BASIC PRINCIPLES OF ECOSYSTEM

Ecosystem : An ecosystem is an organizational unit in a given space containing living (plants , animals and micro- organisms) and non-living elements that interact with one another and lead to an exchange of materials between its living and non-living elements .

According to British ecologist **Arthur Tansley (1935),** "An ecosystem is a system that arises from the integration of all living and non-living factors of the environment."

The concept has become important, since **the Convention on Biological Diversity (CBD),** signed by almost 200 nations. The CBD formulates the concept in the following definition: "Ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (Convention on the Biological Diversity, 1992).

Structure of an ecosystem

A- Biotic (living) Components of Ecosystems:

1- **Producers (Autotrophs)** : Green plants and some bacteria (photosynthetic bacteria , chemosynthetic bacteria) which manufacture their own food .

2- **Consumers (non-autotrophs)** : Animals which obtain their food from producers .

a- **Primary consumers (Herbivores)** : Consumed organisms that feed on plants such as sheep, rodents, deer, seed-eating some of birds, some of insects, and some aquatic organisms that feed on algae, all of which are considered primary consumers.

b- Secondary , tertiary etc. consumers (Carnivores) : Carnivores that eat meat. The level of food is different. It may be a secondary or tertiary consumer by its food role in the food chain.

3- Omnivores (non-autotrophs): Consumed organisms that feed on plants and animals together . They can thus be first, second and third consumers at the same time, including humans, beer , pig , fox . Plant parasites take the same nutritional level as herbivores and animal parasites take the same nutritional level as carnivores. Scavenger animals such as eagles and hyenas represent the role of carnivores but feed on dead animals.

4- Decomposers :They are the final link in the food chain. Comprise of organisms that feed on dead matter and break it down to release chemical energy back into the soil for plants to re-use them. E.g. fungi, bacteria and others.

It is classified into three types as per the requirements of oxygen:

a- Aerobic microbes: - These organisms need enough oxygen to continue their life and activity as in the equation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

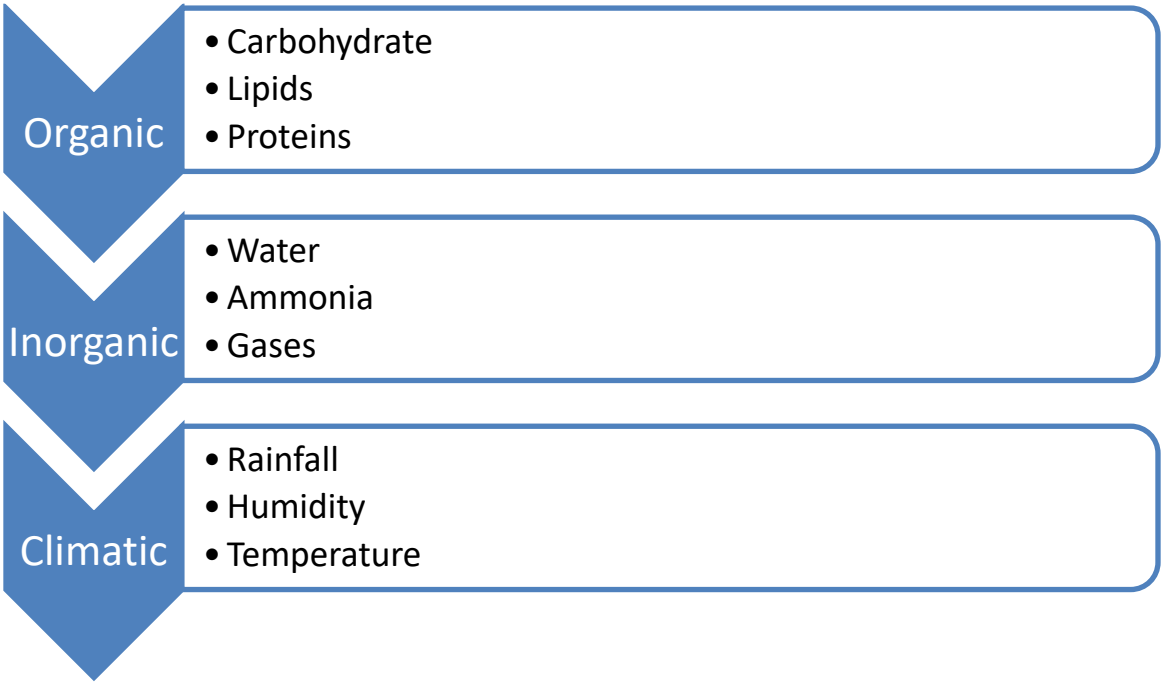
b- Anaerobic microbes: - These organisms need a medium where oxygen is not available for the continuation of its life and activity and when the availability of oxygen is poisonous and deadly.

c- Facultative microbes - organisms that can live with or without oxygen .

Note:

Some insects and beetles also contribute to the process of analysis of organic matter by cutting and reducing the size of organic matter, leading to an increase in the surface area of decomposition .

