weighs twice as much as the lions do.
- **Tertiary Consumers (Fourth Trophic Level)** − Tertiary consumers are animals eating other carnivores. The secretary bird in Africa and the King Cobra specialize in killing and eating snakes but all snakes are carnivores. The leopard seal eats mostly other carnivores - mainly other seals, squids, and penguins, all of which are carnivores.

Decomposers − Decomposers which don't always appear in the pictorial presentation of the food chain, play an important part in completing the food chain. These organisms break down dead organic material and wastes. Fungi and bacteria are the key decomposers in many ecosystems; they use the chemical energy in dead matter and wastes to fuel their metabolic processes. Other decomposers are detritivores—detritus eaters or debris eaters.

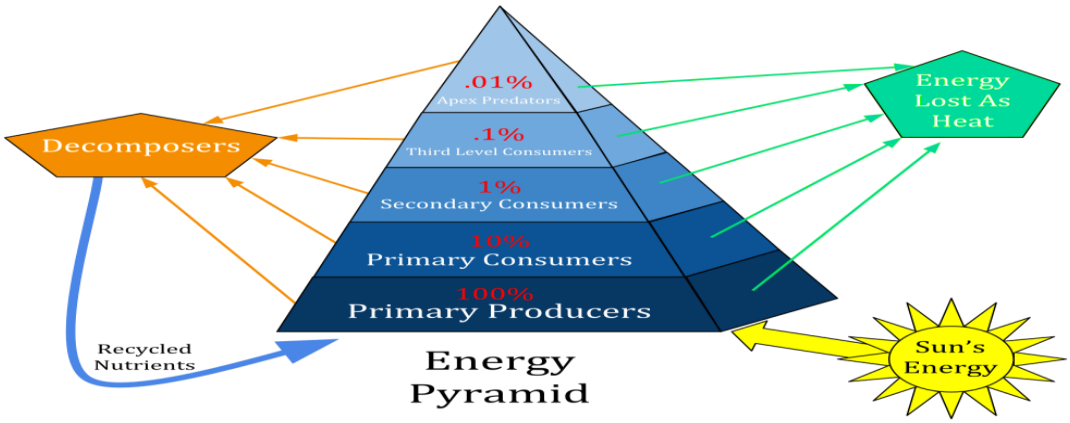
Food Web The word 'web' means network. Food web can be defined as 'a network of interconnected food chains so as to form a number of feeding relationships amongst different organism of a biotic community.

A food chain cannot stand isolated in an ecosystem. The same food resource may be a part of more than one chain. This is possible when the resource is at the lower tropic level. A food web comprises all the food chains in a single ecosystem



A single food chain is the single possible path that energy and nutrients may make while passing through the ecosystem. All the interconnected and overlapping food chains in an ecosystem make up a food web.

Food webs are significant tools in understanding that plants are the foundation of all ecosystem and food chains. The food web provides stability to the ecosystem.
The tertiary consumers are eaten by quaternary consumers. For example, a hawk that eats owls. Each food chain ends with a top predator and animal with no natural enemies
Ecological Pyramid refers to a graphical (pyramidal) representation to show the number of organisms, biomass, and productivity at each trophic level. It is also known as Energy Pyramid. There are three types of pyramids.
Pyramid of Biomass As the name suggests, the Biomass Pyramids show the amount of biomass (living or organic matter present in an organism) present per unit area at each trophic level. It is drawn with the producers at the base and the top carnivores at the tip.
Pyramid of biomass is generally ascertained by gathering all organisms occupying each trophic level separately and measuring their dry weight. Each trophic level has a certain mass of living material at a particular time called standing crop, which is measured as the mass of living organisms (biomass) or the number in a unit area
Upright Pyramid of Biomass Ecosystems found on land mostly have pyramids of biomass with large base of primary producers with smaller trophic level perched on top, hence the upright pyramid of biomass.

