

## MODULE-1: ECOSYSTEM

The ecosystem is the structural and functional unit of ecology where the living organisms interact with each other and the surrounding environment. The term “Ecosystem” was first coined by A.G.Tansley, an English botanist, in 1935.

### **1. Types of Ecosystem**

There are two types of ecosystem: 1. Terrestrial Ecosystem 2. Aquatic Ecosystem

#### **Terrestrial Ecosystems**

Terrestrial ecosystems are land-based ecosystems. Different types of terrestrial ecosystems are,

1. Forest Ecosystem 2. Grassland Ecosystem 3. Tundra Ecosystem 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.

##### 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.

#### **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

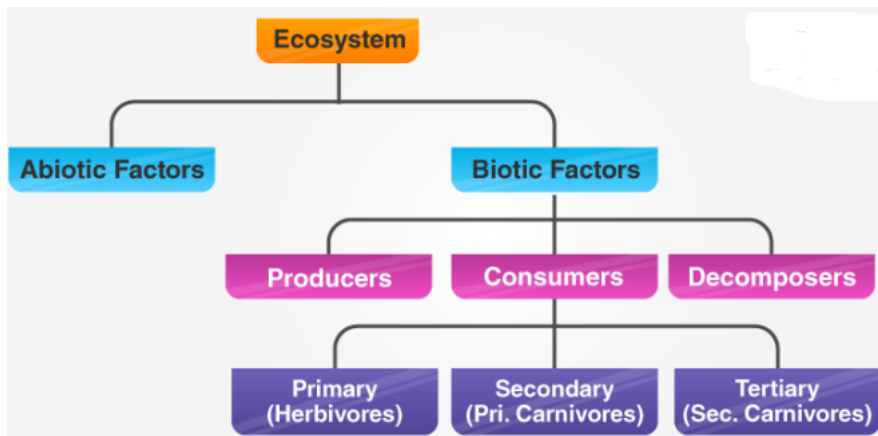
##### Freshwater Ecosystem

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content.

##### 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

## 2. Structure of Ecosystem



### Biotic Components

Biotic components refer to all life in an ecosystem.

**Producers** include all autotrophs such as plants. They are called autotrophs as they can produce food through the process of photosynthesis.

**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.

**Decomposers** include 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

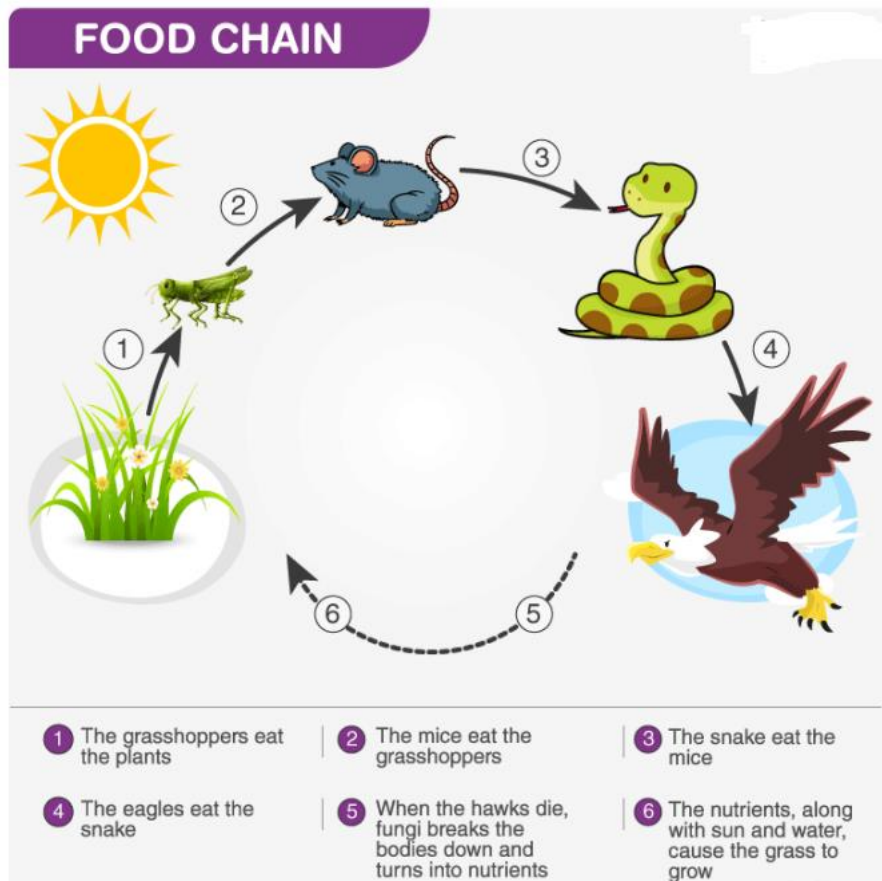
Abiotic components are the non-living component of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity, etc.