B- Abiotic (non- living)components of an Ecosystem:



Types of Ecosystems according to the availability of living and non-living components:

Ecosystems are divided into two parts:

1 - Complete Ecosystem: - Sometimes referred to as Open Ecosystem, which contains all the basic components mentioned earlier (live and non-living) such as forest, swamp, river and pond .

2- Incomplete Ecosystem: Sometimes referred to as the Closed Ecosystem, which lacks one or more basic components such as the deep depths of the sea and the closed caves (loss of products due to light loss).

Types of Ecosystems according to the Environment:

1. Aquatic Ecosystem (Fresh water ecosystem , marine ecosystem etc.)
2. Terrestrial Ecosystem (Tropical forest ecosystem , Tundra , desert etc.)

Types of ecosystems according to Size :

1- Micro -Ecosystems **:** As a drop of water , etc.

2- Macro-Ecosystem : As the Caribbean Sea, the mountain range of the Andes, etc.

Functions of an Ecosystem:

1- Food chain and Food web
2- Energy flow
3- Cycling of matter (chemicals)

- **Food Chain:** The transfer of food energy from the source in plants through a series of organisms (prey and predator ; host and parasite ; decomposition of organisms by bacteria , ……).

  Food chains can be divided according to how the energy is transferred in successive stages into three types:

  1 - Predator chains: - In which energy is transferred from plants to small animals and then to large animals and predators.

  2 - Parasitic chains: - In which energy is transferred from large animals to small organisms.

  3 - Saprophytic chains: - In which energy is transferred from dead organisms (plant or animal) to various microorganisms.

- **Food Web:** The interlocking patterns formed by several food chains that are linked together are called food webs.

When understanding the dynamics of food webs we can take advantage of them as follows: -

1- Biological control: Reducing the spread of harmful pests and insects that have caused serious damage to plants, animals and humans due to the pollution caused by the chemical control of the environment and immunity in harmful insects and killing useful species of living organisms.
2- Stop the phenomenon of extinction of animals and plants, where our understanding of the food web knowledge of predators and herbivores that feed on rare species and thus protect them from these organisms.
3- An understanding of the food web is useful in providing indicators to allow the transfer or non-transfer of a particular species to a new environment. For example, in 1788, three rabbits were introduced into Australia that Australia did not know before , As a result of the availability of food and the absence of negative interactions such as competition and predation with other animals increased dramatically to reach 750 million rabbits in 1950 destroyed the vegetation, and to control these numbers was applied the concept of biological control by injecting it with a deadly virus that led to the spread of the disease among them and reduce the number of them by 80 - 90% in just three years and Australia is still suffering from this problem to date, where rabbits have been able to resist the virus as a result of new genetic structures formed through many generations and the virus is now living almost symbiotic living with these rabbits .
4- Follow-up toxic substances accumulated in the bodies of living organisms, it was noted that there is an increase in the concentration of some radioactive materials and pesticides in the bodies of living organisms in an upward manner. For example, an increase in the concentration of D.D.T (used to kill mosquitoes in swamps) has been observed where its ratio is harmless in water but becomes harmful as we rise up in the food chain.

Note:

Food chains and food webs can be studied by injecting producers with radioactive elements involved in the metabolism of the organism and following those radioactive elements.

Q / What are the generalized and specific species?

specific species : Species that feed on one type of organisms .

generalized species : Species that feed on many types of organisms .

Q / What is the relationship between the size of organisms and the food chain?

Size is a very important factor in the length of the food chain , It was observed that (short food chains contain large herbivore) for example :

1- The food chain in grassy areas: (herbs → sheep → human)
2- The food chain in wild areas (grasses → small insects - large insects → rodents → snakes → hawks)
3- The food chain in aquatic areas: (algae → single-celled organisms → crustaceans → small fish → large fish → whales). Typically, the aquatic food chain is longer in nature than the wild chain, mainly because of the small size of herbivores and the small organisms (consumers) at the levels following the herbivores.

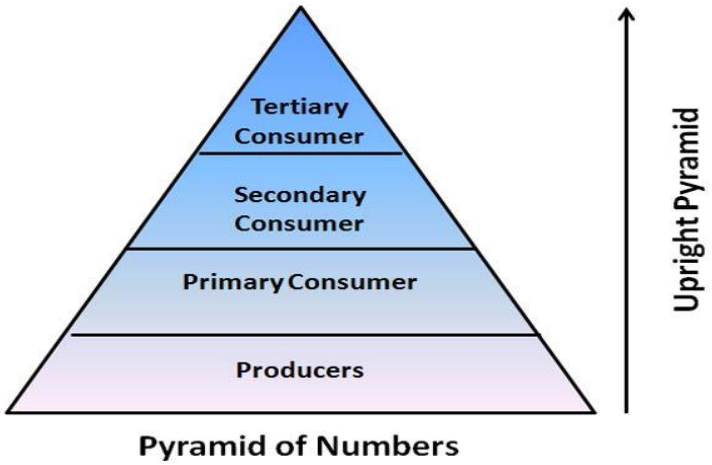
❖ **Biogeochemical cycling:** The cycling movement of minerals from their reservoirs (air, water and soil) to the living components and back to the reservoirs is called nutrient cycling or biogeochemical cycles.

