UNIT -1

INTRODUCTION TO ENVIRONMENTAL STUDIES AND ECOSYSTEMS

A. Very short type questions & answers (1 mark each)

Q1. Who has coined the term "ecosystem"?

Ans: A. G. Tansley (1935).

Q2. What is the ultimate source of energy that keeps this earth functioning?

Ans: The Sun.

Q3. How many possible trophic links are there in food chain?

Ans: Three to Five.

Q4. Name the different types of food chain that prevail in nature?

Ans: Grazing Food Chain and Detritus Food Chain.

Q5. Who have given the concept of ecological succession?

Ans: E. Warming (1896) & Henry cowls (1901).

Q6. What is Sere?

Ans: The entire series of community of succession from pioneer to climax community is known as sere.

Q7. What are the main three process involved in carbon cycle?

Ans: Photosynthesis, Respiration & Decomposition.

Q8. What are the different types of bacteria on which Nitrogen cycle depends?

Ans: The decay causers, the Nitrifiers, the Denitrifiers & the Nitrogen-Fixers.

Q9. Name two producers in a pond ecosystem.

Ans: Minute floating phytoplankton & Rooted or large floated plants.

Q10. Name two consumers in an ecosystem?

Ans: Tiger and Deer.

B. Short type questions & answers (2 marks each)

Q1. What do you mean by environmental studies?

Ans: Environmental studies can be defined as a multidisciplinary subject that deals with the study of the various components of the environment, the interactions among the biological, physical and chemical components of environment, their conservation, pollution, ill effects of degraded environment and measures to overcome such ill-consequences.

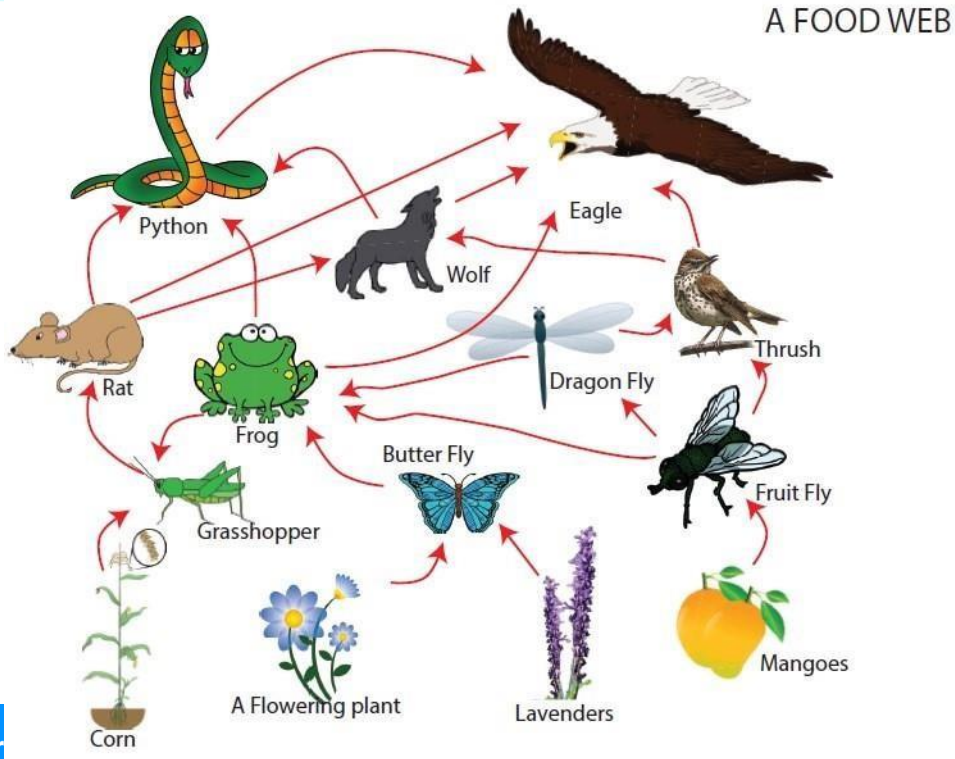
It basically aims in **creating awareness**- among individuals about the various aspects of the environment; **imposing knowledge**- about the environment, its belongings, ill-effects, its associated facts, how to deal with it; **generating attitude**- to deal with any issues which is directly or indirectly related to the environment; **developing skills**- for positively handling various issues related to the environment, through active participation.

Q2. Define the term "environment".

Ans: The word environment is derived from the French word "environ", meaning 'surroundings'. Simply, everything that surrounds us is termed as environment. It encompasses all the living and non-living things. It is the environment form which every organism derives its requirement for the sustenance of life on earth.

Q3. Define food web.

Ans: Food web can be defined as a combination of food chains that integrates to form a network. It represents a wide verity of species interactions. In other words, food web is a process consisting of interlocking food chains to depict the feeding relationship between organisms and ecosystem, which leads from primarily producer through an array consumer.



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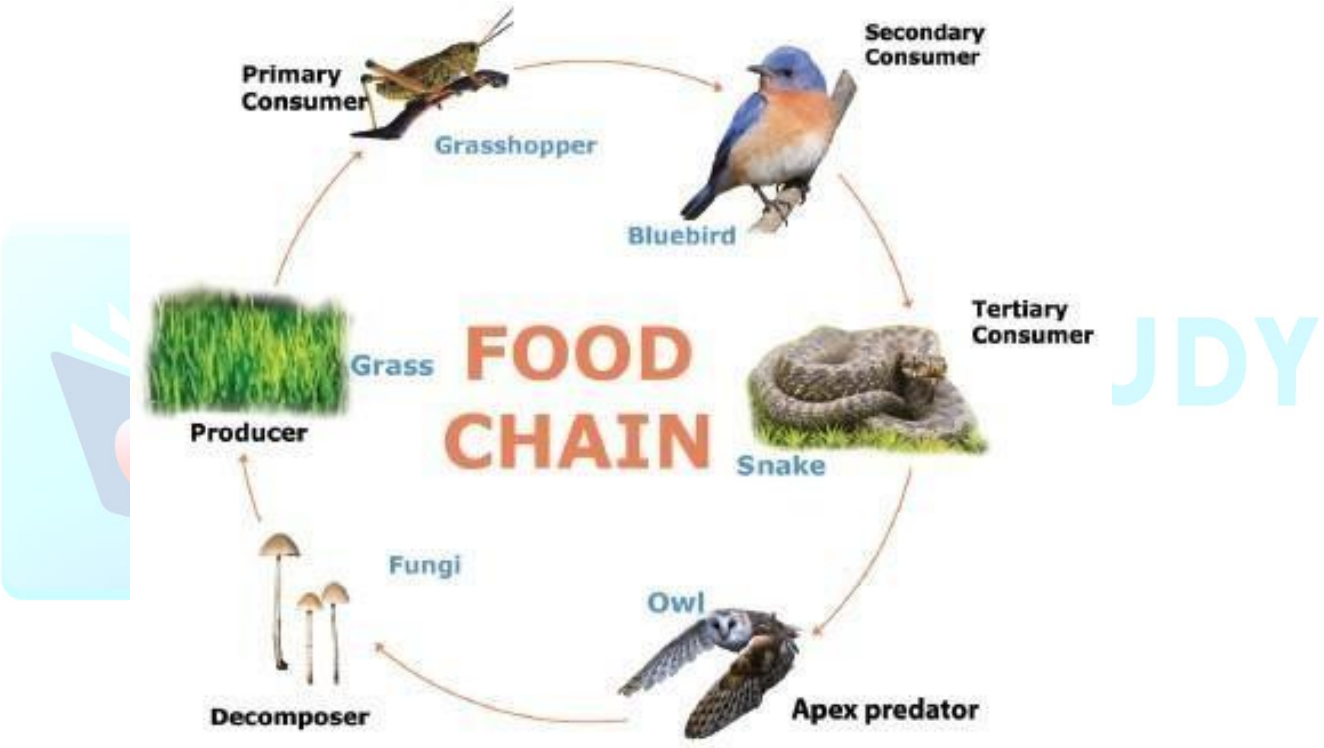
Q4. Define food chain.

