Ecosystem

The word ecosystem is divided into two words Eco implies environment and system implies interacting, interdependent complex of living things. Ecosystem is a place where organism live, interacts with plants, animals and environment. During interaction they exchange material and energy. The ecosystem was first coined by ecologist **Arthur. G. Tansley in 1935.**

An ecosystem consists of biotic and abiotic components that are animals, plants and microorganisms as biotic components and soil, minerals, water and air as abiotic components. All of these together form an ecosystem. In short an ecosystem is a community of living organisms in conjunction with the non living components of environment. Ecosystem can be any size. Sun is primary or major source to provide energy which then flows through any ecosystem.

Definition: ecologist Arthur Tansley has defined ecosystem as "the whole system including not only the organism complex, but also the whole complex of physical factors forming what we call environment".

Components of ecosystem: there are two components of ecosystem.

- Biotic component: also called as living things. It can be classified into 3 types:
  1. Producers: also called as Autotrophs (Auto-self, trophs-production). Producers mean they make their own food. E.g. all green plants.
  2. Consumers: also called as Heterotrophs (Hetero: others, trophs: production). Further classified into 3 types-
     a. Primary consumers: it is also called as herbivorous animals. Herbivorous animals mean they only depend on plants to fulfill their food need. E.g. Rabbit, cow
     b. Secondary consumers: it is also called as carnivorous animals. They depend on primary consumers. E.g. lion, tiger
     c. Tertiary consumers: it is also called as omnivorous animals. They eat plants as well as animals. E.g. Humans.
  3. Decomposers: those microorganisms which is feed on organic matter. Decomposers breakdown complex organic substance into simple inorganic matter. E.g. bacteria, fungi.
- Abiotic components: can be classified into 3 types
  1. Climatic factors: related to climate like temperature, humidity, sunlight, rainfall included in climatic factors.
  2. Inorganic components: it includes inorganic components which is present in our environment. E.g. calcium, magnesium, minerals.
  3. Organic components: it includes organic components which present in our environment. E.g. DO, turbidity, pH, CO_2.

Division of ecosystem: the ecosystems are broadly classified in following two types.

1. Terrestrial ecosystems: they include grassland, cropland, forest, desert etc.
2. Aquatic ecosystems: these can be broadly divided into two classes
    i. Fresh water ecosystem : e.g. lake, pond etc
    ii. Marine water ecosystem: e.g. marine, estuaries etc

General characteristics of Ecosystem:

An ecosystem contained in particular region depends upon temperature, other atmospheric parameters like gases, plants growth in area, overall climate and the fluctuations faced. Any such ecosystem is called as Biomes.

Biome can be defined as, "an area of land contained with plants and animals which are adapted according to climatic conditions of environment in the region"

Types of ecosystem or Biomes in world:

1. Tundra: tundra's are among earths coldest hardest biomes. Tundra ecosystems are treeless region found in the Arctic region (polar region located at northernmost part of earth) and on the top of mountains, where the climate is cold and windy and rainfall are scant. Tundra lands are snow covered.
2. Taiga: taiga biome is the largest terrestrial biome and extends across Europe, North America and Asia. It located below the tundra biome. The taiga biome is also known as coniferous or boreal forest. Coniferous trees in taiga biome referred as Evergreen.
3. Grassland: grassland biomes are large, rolling terrains of grasses. Latitude, soil and local climate are responsible for grassland. Two types of grassland:
    i. Tropical/Savannas: found in Africa, Australia, America and India. Always found in warm or hot summer where annual rainfall is about 50.8-127 cm/yr.
    ii. Temperate grassland: amount of rainfall is less than tropical. Found in America, Africa, Argentina. Annual rainfall is 50.8-88.9 cm/yr.
4. Chaparral biome: consists of various types of terrain including mountains and plains. It exists in Africa. The rainfall is 10-17 inches/yr. average temperature is 64^0 F. The summer season is very dry so make fires and droughts. Majority animals are Nocturnal, sleeping during day then coming out at night. Some animals are coyotes, mule deer, lady bugs.
5. Desert: desert cover 20% area of earth. Temperature is very high. Rainfall is low there are 4 types of deserts, hot and dry, semiarid, coastal and cold. Small trees are present. Rodent and reptiles present.
6. Rain forest: two types
    i. Tropical rain forest: cover 7% of earth's surface. Found all over the world. It is very rainy about 400 inches rainfall per yr. Responsible for majority O_2 production. Different types of trees are present.

ii. Temperate rain forest: the temperate rain forest has seasonal variation, summer temperature rising about 80^0 F and winter temperature dropping to near freezing. It is found in America.