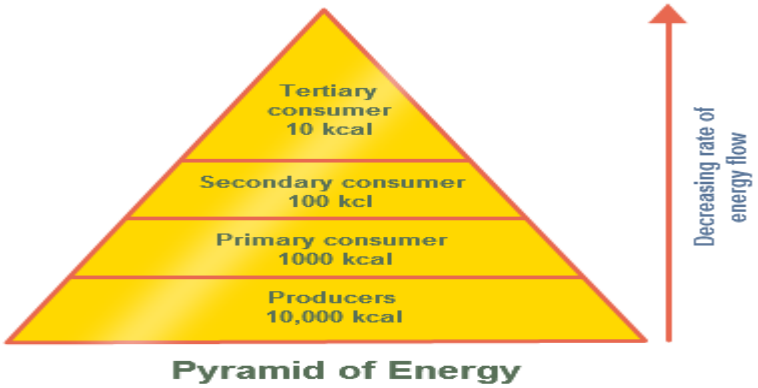


The biomass of autotrophs or producers is at the maximum. The biomass of next trophic level, i.e. primary consumers is less than the producers. Similarly, the other consumers such as secondary and tertiary consumers are comparatively less than its lower level respectively. The top of the pyramid has very less amount of biomass

Inverted Pyramid of Biomass On the other hand, a reverse pyramidal structure is found in most aquatic ecosystems. Here, the pyramid of biomass may assume an inverted pattern. However, pyramid of numbers for aquatic ecosystem is upright.

In a water body, the producers are tiny phytoplankton that grow and reproduce rapidly. In this condition, the pyramid of biomass has a small base, with the producer biomass at the base providing support to consumer biomass of large weight. Hence, it assumes an inverted shape.

Pyramid of Energy It is a graphical structure representing the flow of energy through each trophic level of a food chain over a fixed part of the natural environment. An energy pyramid represents the amount of energy at each trophic level and loss of energy at each is transferred to another trophic level. Energy pyramid, sometimes called trophic pyramid or ecological pyramid, is useful in quantifying the energy transfer from one organism to another along the food chain



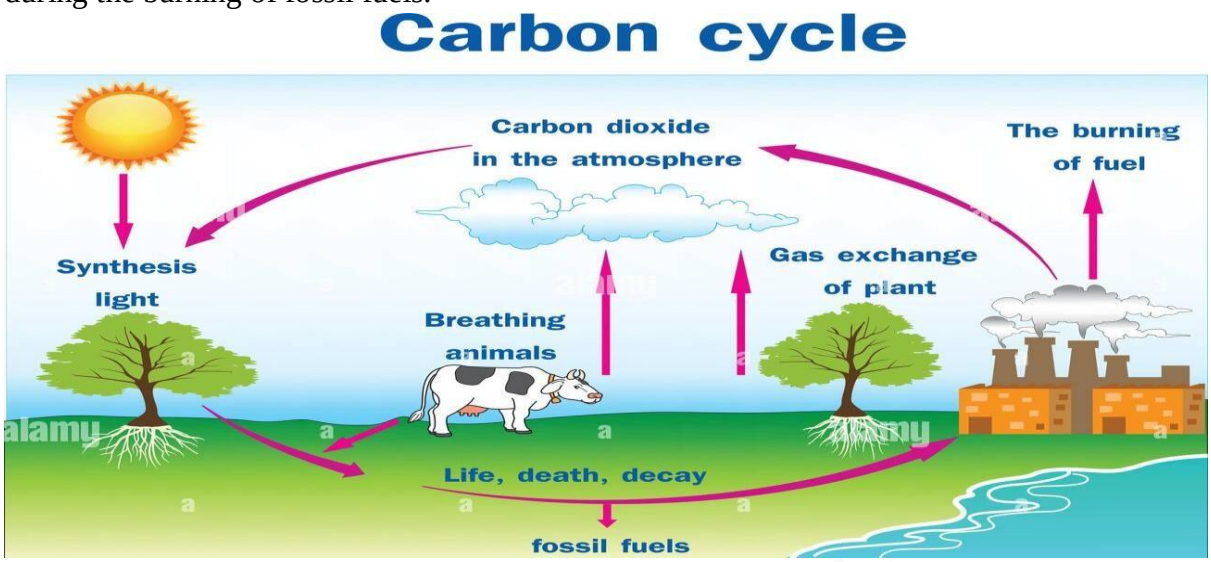
Biogeochemical Cycles All elements in the earth are recycled time and again. The major elements such as oxygen, carbon, nitrogen, phosphorous, and sulphur are essential ingredients that make up organisms.