Ans: The process of eating and being eaten, with the resultant transfer of energy from primary producer to ultimate consumer in a region is termed as food chain. In general, food chains have three to a five trophic links. There are two types of food chain namely, Grazing food chain & Detritus food chain.

A typical example of food chain is in a grassland ecosystem, where the producer i.e. the grass is fed upon by the grasshopper, which in turn is eaten by blue bird, which in turn is eaten by the snake and the snake is eaten by the apex predator, owl. After the death of the owl, the decomposers viz. fungi, which decomposes the complex substances into simple useable forms which is again utilized by the producers.



Q5. What do you mean by producer of an ecosystem?

Ans: Producers are the group of organisms which can synthesis their own food i.e. they can prepare their own food. The green plants or the autotrophs are the producers of an ecosystem. They synthesis their food (organic molecule) by using carbon dioxide and other inorganic materials obtained from the environment, in presence of sunlight and chlorophyll. They are the ultimate source of organic compounds for the heterotrophic organisms.

The herbivores (animals that eat plants only) feed on the producers and in turn is fed upon by other organisms, in this way the transfer of energy and organic compounds from producers to the subsequent trophic levels takes place.

Q6. What is a nutrient cycle?

Ans: Nutrient cycle refers to the uses of the nutrients by the living organisms from the environment, their movement through the biotic and abiotic components of the environment and the process by which they are recycled back to the environment. The recycling of the nutrients is important to ensure a continuous supply of essential nutrients for the growth and survibility of the living organisms on earth.

The process constitutes a cyclic path involving the movement of the nutrients and the compounds they are derived, from the environment via land, water, air, living organisms and back to the environment, hence it is termed as nutrient cycles. The major nutrient cycle includes the carbon, nitrogen, oxygen, hydrogen, sulphur and phosphorus cycle.

Q7. Define ecological pyramid.

Ans: Ecological pyramids are the geographical representation of the trophic structure of an ecosystem. It represents the individuals and their numbers in the various trophic levels. The concept was given by Charles Elton (1927). An ecological pyramid can be upright or inverted with the producers at the base and secondary or tertiary consumers at the apex.

The ecological pyramids can be of three types:-

i) **Pyramid of numbers** - On the basis of the number of individuals at each trophic Levels; (May be inverted or upright).

ii) **Pyramid of biomass** - On the basis of the dry-weight of individuals at each trophic levels; (May be inverted or upright).

iii) **Pyramid of energy** - On the basis of the transfer of energy individuals at each trophic levels; (Always upright).

Q8. What do mean by Autotrophs and Heterotrophs?

Ans: Autotrophs are those groups of organisms which can synthesize (prepare) their own food (organic molecules) in order to obtain their energy, by the utilization of inorganic raw materials (CO_2, H_2O, etc.) in presence of sunlight and chlorophyll (as in case of plants) through a process called photosynthesis or in absence of sunlight and chlorophyll (in case of Bacteria & Fungi) by a process called Chemosynthesis. The autotrophs are designated as the producers of an ecosystem.

Eg:- All Green plants viz. Phytoplankton, Blue-Green Algae, trees, etc., some bacteria & some fungi,.

Heterotrophs on the other hand are those groups of organisms which cannot synthesis their own food. They are dependent on other organisms for their obtaining their energy from

the food. The heterotrophs obtain their food from the producers and other organisms they feed upon. The heterotrophs are also known as consumers of an ecosystem.

Heterotrophs are broadly divided into three categories on the basis of their food habits viz. Herbivore (Organisms that feed on plants), Carnivore (Organisms that feed on animals) & Omnivores (Organisms that feed on both plants and animals), which in turn is again sub-divided into many categories like Sanguivores (organisms which feed on blood), Frugivores (organisms which feed on fruits), Cannivores (organisms that feed on their own kind), etc.

Eg:- All consumers viz. grasshopper, Deer, Lion, Birds, Bats, Fishes, Frogs, leeches, Humans etc.

Q9. What do you mean by Ecological Succession?

Ans: Ecological succession can be defined as the gradual process of the changes in the community structure over time. The concept of ecological succession was given by E. Warming of Denmark (1896) and Henry Cowles of US (1901). It is a process by which an ecological community undergoes more or less orderly and predictable change over a period of time. The first community that inhibits the area is termed as the pioneer community, while the last stable community is termed as the climax community. The intermediate community between pioneer and the climax community is termed as Seral or Transitional communities.

There are two main types of Ecological Succession: Primary Ecological Succession and Secondary Ecological succession

(i) **Primary Ecological Succession:** It is the series of community changes which occur on an entirely new habitat which has never been colonized before by any life forms.
E.g. Succession in barren land, newly quarried rock, sand dunes, etc.

(ii) **Secondary Ecological succession:** It is the series of community changes which take place on a place which was once previously colonized by life forms, but was disturbed or damaged later.
E.g. Succession in Damage land - out of forest fires, extensive deforestation, etc.

Q10. Write four important needs for public awareness about our environment?

Ans: The four important needs for public awareness about the environment are as follows:-

i) Rapid industrialization and rise in population has led to overexploitation of the natural resources, leading to the abrupt destruction of the environment by creating an imbalance in the nature, so creating awareness among people on about environmental issues and its conservation is necessary.

ii) Creating an atmosphere so that people find themselves fit enough to participate in decision making process related to various developmental issues/programmes.

iii) Various laws have been enacted for the protection, maintenance and preservation of the declining health of the environment, but law alone cannot be rewarding if the human beings are not concerned.

iv) Active participation of people is much needed for the protection and restoration of the environment. The awareness thus aims in imposing knowledge, generating attitude, developing skills for active participation of the people to contribute their part for a green environment.

C. Long type questions & answers (5 marks each)

Q1. Describe the multidisciplinary of environmental studies and illustration.

Ans: Environmental studies relates to not only the branch of biology, but also other branches of studies as well viz. chemistry, physics, engineering, geology, geography, meteorology, economics, law, archeology, economics, anthropology, sociology, mathematics, statistics, etc. Hence, it is also known as multidisciplinary subject in which the knowledge from various fields are required in order to have a clear cut understanding about the environment, its related components, and their associated facts.

The multidisciplinary knowledge relevant to the organism helps in understanding the organism and its related fatcts viz. its appearance, the place it lives in, the favourable environmental parameters required for its sustenance, the food it takes, its influence/relationship with the environment and other organisms, evolutionary relationship, genes it contains, physiological processes, economical value, effect of pollution on it and measures to overcome those, its statistics, laws to deal with the crimes against it, etc.