7. Alpine biome: found on the great mountain ranges around world. There is very cold temperature. There are fewer atmospheres to filter suns UV rays. The alpine biome usually lies between an altitude about 10000 feet and place where snow line of mountain begins. Summer is June to September and winter October to May. It has drastic fluctuation. It is just below Himalayan Mountain. Alpine animals adapt to the cold by hibernating, migrating to warmer areas or insulating their bodies with layer of fat and fur. Their bodies tend to have shorter legs, tails and ears in order to reduce heat loss. Alpine animals also have larger lungs, more blood cells and blood that can deal with lower levels of oxygen at higher altitude/pressure. E.g. goats, sheep, butterflies, beetles, grasshoppers. The alpine biomes are present in high altitude where carbon dioxide is very little and it is important for photosynthesis. Some plants found here are grasses, small leafed shrubs etc.
8. Deciduous forest: deciduous means "falling the leaves during winter" in deciduous forest summer warm. It has 4 seasons spring, summer, autumn and winter. In the autumn the leaves change colour.

Functions of Ecosystem: functions may be divided into 4 types:

1. Productivity and level: the rate of production of biomass in per unit area and per unit time called as productivity. It is classified into
   i. Primary productivity: it is related to producers. When synthesis is done by only producers called as primary productivity. Primary productivity is again divided in Gross Primary Productivity: amount of biomass which synthesized by producers. Net Primary Productivity: amount of biomass which stored in producers.
   ii. Secondary productivity: is related to consumers. When synthesis is done by only consumers called as secondary consumers.

   There are 4 levels of productivity.

   a) High productivity: net production is high
   b) Average productivity: net production is average
   c) Less productivity: where 200-1000 gm/m^2 /yr production.
   d) Low productivity: less than 200 gm/m^2/yr
2. Decomposition: it is divided into food chain, food web and ecological pyramid.
   I. Food chain: the transfer of food energy from producers through a series of organisms with repeated eating and being eaten is known as food chain. Or it is series of living organisms feeding on one another is called as food chain.
   e.g. plant ⟶ grasshopper ⟶ frog ⟶ snake ⟶ eagle
   Arrow shows where energy is transferred. Food chain can be divided into 2 types.

a. Grazing/grazer food chain: it is directly depending on sunlight. It always starts with green plants/producers.
   e.g. plant ⟶ grasshopper ⟶ frog ⟶ snake ⟶ eagle
b. Detritus food chain: it is indirectly depending on sunlight. It always starts with dead organic matter.
   e.g. dead organic matter ⟶ detrivours ⟶ inorganic components

Grazing food chain and detritus food chain are different from each other but grazing food chain supports detritus food chain my making many types of organic matter and detritus food chain supports grazing food chain by making different kind of inorganic components.

II. Food web: various food chains when interconnected with each other are called as food web. It is very necessary for homiostasis or balance of our ecosystem. Everything is connected to everything else.
e.g.