## 3. Food chain

A *food chain* is a linear sequence of organisms through which nutrients and energy pass as one organism eats another. Let's look at the parts of a typical food chain, starting from the bottom—the producers—and moving upward.

- At the base of the food chain lie the **primary producers**. The primary producers are autotrophs and are most often photosynthetic organisms such as plants.

- The organisms that eat the primary producers are called **primary consumers**. Primary consumers are usually **herbivores**, plant-eaters.
- The organisms that eat the primary consumers are called **secondary consumers**. Secondary consumers are generally meat-eaters—**carnivores**.
- The organisms that eat the secondary consumers are called **tertiary consumers**. These are carnivore-eating carnivores, like eagles or big fish.
- **Decomposers** break down dead organic materials and wastes.

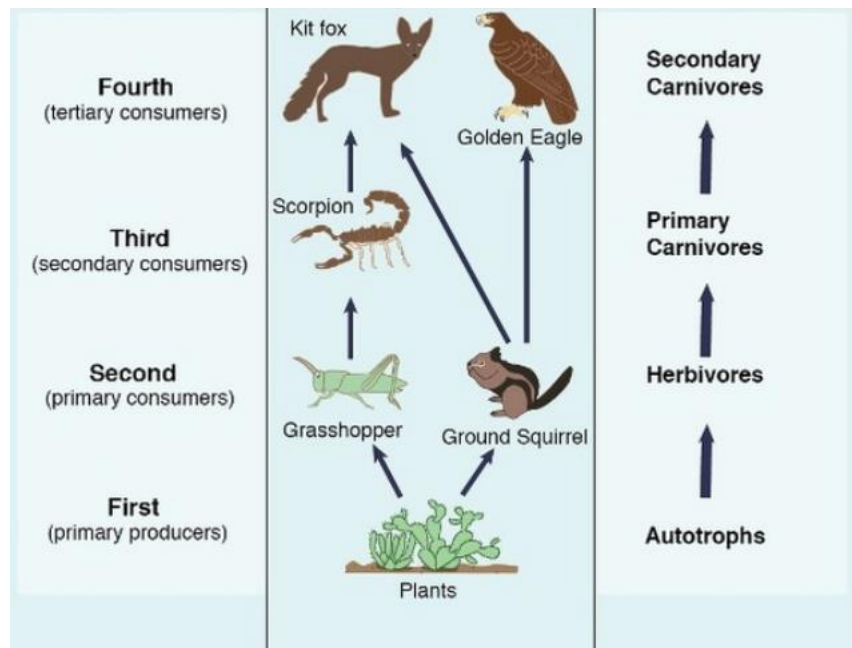


#### **4. Food web**

A food chain is a linear flow of energy and nutrients from one organism to another.