Let us take an example; For explaining an organism and its related facts - the raw data has to be processed from various studies like Taxonomy-for naming and classification of the organism, Morphology-to know about its external appearance, Anatomy-to know about its internal composition, Cytology-to know about the cell, chromosomes, etc. it is made up of, Genetics-to know about the genes it contains and their functions, Molecular biology-to know about the facts related to the biological processes of the organism, Meteorological studies-to know about the favourable environmental parameters required for the sustenance of the organism, Geographical features-to know about the topographical features of the habitat area of the organism and its associated parameters, Ecology-to study the inter-relationship of the organism with the

environment, Economics-to know its economic importance, statistics-to known about its population, occurrence, etc., Law-to deal with environmental crimes relevant to the organism, etc.

Q2. Describe the scope of environmental studies.

Ans: The scope of environmental studies is quite vast. For better understanding of the fundamental relationship of the communities in nature and the science lying therein, the study of ecological principles stands mandatory. The opportunities in this field are immense not only for the scientists but also for Industrialists, sociologists, Geologists, Conservationists, biologists, engineers, economists, environmentalists, environment journalists, etc.

Environmental science can be applied in many areas, some of the following spheres are:-

(i) **Natural Resources Conservation:** The knowledge of environmental science in this field is useful in identifying the important and valuable resources of earth, their status, ecology, the geography, ecosystem they are a part of and the factors affecting their growth, development and sustenance. It also helps in formulating ways to conserve them viz. through awareness campaigns, Ex-Situ & In-Situ conservation measures, large-scale afforestation programmes, social forestry, Shifting to non-conventional, renewable energy resources, setting up laws against environmental crimes, etc.

(ii) **Environmental Pollution Control:** The knowledge of environmental science in this field is useful in identifying different types of pollutants, their sources and the nature of pollution it causes. It also helps in dealing with those factors accordingly viz. large-scale plantation of trees near inhabited land, agricultural farmland and along the road-side, setting up laws to deal with polluters, use of catalytic converter in automobiles, installation of Scrubbers, electrostatic precipitators in factories, etc.

(iii) **Environmental Management:** Earth has enough to satisfy one's need but not one's greed. The environment has everything for the growth and sustenance of living beings. Some of the resources are abundant i.e. inexhaustible, while the others are limited i.e. exhaustible. Some are highly valuable from the medicinal point of view. So it is must to ensure their safety and a sustainable utilization of such resources so that the balance is not altered. The study of environmental studies help us in knowing the environmental resources, differentiating them based upon their exhaustible, in-exhaustible nature, their uses & economic importance, in formulating measures for their sustainable utilization and in setting up laws over their extraction, transportation and uses.

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(iv) **Industry:** Things started to become messy after the advent of industrial revolution i.e. through human intervention, arising out of greed for wealth mostly. The industries contributed a large number of environmental degradation factors in the form of deforestation, release of harmful substances in the air, water and soil etc. It is a must to have knowledge about the type and nature of pollutants that could be released from the substances to be used in the industry, their ill-effects both on the environment, human beings and other life forms as well and find out measures of prevention or for dealing with any odd circumstances, before setting up an industry. The knowledge of environmental science in this field is useful in identifying the gaps and take necessary steps for preventive measures viz. location study-its components, to identify the useful resources, biodiversity, conservation status of the life-forms inhabiting the area, etc., use of sound proof, radiation proof, dust poof materials inside the factory/industry, installing filtering and conversion equipment so as to ensure release of only non-toxic substances from the industry.

(v) **Medicine:** In ancient times, men were dependent totally on the environment for curing their illness. With the advent of time and technological advancement, men are able to synthesize drug in laboratories. However the fundamental leads/clues are still obtained from the wild resources for the development of a drug molecule. The study of environmental science in this case basically aims in conservation of such valuable resources in identifying their favourable environmental factors, their occurrence and distribution, the geographical features of their dwelling area, their ecological behavior, their mode of interactions among themselves and also with their surrounding environment, etc. We are also able to prevent illegal trade of important resources through identifying them and setting up measures to stop such illegal activities.

(vi) **Research and Development:** The knowledge of environmental science in this field is useful in providing a preliminary data about the environment, its components, various environmental parameters, morphological characteristics of the components of the environment, the factors they are dependent on, their ecological behaviour, their nature and way of living. Such data helps in further investigation with an aims of maintaining a healthy environment full with useful resources, maintaining continuous supply of the resources without affecting the environment, developing disease resistant and high yielding crop and other biotic components by improving their varieties and quantity through the use of scientific techniques like genetic engineering, tissue culture techniques, etc., so as to ensure food supply with high nutritional value and their positive conservation.

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(vii) **Social Development:** The knowledge of environmental science makes it easy for the society to understand the gaps between man and his environment which lead to miseries like crop failure, epidemics, crop shortage, fallen economy, etc. It helps in taking various eco-friendly measures like social forestry, transformation of an unfertile land into cultivable land mostly by aforestation, organic farming, various agricultural practices like crop farming, intercropping, crop rotation. Counter terrace farming practices etc. to overcome the shortage of foods, crop failure, falling economy, prevent any disease and contribute a helping hand in the society towards developing a eco-friendly environment. The knowledge makes one capable of differentiating between eco-friendly factors and those that are not, thus the rate of contribution of Non eco-friendly factors by mankind decline, which leads to high rate of healthy resource production, benefiting both the economy and livelihood of the individual of the society.

(viii) **Enhancing Economy:** Nature has variety of destinations for recreation and relaxing. A large number of the environmental factors viz. the climate of an area and the natural components viz. as biotic and abiotic components, attract a large number of tourists from across the world. The knowledge of environmental science in this field basically helps in conservation of such attractions, it makes easy to understand the important factors required for the survival, existence, their flourishing, sustenance and the antagonistic factors of such attractions. The quality and availability of such attractions brings tourist from all around the world with certain charges to witness them which add to the revenue to the government thus helping in its economy. Therefore the need to understand the environment and the facts associated with it is very necessary. Other economy enhancing measures is the export of essential commodities like spices, crops, fruits, etc. which adds a good amount to the economy, provided they are in good conditions both in terms of quality and quantity. It is here where the knowledge of environmental science adds a relief.

Q3. Define "ecosystem". Describe the Producer, Consumer, and Decomposers of an ecosystem?

Ans: Ecosystem can be defined as a self-sustained ecological unit in which the biotic components interact with the abiotic components i.e. the sum total of the biotic and abiotic components present in an area and their interactions among themselves is termed as an ecosystem.

The biotic components include all living organism on earth viz. Plants, Animals, and Microbes, which interact with each other and also with the abiotic components for sustaining their lives. The abiotic components on the other hand consists of all the non-living substances viz. atmosphere, hydrosphere and lithosphere, minerals, nutrients, etc. which are designated by factors such as light, temperature, soil, pressure, pH, concentration of gases etc. The biotic

components are dependent on the abiotic components for food synthesis, energy, reproduction, growth and development.