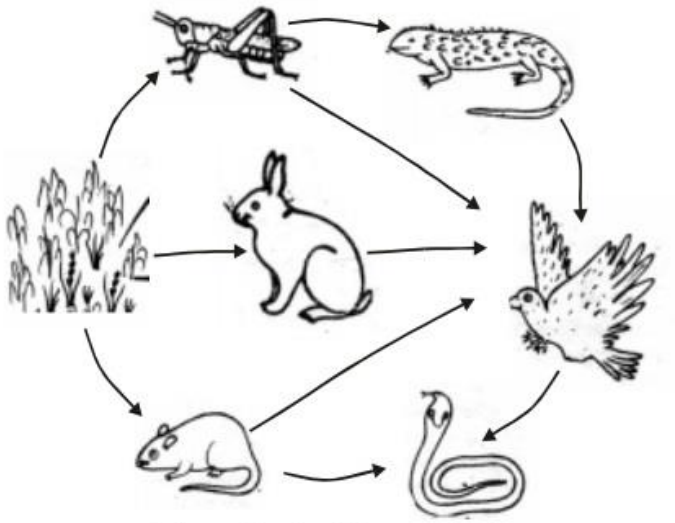
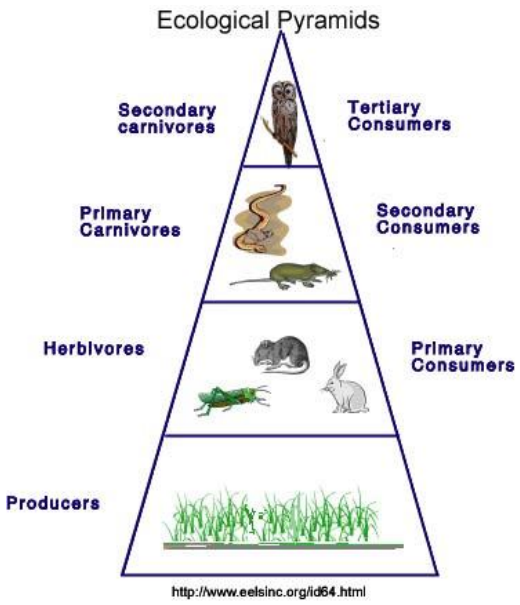


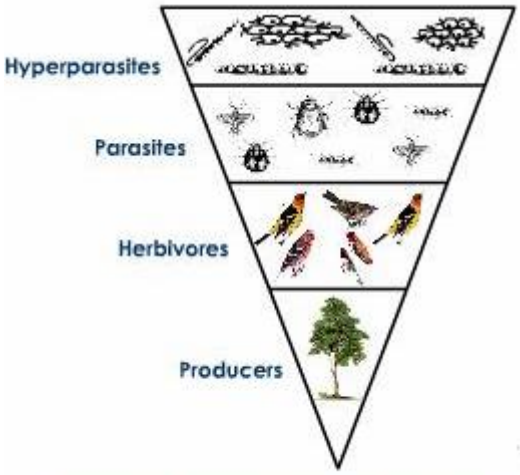
Fig Food web in a grassland

III. Ecological pyramid: ecological pyramid is a graphical representation for showing the biomass or biomass productivity at each tropic level in a given ecosystem. It was first proposed by Charls Elton in 1927.

A. Pyramid of number: number of individual organisms at each tropic level in a food chain. There are 3 types of pyramid of number:
   a) Upright: The numbers of producers are more. The number of herbivorous animals are low than producers and carnivorous animals are very less. Number is decrease when go up so graph will be called upright.



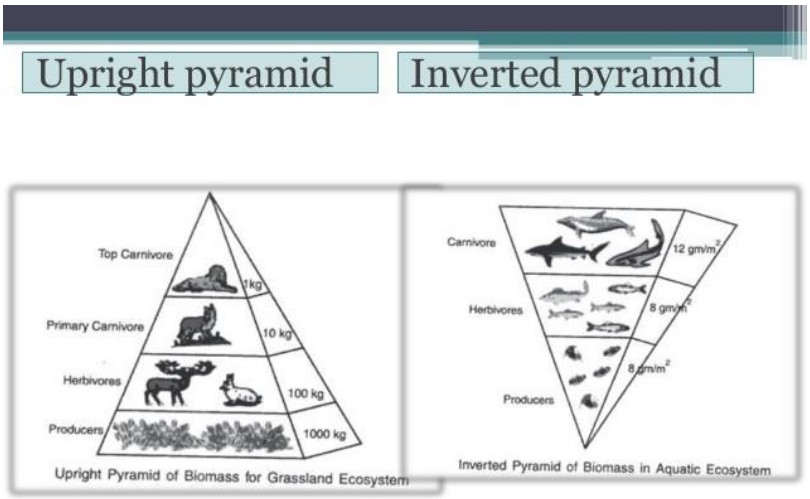
b) Inverted: e.g. number of producers is low and decomposers are more.