❖ **Ecological pyramid:** In 1927, the concept of ecological pyramid was first proposed by English Ecologist named Charles Elton (1900-1991) (thus, they are also known as Eltonian pyramids).The graphical representations of different trophic levels in an ecosystem is known as Ecological Pyramid

They are used to illustrate the feeding relationships between organisms.

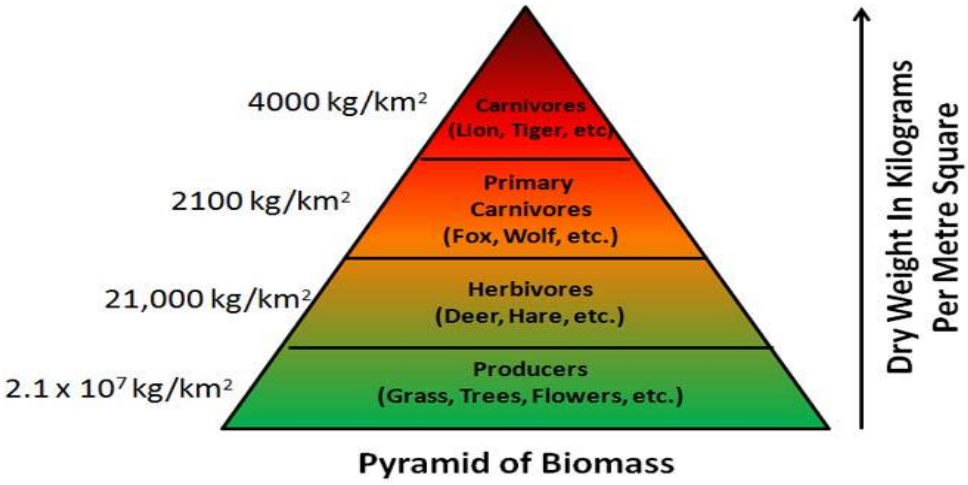
Types of ecological pyramids:

- Pyramid of Number: To show the number of individuals in each trophic level. Is upright and this generally occurs in grassland and pond ecosystem .



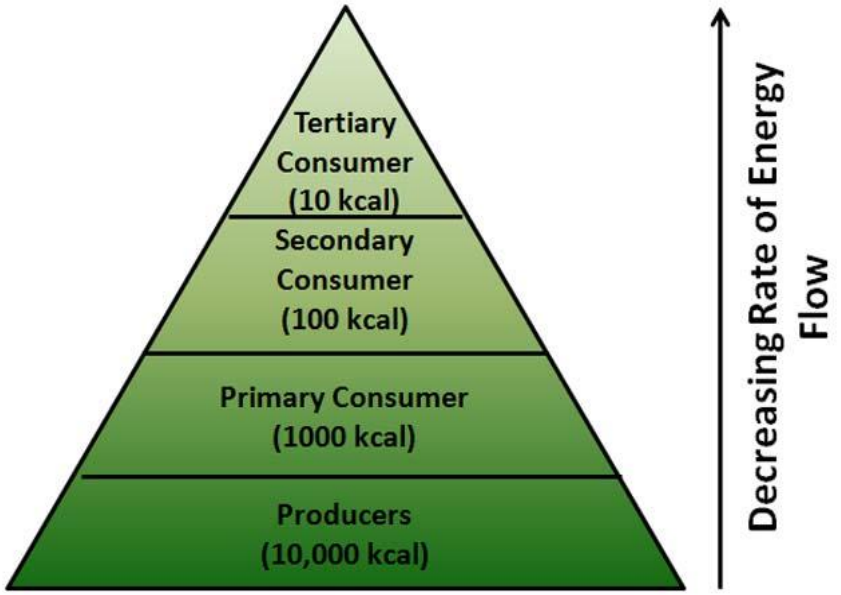
In some cases the pyramid of number will be inverted.
E.g. in case of forest ecosystem.

- Pyramid of biomass:. To show the total biomass of individuals (0rganisms) in each trophic level. Pyramid of biomass is better in than pyramid of number in showing the relationships between organisms. Pyramid of biomass is upright in case of grassland and forest ecosystem whereas inverted in case of pond ecosystem.



Pyramid of Biomass

- Pyramid of energy: To show the amount of energy transferred in each trophic level. The pyramid of energy flow is always upright because there is always loss of energy while moving from each trophic level. Therefore the energy reaching the next trophic level is always decreasing.



Pyramid of Energy

Q/Why are ecological pyramids shaped as pyramids?

When the food passed from primary producers to secondary consumers and then to tertiary consumers (carnivores), it is estimated that about 10% of energy is lost during the process. To graphically explain this concept, ecologists came up with the pyramid diagrams, hence the 'Ecological Pyramids.'