The term ecosystem was coined by A.G. Tansley (1935). An ecosystem can be natural (forest, ocean, desert ecosystem, etc.) or man-made (crop field, pond, aquarium, etc.). It can range from as small as a drop of water (Nano-ecosystem) to as large as an entire planet (Macro-ecosystem).

From the point of view of energy consumption, each ecosystem includes three types of organisms: Producer, Consumer, and Decomposer.

(i) **Producers:** The producers are the group of organisms which can synthesis their own food. The autotrophs (Photoautotrophs- Green plants & Chemoautotrophs-some group of bacteria and fungi) are known as producers of an ecosystem. They synthesis their food (organic molecules) from carbon dioxide and other inorganic raw materials obtained from the environment by directly utilizing the solar energy (in presence of light) or through the uptake of raw materials (in absence of light). They are the ultimate source of organic compounds for all the heterotrophic organisms.

(ii) **Consumers:** The consumers are the group of organism which cannot synthesis their own food. The heterotrophs (mostly animals) are known as the consumers of an ecosystem. They obtain their food from other organisms and are dependent upon the organisms like Green plants, microbes and other animals for obtaining their energy. Depending upon the level of feed, the consumers are categorized as primary consumer (which obtain their energy directly from the producer), Secondary consumer (which obtain their energy from the primary consumer viz. meat or the products from primary producers viz. eggs, milk, cheese etc.), tertiary consumer (which obtain their energy from the secondary consumer) and so on. The consumer which dominates an ecosystem is termed as top consumer.

(iii) **Decomposers:** Some heterotrophs consume the remains of dead organisms by decomposing them i.e. breaking down of complex substances they are built up of, into simpler forms which is then absorbed by the decomposers through their body surface. The decomposers feed on organic litter carcasses, rotten vegetables, fallen leaves, dead bodies, etc. The decomposers play a vital role in the cycling of nutrients in the environment. They break down the complex substances which is stored in the organism's body during their life time into simpler substances which is then released back in the environment in raw form for the next uptake by another live organism. E.g. Bacteria and Fungi.

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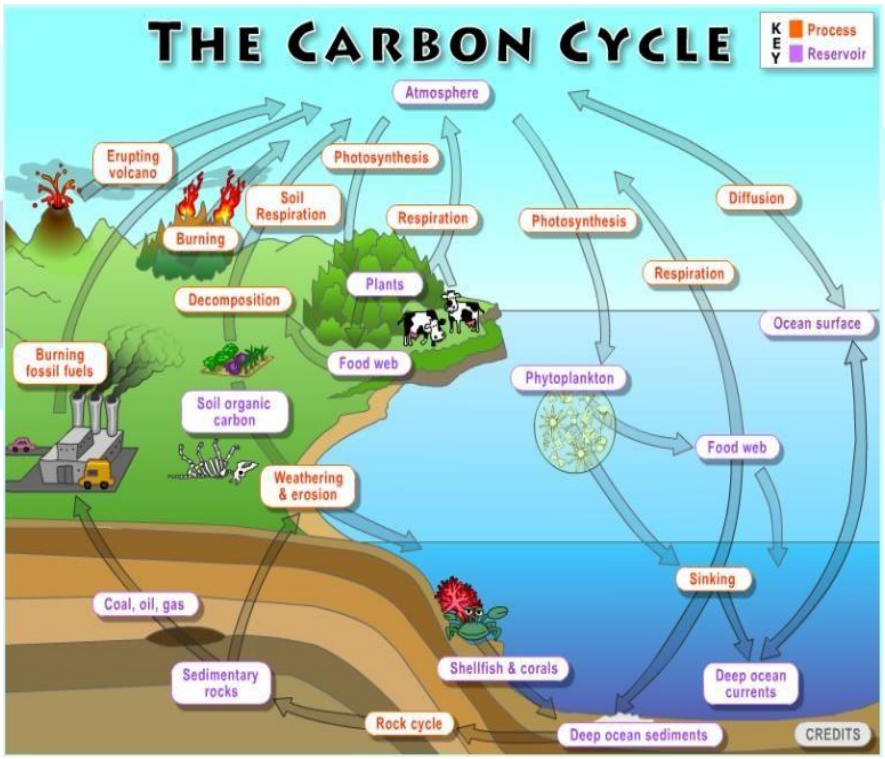
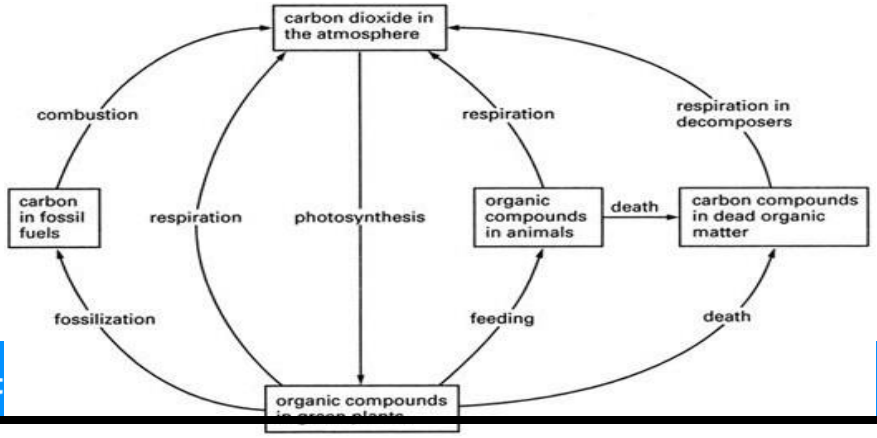
Q4. Describe the carbon cycle with illustration.

Ans: Carbon cycle can be defined as a biogeochemical cycle by which the carbon compounds are interconverted in the environment, involving the incorporation of carbon dioxide into the living tissue by photosynthesis and its return to the atmosphere through respiration, the decay of dead organisms, as by product of industrial emission, combustion, etc.

Through carbon cycle, carbon compounds cycles from the atmosphere through the land, water, living organisms and then is released back into the atmosphere. Naturally, it involves the combined processes of photosynthesis, decomposition, and respiration while the human-induced factors involves the burning of fossil fuels, industrial emissions, etc., in which the Carbon compound is utilized, generated and released, from and back into the environment.

The carbon cycle is very much essential for plants to carry out photosynthesis which in turn is essential for other group of organisms dependent on the plants for obtaining their energy as well as maintaining the earth's temperature.