Inverted pyramid of number

c) Intermediate: e.g. forest ecosystem. In forest ecosystem the large size of trees are small as well as the number of carnivorous animals are small but number of herbivorous animals are more.

B. Pyramid of biomass: in pyramid of biomass specific weight of particular plants or animals. It can be upright or inverted.



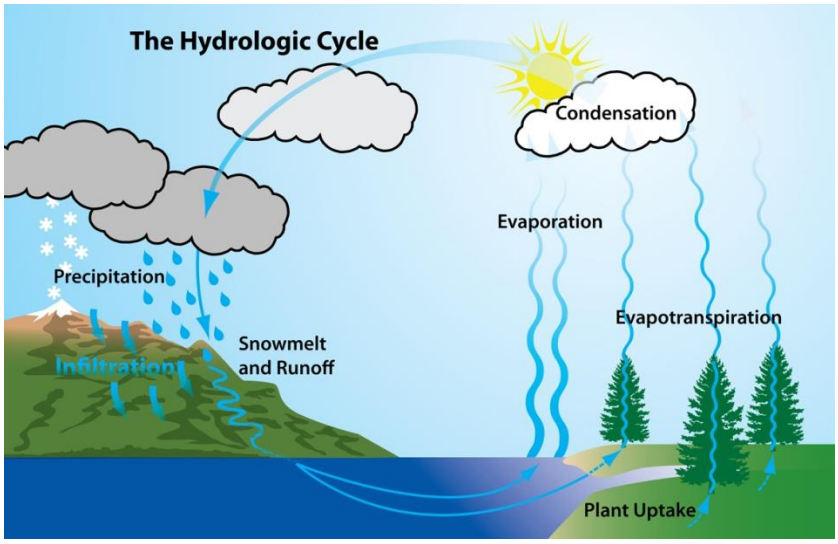
E.g. Grassland ecosystem: In grassland ecosystem weight of plants are 80kg. The weight of herbivorous animals is less than producers and weight carnivorous animals are less than herbivorous animals.
E.g. Aquatic ecosystem. In aquatic ecosystem the weight of phytoplanktons are very less and weight of small fishes and large fishes are more.

C. Pyramid of energy/production: it shows how much energy is available in each tropic level. It indicates in each tropic level 10% loss of energy is done. Unit of productivity is gm/m^2/yr or calories/m^2/yr. it is always upright.
e.g. if producers have 100% energy 10% are given to herbivorous, 1% is transfer to carnivorous and 0.1% energy is transfer to tertiary consumers.