Biogeochemical cycles refer to the flow of such chemical elements and compounds between organisms and the physical environment. Chemicals taken in by organisms are passed through the food chain and come back to the soil, air, and water through mechanisms such as respiration, excretion, and decomposition

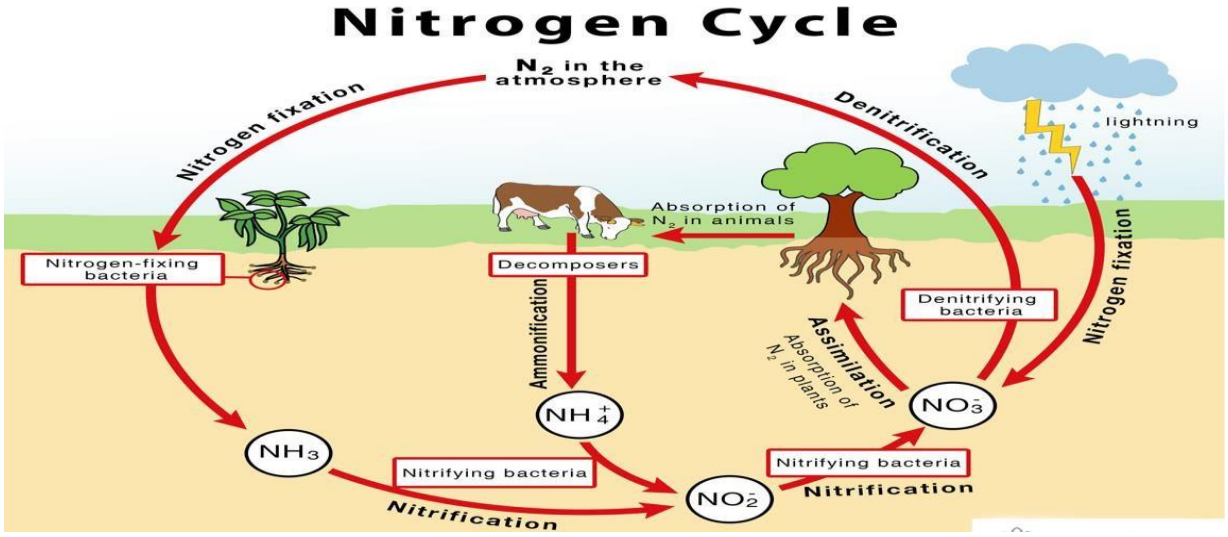
Following are some important biogeochemical cycles –

- Carbon Cycle
- Nitrogen Cycle
- Phosphorus Cycle

Carbon Cycle Carbon enters into the living world in the form of carbon dioxide through the process of photosynthesis as carbohydrates. These organic compounds (food) are then passed from the producers to the consumers (herbivores & carnivores). This carbon is finally returned to the surrounding medium by the process of respiration or decomposition of plants and animals by the decomposers. Carbon is also recycled during the burning of fossil fuels.