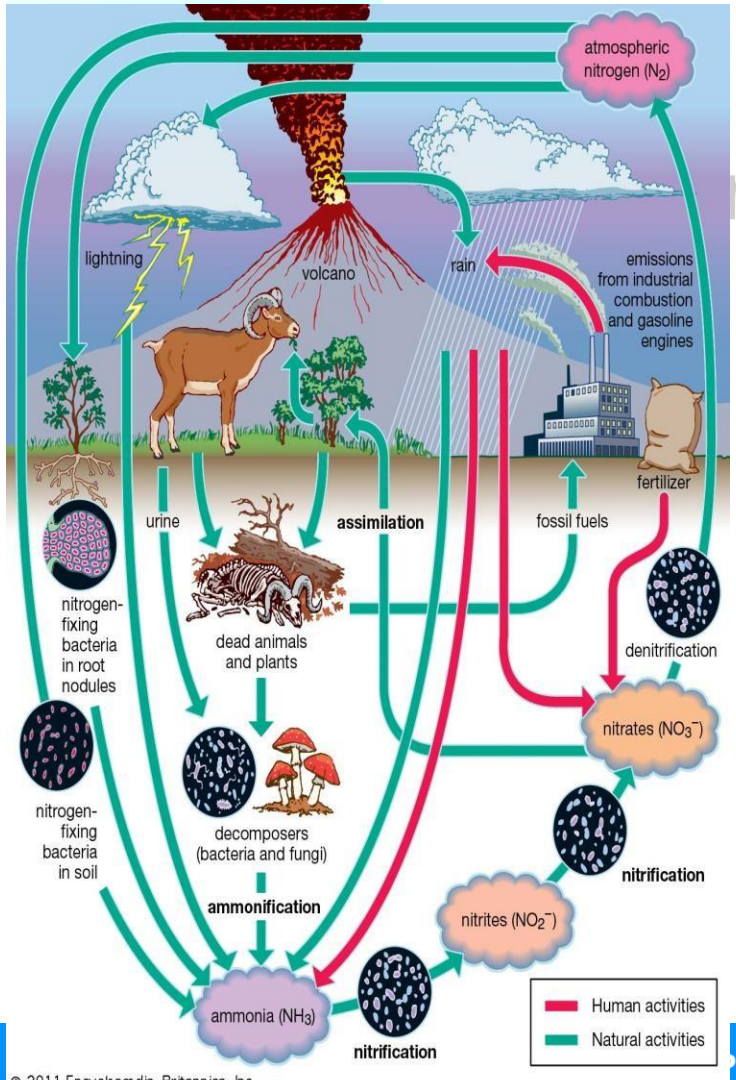


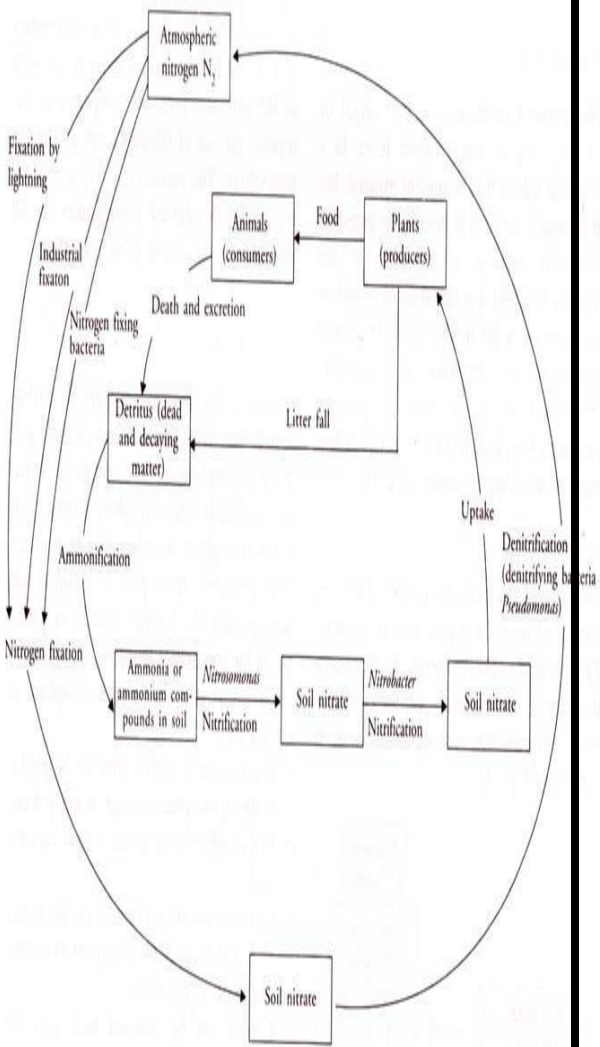
Q5. Describe the nitrogen cycle with illustration.

Ans: Nitrogen cycle can be defined as a biogeochemical cycle in which nitrogen is converted into multiple chemical forms as it circulates through the atmosphere, land, water and living organisms. The conversion of nitrogen can be carried out through both biological and physical processes.

The nitrogen cycle involves several steps viz. ammonification, nitrogen fixation, nitrification and denitrification. Biologically, Nitrogen cycle depends upon at least four different kinds of bacteria viz. the decay causers (decomposers), the Nitrifiers, the Denitrifiers and the Nitrogen-fixers. In nitrogen cycle, there is a regular circulation of nitrogen through the air, soil, plants and animals. Physically, atmospheric nitrogen is fixed by lightening, precipitation, etc.

Nitrogen cycle is essential for the living organisms as it is a major component of amino acids - the building blocks of proteins and of nucleic acids such as DNA & RNA. Nitrogen is also vital for plants as because it is a major component of chlorophyll-which traps the sunlight for photosynthesis. Overall, nitrogen is essential for the growth, reproduction and development of a living organism.





Q6. Describe pond ecosystem with an illustration.

Ans: Ponds are aquatic, freshwater bodies that naturally form in depressions in the earth's surface. They consist of a quite body of water, with no wave action. The total biotic and abiotic component present in a pond constitutes the pond ecosystem. The biotic components constitute of mostly the aquatic organisms viz. planktons, fishes, crustaceans, etc. whereas the abiotic components includes the water, chemicals dissolved in the water, environmental parameters like light, temperature, pH, etc.

The typical structure of a pond ecosystem can be summarized as follows:-

A. Biotic components: The biotic components in a pond ecosystem comprises of the following:

(i) **Producers:** Minute floating phytoplankton and rooted or large floated plants are the producers in a pond ecosystem.

(ii) **Consumers:** Insects, crustaceans and tiny fishes are the primary consumers in a pond ecosystem. Small carnivorous fishes that feed on tiny fishes act as secondary consumers. The big carnivorous fishes that feed on the small carnivorous fishes act as tertiary consumer.

(iii) **Decomposers:** In favorable temperature condition, aquatic bacteria and fungi cause rapid decomposition at the bottom of the pond. The decomposers of pond ecosystem either live in soil layer beneath water or in mud. They play important role in nutrient cycling process.

B. Abiotic components: The abiotic components mostly include the water, gases and chemicals dissolved in the water, environmental parameters like light, temperature, pH, etc. The abiotic factors are vital for the growth, reproduction, development and sustenance of the aquatic organisms.