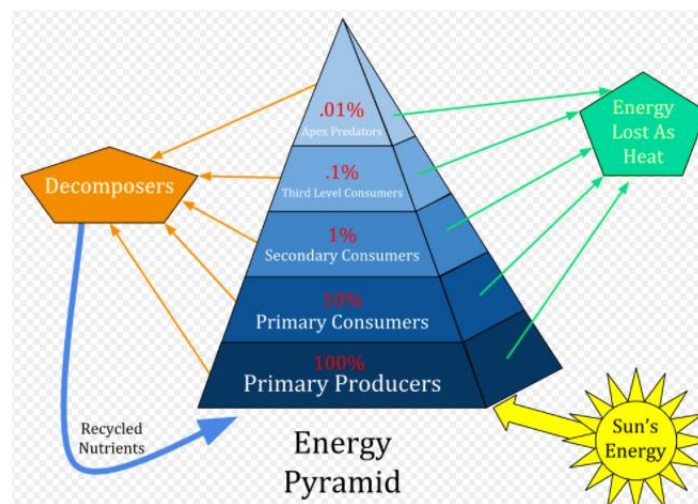
A **food web** can be termed as the combination of many different food chains and the relationship that exists between each organism.

Food Chain	Food Web
A linear pathway showing the flow of energy	A multitude of networks showing the flow of energy
An organism of higher level trophic feeds on a specific organism of lower trophic level	An organism of higher trophic level has access to more members of a lower trophic level.



### 5. Ecological pyramid

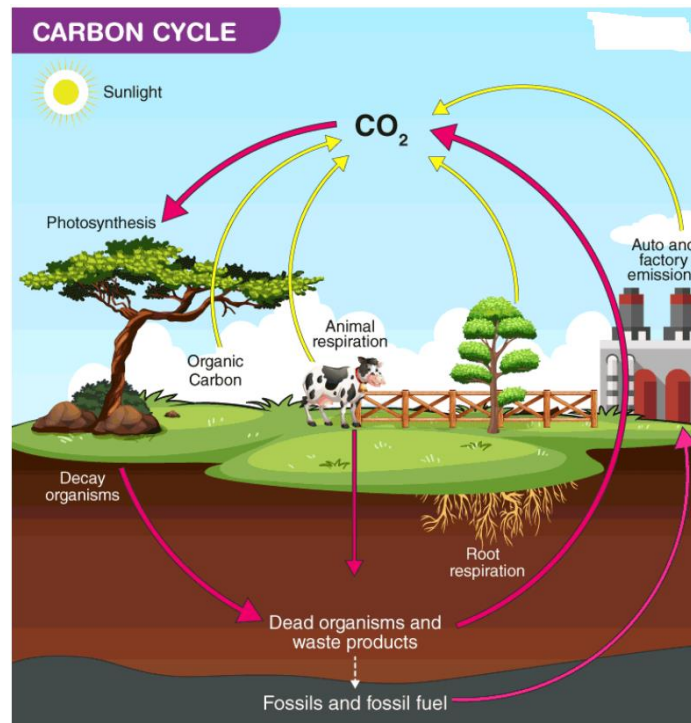
An ecological pyramid is a graphical representation showing the relationship between different organisms in an ecosystem. It shows the flow of energy at different trophic levels in an ecosystem.



A *pyramid of energy* represents how much energy, initially from the sun, is retained or stored in the form of new biomass at each trophic level in an ecosystem. Typically, about 10% of the energy is transferred from one trophic level to the next, thus preventing a large number of trophic levels. Energy pyramids are necessarily upright in healthy ecosystems, that is, there must always be more energy available at a given level of the pyramid to support the energy and biomass requirement of the next trophic level.

### **5. Carbon cycle**

Carbon cycle is the process where carbon compounds are interchanged among the biosphere, geosphere, pedosphere, hydrosphere, and atmosphere of the earth.