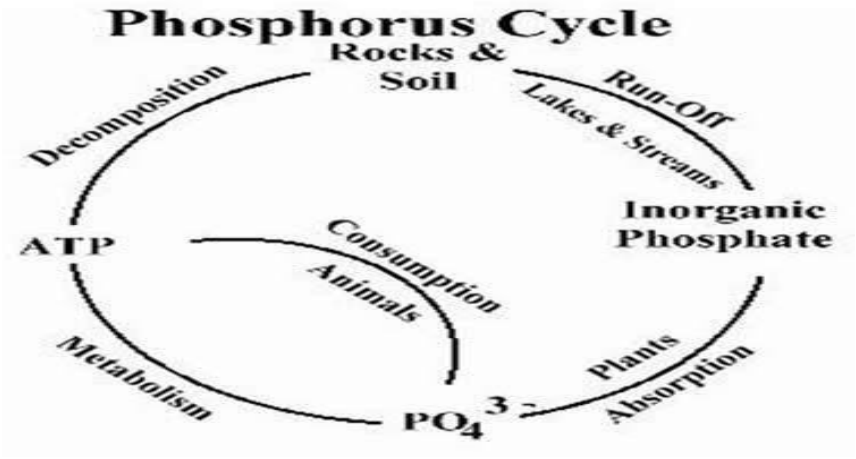


Nitrogen Cycle Nitrogen is present in the atmosphere in an elemental form and as such it cannot be utilized by living organisms. This elemental form of nitrogen is converted into combined state with elements such as H, C, O by certain bacteria, so that it can be readily used by the plants.
Nitrogen is being continuously expelled into the air by the action of microorganisms such as denitrifying bacteria and finally returned to the cycle through the action of lightening and electrification



Phosphorus Cycle

In this biogeochemical cycle, phosphorus moves through the hydrosphere, lithosphere and biosphere. Phosphorus is extracted by the weathering of rocks. Due to rains and erosion phosphorus is washed away in the soil and water bodies. Plants and animals obtain this phosphorus through the soil and water and grow. Microorganisms also require phosphorus for their growth. When the plants and animals die they decompose, and the stored phosphorus is returned to the soil and water bodies which is again consumed by plants and animals and the cycle continues



Biodiversity

Biodiversity Definition

"Biodiversity is the variation among living organisms from different sources including terrestrial, marine and desert ecosystems, and the ecological complexes of which they are a part."

Biodiversity describes the richness and variety of life on earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain.

The term biodiversity was coined in 1985. It is important in natural as well as artificial ecosystems.

Biodiversity holds ecological and economic significance. It provides the with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Types of Biodiversity

Biodiversity further classifies into three major types. They are:

- Genetic Diversity
- Species Diversity
- Ecological Diversity

Genetic Diversity

It is basically the variety of species expressed at the genetic level by each individual in a species. No two individuals belonging to the same species are exactly similar. For example, in the species of human beings, each human shows a lot of diversity in comparison to another human. People living in different regions show a great level of variation.

Species Diversity

It is the biodiversity observed within a community. It stands for the number and distribution of species. The number of species in a region varies widely depending upon the varied environmental conditions. For example, it is usually observed that civilizations residing beside water bodies show more species than the one compared to the areas away from water bodies.

Ecological diversity

It defines the diversity observed among the ecosystems in a particular region. Different ecosystems like mangroves, rainforests, deserts, etc., show a great variety of life forms residing in them.

Importance of Biodiversity

All these diversities help in maintaining the correct balance of nature. But, gradually over the years, there has been a major loss in the biodiversity across the globe. The loss of biodiversity could adversely affect our environment as the balance is lost and the natural food web is disturbed.

Thus, due to its major role in our survival, conservation of biodiversity has now become a matter of high priority. Everybody is paying high attention to it. We still have not identified all the species living on the earth but of all the ones identified till now, many have already been marked as extinct.

Recently, the rate of extinction has gone high and this is causing direct impact on our earth like overuse of resources in some parts, the overpopulation of some species, etc. This has created a great imbalance in nature. Thus, we have to understand the importance of biodiversity.

Magnitude of Biodiversity

Systematic work on identifying and naming species has been in progress for the last 250 years. But still, collected, described and named far less number of species that the actual number present.

The known and described number of species of all organisms on the earth is between 1.7 and 1.8 million, which is fewer than 15percent of the actual number. The predicted number of total species varies from 5 to 50 million and averages at 14 million. About 61 percent of the known species are insects. Only 4650 species of mammals are known to science.