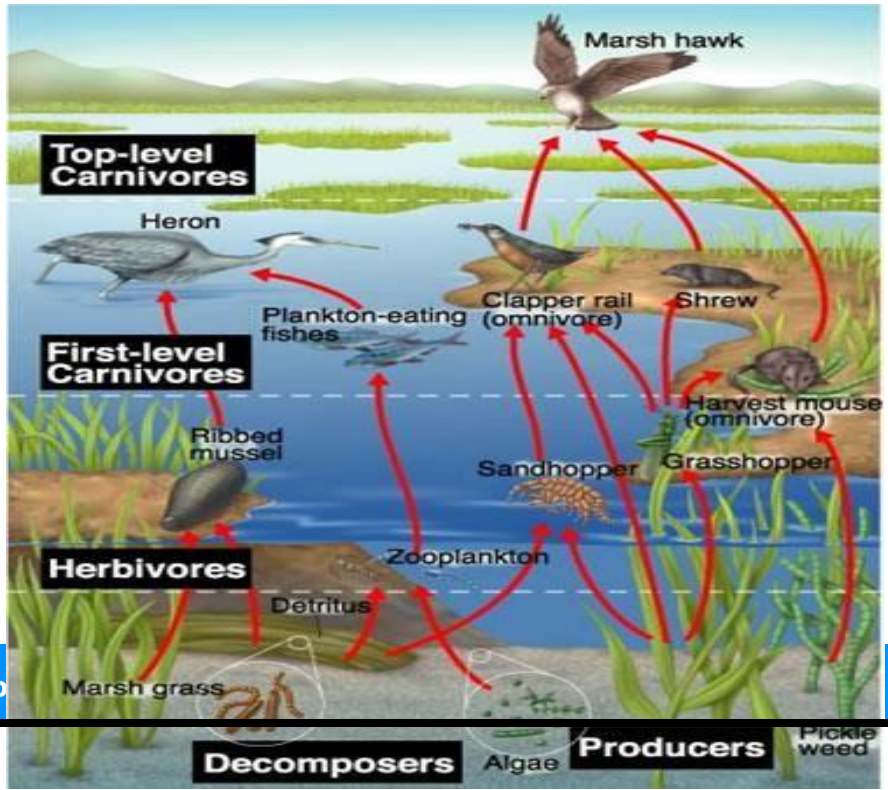


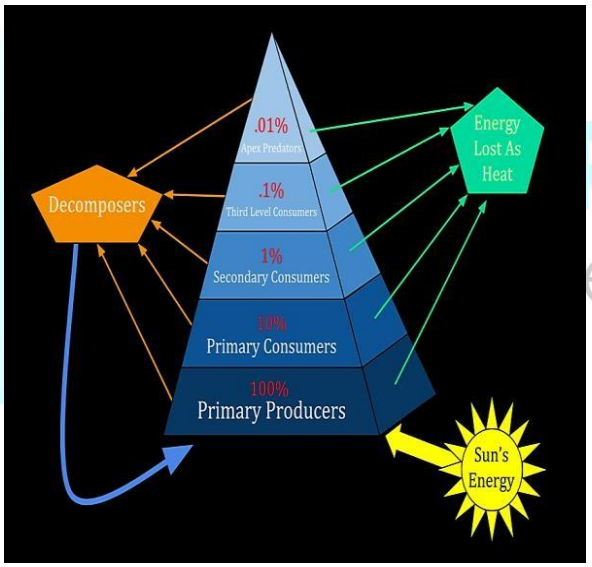
Fig. A pond Ecosystem.

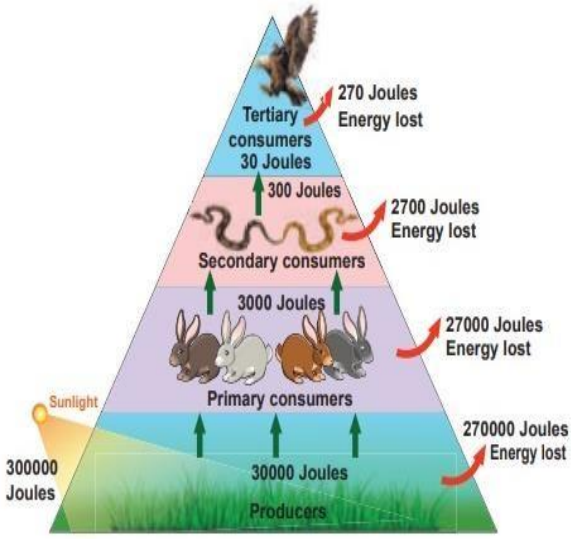
Q7. Enumerate the concept of energy flow through an ecosystem with illustration.

Ans: Energy is a capacity to do work. All biological activities require consumption of energy, which ultimately comes from the sun and gets transferred to subsequent trophic levels via the living organisms. The transfer of energy through the food chain of an ecosystem is termed as energy flow in an ecosystem.

Radiant energy of the sun is transformed into chemical energy by the process of photosynthesis- this is stored in the plant tissues and then transformed into mechanical energy and heat energy during the metabolic activities. The energy flows through the sun to the plants and then to all heterotrophic organisms such as animals, human beings and even microorganisms.

The amount of energy transfer in the subsequent trophic levels follows a 10% energy transfer rule. The amount of energy available in a trophic level is 10% of the energy of its preceding trophic level.





Q8. Describe forest ecosystem with an illustration.

Ans: A forest ecosystem comprises of organisms that lives within the forest and interacts with the abiotic components of that area. There are various types of forest ecosystems throughout the world, for example, the temperate forest ecosystem and the tropical rain forest ecosystem.

The typical structure of a forest ecosystem can be summarized as follows:-

A. Biotic components: The biotic components comprises of the following groups:

(i) **Producers:** Trees or other plants are the producers as they utilize the sunlight to prepare food. They are the primary source of energy for the heterotrophic organisms.

(ii) **Consumers:** Herbivores are the primary consumers in a forest ecosystem. For example, ants, leaf hopper, bug, deer, etc. Carnivores that feed on herbivores are the secondary consumers viz. birds, frogs, hyena, etc. Top carnivores like lion, tiger, vulture, etc. that feed on herbivores and other carnivores are the tertiary consumers.

(iii) **Decomposers:** Some bacteria and Actinomycetes are the decomposers in a forest ecosystem that break leaves and old branches that fall to the forest floor. The decomposers of the forest ecosystem decompose the dead materials and provide nutrients to the forest floor.

B. Abiotic components: The abiotic components mostly include the moisture, gases and chemicals present in the soil, environmental parameters like light, temperature, pH, etc. The abiotic factors are vital for the growth, reproduction, development and sustenance of the interacting biotic components.