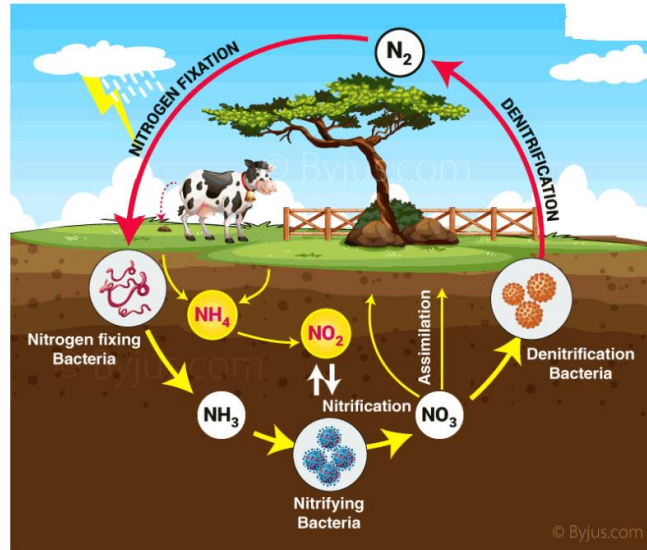


#### **Four steps of carbon cycle.**

- Carbon enters the atmosphere as CO<sub>2</sub>
- CO<sub>2</sub> is absorbed by autotrophs such as green plants
- Animals consume plants, thereby, incorporating carbon into their system
- Animals and plants die, their bodies decompose and carbon is reabsorbed back into the atmosphere.

### **6. Nitrogen cycle**

Nitrogen Cycle is a biogeochemical process which transforms the inert nitrogen present in the atmosphere to a more usable form for living organisms.



### Nitrogen Fixation Process

It is the initial step of the nitrogen cycle. Here, Atmospheric nitrogen ( $N_2$ ) which is primarily available in an inert form, is converted into the usable form - ammonia ( $NH_3$ ).

### Nitrification

In this process, the ammonia is converted into nitrate by the presence of bacteria in the soil.

### Assimilation

Primary producers – plants, take in the nitrogen compounds from the soil with the help of their roots, which are available in the form of ammonia, nitrite ions, nitrate ions or ammonium ions and are used in the formation of the plant and animal proteins.

### Denitrification

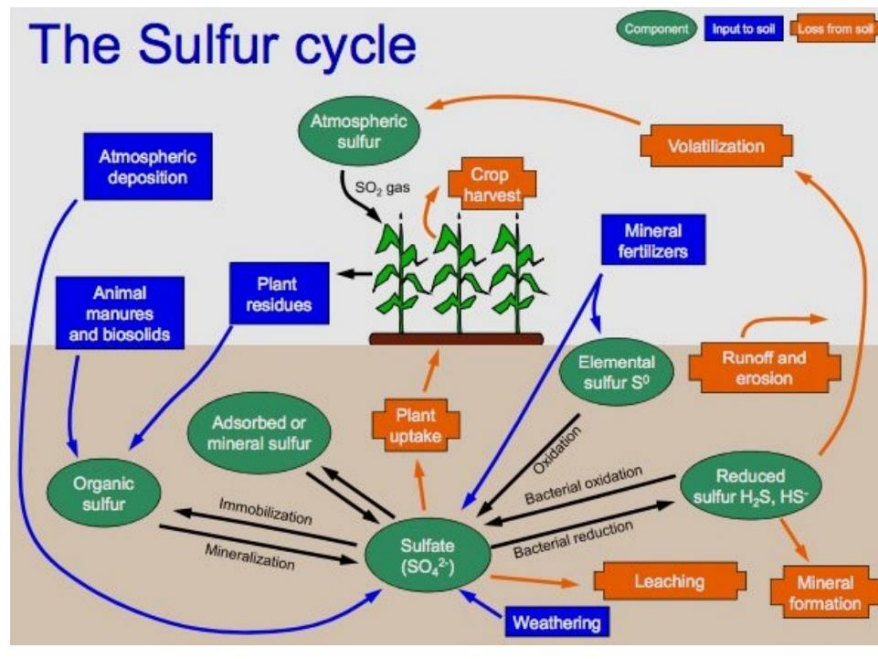
Denitrification is the process in which the nitrogen compounds makes their way back into the atmosphere by converting nitrate ( $NO_3^-$ ) into gaseous nitrogen ( $N_2$ ).

## **7. Sulphur cycle**

The process of sulphur cycle is:

- The sulphur is released by the weathering of rocks.
- Sulphur comes in contact with air and is converted into sulphates.
- Sulphates are taken up by plants and microbes and are converted into organic forms.
- The organic form of sulphur is then consumed by the animals through their food and thus sulphur moves in the food chain.
- When the animals die, some of the sulphur is released by decomposition while some enter the tissues of microbes.