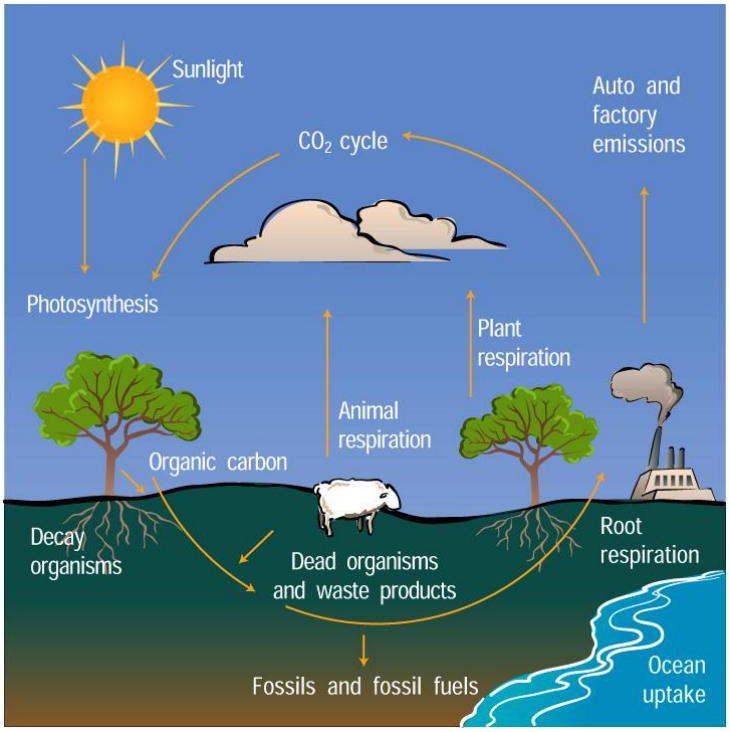
3. Nutrient cycling: it is a closed system where different kinds of nutrients go from biotic components to abiotic components and abiotic components to biotic components. Nutrients are very necessary for growth and metabolism of plants and animals. Plants mainly used nutrients from soil and animals get nutrients from food. Nutrient cycle also called as “Biogeochemical Cycle”. Biogeochemical cycle is circulation of different chemical compounds such as C, N, P, S into life through earth and again earth through life.
   Types of nutrient cycle: can be divided into 2 types
   1. Gaseous cycle: transfer of nutrients from atmosphere called gaseous cycle. These are N, C and Hydrological cycle.
   2. Sedimentary cycle: transfer of nutrients from lithosphere. These are P, S.

Hydrological cycle: how water is cycled from abiotic compounds to biotic compounds. It is also called as water cycle. Water is mainly present in water resources like rivers,

oceans, ponds etc. Process of hydrological cycle starts with oceans. Water in oceans, gets evaporated due to heat energy provided by solar radiation and forms water vapor. This water vapor moves upwards to higher altitudes forming clouds. Most of the clouds condense and precipitate in any form like rain, hail, snow, sleet. And a part of clouds is driven to land by winds. Precipitation, while falling to the ground, some part of it evaporates back to atmosphere.



Carbon cycle: in atmosphere 0.03% carbon dioxide is present. Carbon is building block of life and essential constituent of carbohydrates, protein, fats and amino acids. Carbon dioxide enters through photosynthesis in plants and produce glucose from plants through animals through food chain and after death of plants and animals again environment.



Nitrogen cycle: Nitrogen is both the most abundant element in the atmosphere and, as a building block of proteins and nucleic acids such as DNA, a crucially important component of all biological life. The nitrogen cycle is a complex biogeochemical cycle in which nitrogen is converted from its inert atmospheric molecular form (N2) into a form that is useful in biological processes. The nitrogen cycle contains several stages:

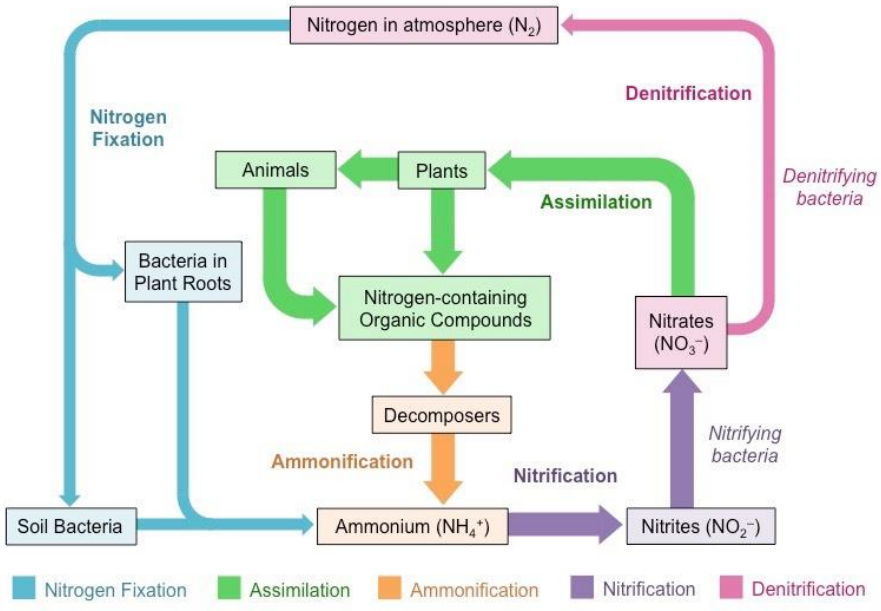
1. **Nitrogen fixation**: Atmospheric nitrogen occurs primarily in an inert form (N2) that few organisms can use; therefore it must be converted to an organic or fixed form in a process called nitrogen fixation. Most atmospheric nitrogen is 'fixed' through biological processes. First, nitrogen is deposited from the atmosphere into soils and surface waters, mainly through precipitation. Once in the soils and surface waters, nitrogen undergoes a set of changes: its two nitrogen atoms separate and combine with hydrogen to form ammonia (NH4+). This is done by microorganisms. A small amount of nitrogen is 'fixed' through a process of high energy fixation that occurs primarily as lighting strikes converting atmospheric nitrogen into ammonia (NH4+) and nitrates (NO3-). Nitrogen can also be fixed through man-made processes, primarily industrial processes that create ammonia and nitrogen-rich fertilizers.