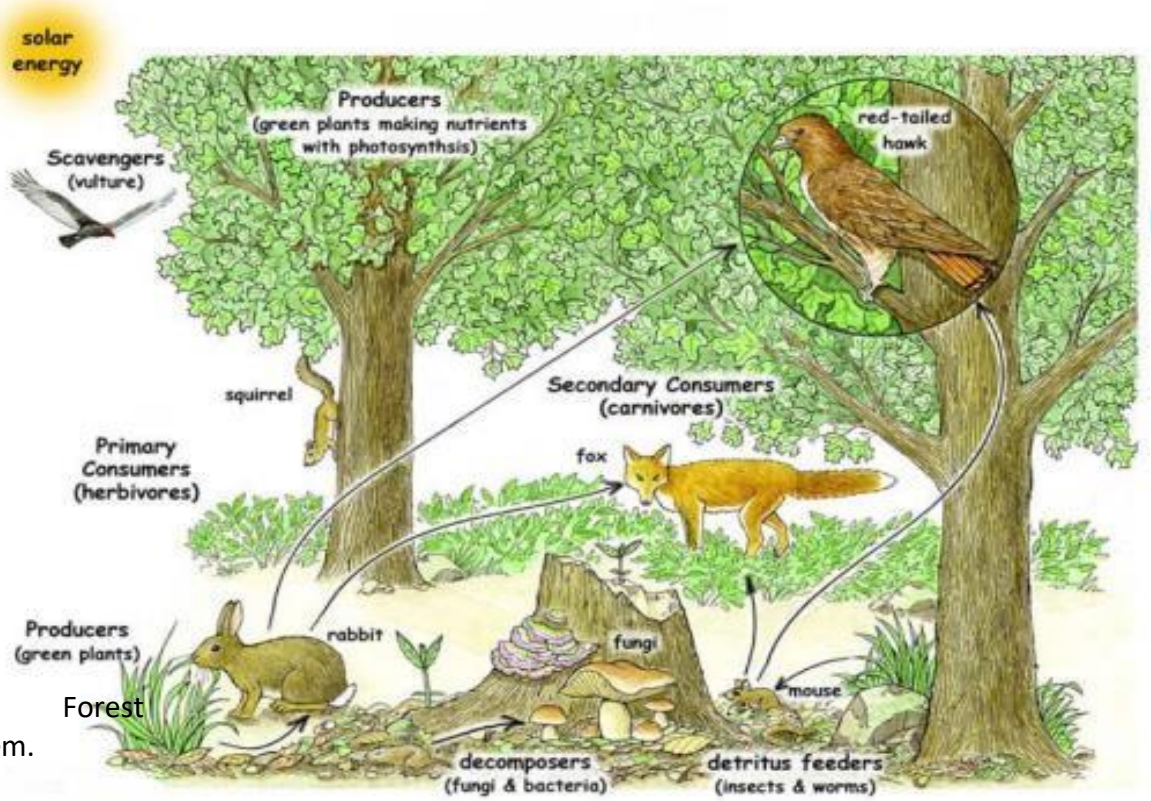


Fig. A Forest Ecosystem.

Q9. Define ecological pyramid. Describe the types of ecological pyramids.

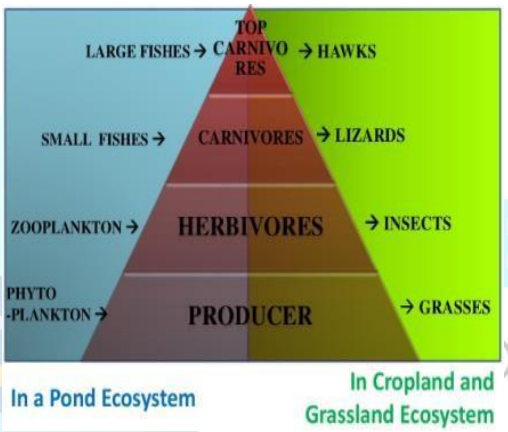
Ans: An Ecological pyramid is the graphical representation of the trophic structure of an ecosystem. The concept was given by Charles Elton in 1927. An ecological pyramid can be upright or inverted with producers at the base and the secondary or tertiary consumers at the

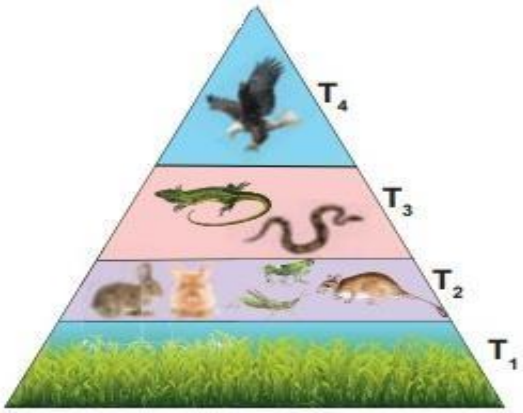
apex. Pyramid of number and pyramid of biomass may be upright or inverted whereas the pyramid of energy is always upright.

The ecological pyramids are of three types:-

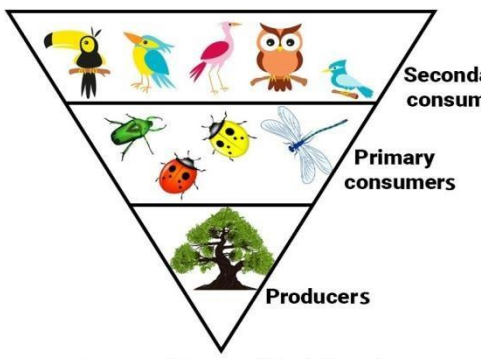
(i) **Pyramid of number:** The pyramid of number represent the total number of individuals of different species belonging to each trophic level in an ecosystem. The pyramid of number is usually upright, but may be inverted and spindle in case of some parasitic food chain and tree ecosystem.

In a Pond, cropland or a grassland ecosystem, the numbers of organisms decreases at successively higher trophic levels i.e. numbers of; Tertiary consumer < Secondary consumer < Primary consumer < Producers. The pyramid formed in such cases will be "upright".

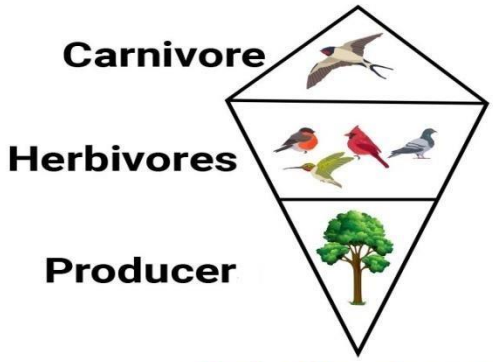




In contrast, in a tree ecosystem, the pyramid of number is 'inverted' as the tree being the only producer and the phytophagous (organism that feed on leafs) insects and other organisms represent the higher trophic levels. In such case, the number of Tertiary consumer > Secondary consumer > Primary consumer > Producer. On the other hand, In case of spindle shaped pyramid, the number of producer is less than the Herbivores which is in turn greater than the Carnivores i.e. Producer<Herbivore>Carnivore.



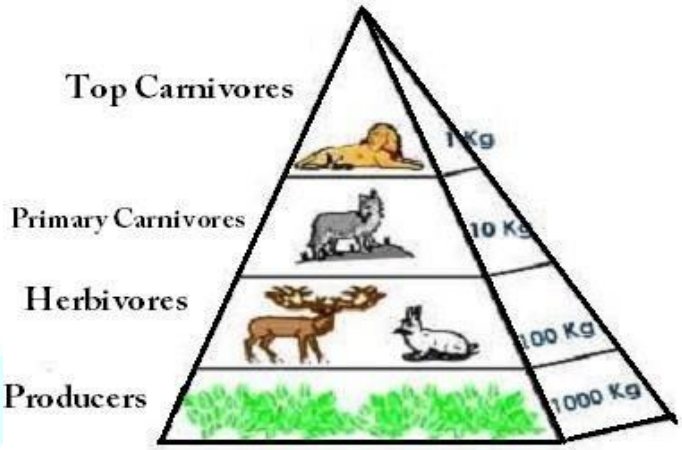
Inverted Pyramid of Numbers



Spindle-shaped

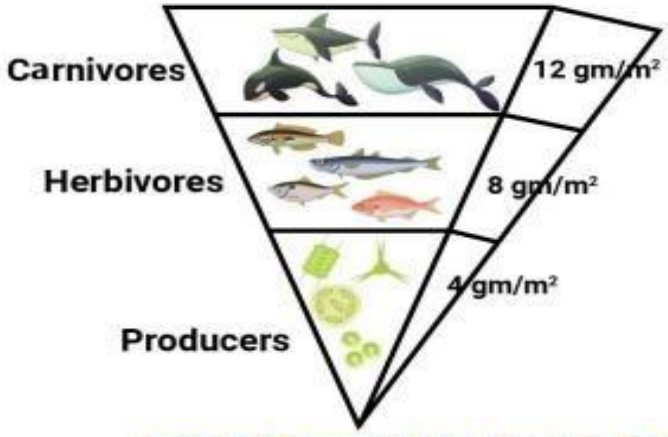
(ii) **Pyramid of biomass:** The graphical representation of the total dry weight of living being of different species of each trophic level at a specific time is called pyramid of biomass.