A large number of plant species and vertebrates are known. There are many more species that have not yet been described, especially in the tropics.

Information about bacteria, viruses, protists and Archaea is just fragmentary. However, new species are being discovered faster than ever before due to the efforts of projects like Global Biodiversity Information Facility and the Species 2000.

The number of species of different taxonomic groups, described from India. To develop conservation plans for biodiversity, we must be clear about the concept of biodiversity.

Bio Geo graphical Classification of India:

The division of India according to biogeographic characteristics is the biogeographical classification of India. India harbours nearly 10% of the world's floral diversity comprising over 17500 documented flowering plants, 6200 endemic species, 7500 medicinal plants and 246 globally threatened species in only 2.4% of world's land area.

Bio-geographers have classified India into ten Bio-geographic zones with each zone having characteristic climate, soil and biodiversity.

1. Trans Himalayan Region of Laddakh
2. The Himalayan Ranges
3. The Terai
4. The Gangetic and Brahmaputra Plains
5. The Thar Desert of Rajasthan
6. The semi arid grassland region of the Deccan plateau Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu
7. The Northeast States of India
8. The Western Ghats
9. The Andaman and Nicobar Islands
10. Western and Eastern Coastal Belt

Trans-Himalaya's:

The Himalayas are extended to the Tibetan plateau. This region harbors the high-altitude cold desert in ladakh (Jammu and Kashmir) and Lahaul Spiti (Himachal Pradesh). It accounts for 5.7% of the country's landmass.

Himalaya's: The Himalayas are the northern boundaries of India. The entire mountain chain is running from Kashmir in the North-west to Assam in the north-east. The Himalayas comprise of a diverse range of biotic provinces and biomes. The Himalayas cover 7.2% of the country's landmass.

Desert: The extremely dry area west of the Aravalli hill range comprises both the salty desert of Gujarat and the sandy desert of Rajasthan. Deserts occupy around 6.9% of the country's land mass. The kinds of deserts found in India are:

(I) The desert of western Rajasthan

(II) The desert of Gujarat

(III) High-altitude cold desert of Jammu & Kashmir and Himachal Pradesh. The Indian deserts have more diversified fauna

Angetic Plain: This plain covers the area between the south Himalayas to the tropic of cancer. These Plains were formed by the Ganges River system and are relatively homogeneous. This region experiences 600 mm rainfall annually. Sundarbans forests are located in this region and it covers 11% of the country's land mass.

The Deccan Plateau: This zone lies between the desert and the Deccan plateau. It includes the Aravalli hill range. It covers approximately 15.6% of the country's landmass. It is a large triangular plateau south of the Narmada valley. Three sides of the plateau are covered by mountains slopes towards east. Satpura Mountains cover the north while Western Ghats cover the west side and Eastern Ghats cover the eastern side of the plateau. It is the one of largest zones covering the southern and south-central plateau with mostly deciduous trees. It covers 4.3% of the country's land mass.

North-East India: These are pains and Non-Himalayan ranges of northeaster India and have a wide variety of vegetation. It covers around 5.2% of the country's land mass.

Western Ghats: The Western Ghats are a mountain range that runs along the western cost of India. They are a range extending north-south from southern tip of Gujarat in the north to Kanyakumari in the south. The mountains cover an area of about 160,000 sq. km. This ghat section covers an extremely diverse range of biotic provinces and biomes. It covers about 5.8% of the country's landmass.

Islands: The Andaman and Nicobar Islands in the Bay of Bengal has almost 300 big and small islands. Among these, only five islands are inhabited. Only tribes are found in the island of Nicobar. These islands have a highly diverse set of biomes and occupy 0.03% of the country's biomass.

Biodiversity at Global, National and Local Levels

There are at present 1.8 million species known and documented by scientists in the world. However, scientists have estimated that the number of species of plants and animals on earth could vary from 1.5 to 20 billion! Thus the majority of species are yet to be discovered.