2. **Nitrification**: While ammonia can be used by some plants, most of the nitrogen taken up by plants is converted by bacteria from ammonia – which is highly toxic to many organisms – into nitrite (NO2-), and then into nitrate (NO3-). This process is called nitrification, and these bacteria are known as nitrifying bacteria.

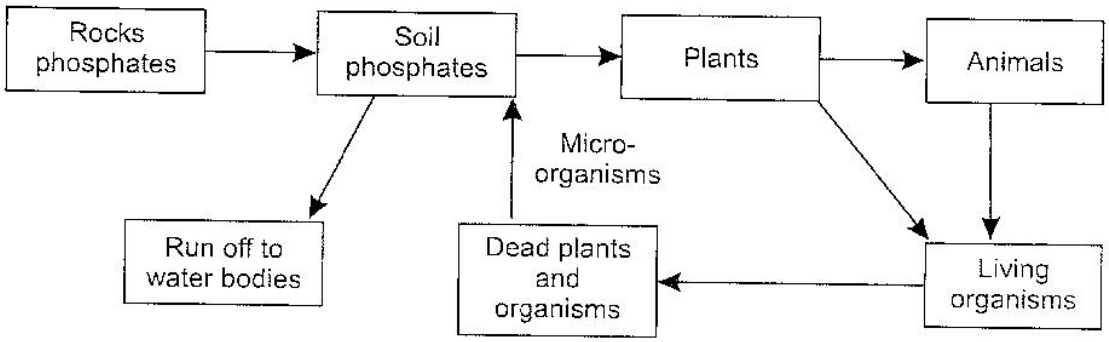
3. **Assimilation**: Nitrogen compounds in various forms, such as nitrate, nitrite, ammonia, and ammonium are taken up from soils by plants which are then used in the formation of plant and animal proteins.

4. **Ammonification**: When plants and animals die, or when animals emit wastes, the nitrogen in the organic matter reenters the soil where it is broken down by other microorganisms, known as decomposers. This decomposition produces ammonia which is then available for other biological processes.

5. **Denitrification**: Nitrogen makes its way back into the atmosphere through a process called denitrification, in which nitrate (NO3-) is converted back to gaseous nitrogen (N2). Denitrification occurs primarily in wet soils where the water makes it difficult for microorganisms to get oxygen. Under these conditions, certain organisms known as denitrifiying bacteria will process nitrate to gain oxygen, leaving free nitrogen gas as a byproduct.



Phosphorus cycle: 'P' atomic no. 15. Important nutrient for plant growth, limiting nutrient. Usually found in soil and rock in the form of calcium phosphate. P is important component of DNA, bones and teeth. Rain and weathering cause rocks to release phosphate ions and other minerals. This inorganic phosphate is distributed from soil and form soil it is consumed by animals. When plant or animal dies it decays and phosphate is returned to the soil.


Rocks phosphates
Soil phosphates
Plants
Animals
Micro-organisms
Run off to water bodies
Dead plants and organisms
Living organisms