The pyramid of biomass is "upright" in case of a grassland ecosystem, where the producer has the maximum biomass followed by the biomass of primary consumer, followed by the secondary consumer and so on. The representation shows an upright arrangement on the basis of the biomasses of different organisms of the ecosystem.



Upright Pyramid of Biomass

In contrast, in many aquatic ecosystems viz. pond, the pyramid of biomass assumes an "inverted" form due to low biomass of the producers (phytoplankton) followed by subsequent increases in the biomass of primary consumers (crustaceans), Secondary consumers (small fish) and Tertiary consumers (Large fish) as we move to different trophic levels.



Inverted Pyramid in an Aquatic Ecosystem

(iii) **Pyramid of energy:** In case of the pyramid of energy, a given trophic level always has lower energy content then the trophic level immediately below it. This is due the fact that some energy is always lost as heat while going from one trophic level to the next. The pyramid of energy is always "upright".

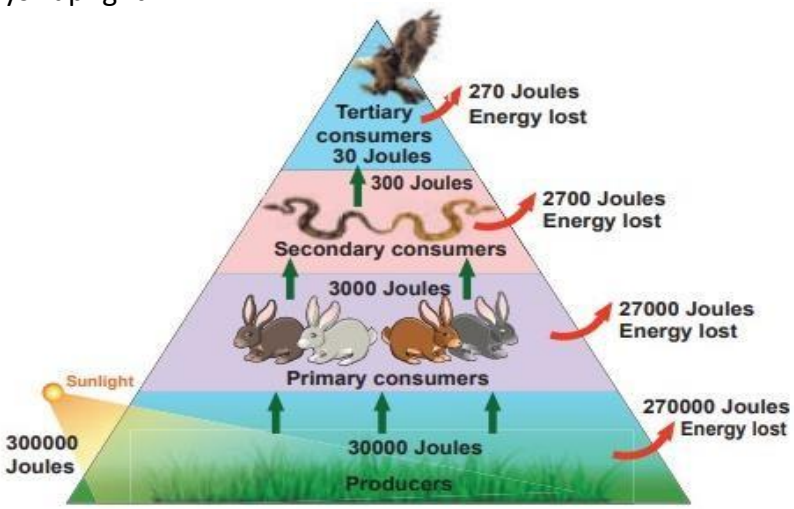


Fig. Pyramid of Energy of a grassland ecosystem

Q10. Define ecological succession with illustration.

Ans: Ecological succession can be defined as the gradual process of the changes in the community structure over time. The concept of ecological succession was given by E. Warming of Denmark (1896) and Henry Cowles of US (1901). It is a process by which an ecological community undergoes more or less orderly and predictable change over a period of time, following disturbance or initial colonization of the habitat.

The driving force behind succession, the reason why change occurs, is not always the same:

(i) **Autogenic succession**: the replacement of one community by the next results from changes in the physical environment that have been produced by the resident organisms. These changes tend to render the site less optimal for the organisms producing the change and more optimal for those organisms that replace them.

(ii) **Allogenic succession**: it occurs when geological processes cause changes in the physical environment, which in turn lead to changes in the biota.

(iii) **Biogenic succession**: it occurs when there is a sudden interference with an autogenic or allogenic succession by a living organism which becomes the major agent of successional change, at least temporally. A sudden change in herbivore pressure on the

plant community or the sudden removal of a segment of the plant community by a pathogen could be two good examples.

The first species that inhabits the bare area is called pioneer community. The last and stable community in the area is called the climax community. It has maximum diversity and niche specialization. The intermediate communities between pioneer and climax communities are called seral or transitional communities. The entire series of communities of biotic succession from pioneer to climax community is known as sere.

There are two main types of Ecological Succession: Primary Ecological Succession and Secondary Ecological succession

(i) **Primary Ecological Succession:** It is the series of community changes which occur on an entirely new habitat which has never been colonized before by any life forms.

E.g. Succession in barren land, newly quarried rock, sand dunes, etc.

(ii) **Secondary Ecological succession:** It is the series of community changes which take place on a place which was once previously colonized by life forms, but was disturbed or damaged later.

E.g. Succession in damage land - out of forest fires, extensive deforestation, etc.

The ecological succession is observed as a sequential development of communities in an area viz. desert, land, bricks, water, rocks, walls, snow etc. The succession starts with appearance of simple life forms to subsequent development of advanced life forms in an area or vice-versa. The succession may be positive I.e. development of simple life forms to advance life forms or negative i.e. from complex to simple and then ultimately loss of quality and quantity of life forms.

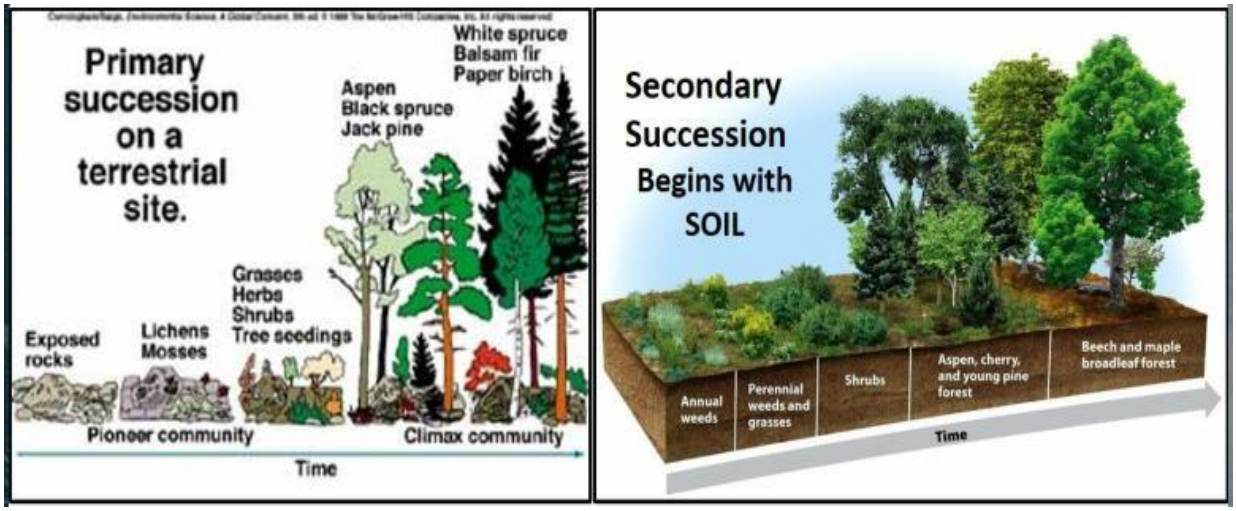


Fig. Primary and Secondary Ecological Successions in a land