- There are several natural sources such as volcanic eruptions, evaporation of water, and breakdown of organic matter in swamps, that release sulphur directly into the atmosphere. This sulphur falls on earth with rainfall.



## **8. Phosphorus cycle**

***Phosphorus cycle is a biogeochemical process that involves the movement of phosphorus through the lithosphere, hydrosphere and biosphere.***

Phosphorus is an important element for all living organisms. It forms a significant part of the structural framework of DNA and RNA. They are also an important component of ATP. Humans contain 80% of phosphorus in teeth and bones.

Phosphorus cycle is a very slow process. Various weather processes help to wash the phosphorus present in the rocks into the soil. Phosphorus is absorbed by the organic matter in the soil which is used for various biological processes.

Since phosphorus and phosphorus-containing compounds are present only on land, atmosphere plays no significant role in the phosphorus cycle.

Let us have a brief look at the phosphorus cycle, its steps and the human impact on phosphorus cycle.

### **Steps in phosphorus cycle**

1. Weathering
2. Absorption by Plants
3. Absorption by Animals
4. Return to the Environment through Decomposition



## **9. Global warming**

Global warming is a consistent increase in the earth's average temperature caused by the emission of greenhouse gases such as carbon dioxide, CFCs, methane, nitrous oxide etc.

### **Causes of global warming**

#### **Man made:-**

1. Deforestation
2. Emission from automobiles & industries
3. Emission of chlorofluoro carbons (CFCs)
4. Combustion of fossil fuels, etc

#### **Natural causes:-**

1. Volcanic eruptions
2. Forest fires
3. Melting of permafrost, etc

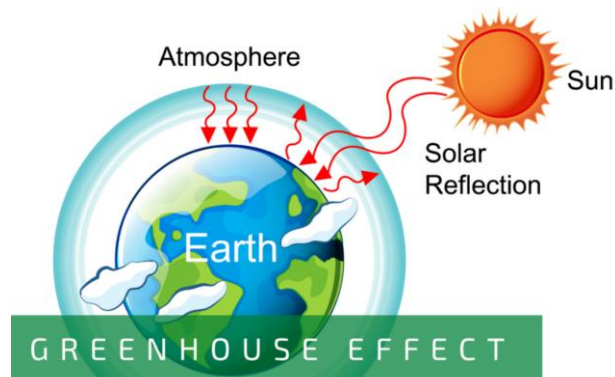
### **Effects of global warming**

1. Melting of glaciers
2. Climate change- increased rainfall
3. Rise in droughts
4. Health issues to living beings
5. Adversely affect agricultural production

## **10. Green House Effect**

Greenhouse effect is the phenomenon of heating up of earth's atmosphere due to the absorption of infra-red radiations by greenhouse gases like  $\text{CO}_2$ ,  $\text{CH}_4$  etc.

The green houses gases like  $\text{CO}_2$  present in the atmosphere absorb infra-red radiations and hence get heated up. This heat is transmitted back to the surface of earth and hence increases the temperature of earth's surface. Due to this effect, the increase in atmospheric temperature may disturb the climate which may affect rainfall, wind, cloud etc.





### **11. Ozone layer depletion**

Ozone gas is found in the stratosphere which acts as a protective umbrella for earth which prevents the harmful ultra violet radiation from the sun.

The major reason for ozone layer depletion is the presence of Chloro Fluoro Carbons (CFCs) in the atmosphere.

*The depletion of ozone layer due to the effect of pollutants like chloro fluoro carbons and oxides of nitrogen is called ozone layer depletion.*

The result of ozone layer depletion is,

1. Increase in skin cancer
2. Changes in global rainfall and temperature fluctuations
3. Changes in the rate of photosynthesis

### **12. Acid rain**

Pollutants like  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{NO}_2$ ,  $\text{NO}$  etc. emitted from industries and automobiles may mix with moisture present in atmosphere to form acids like sulphuric acid, nitric acid etc. These acids may come down along with rain. This phenomenon is called acid rain.

Acid rain may cause damage to buildings, trees, crops, statues, human health etc.