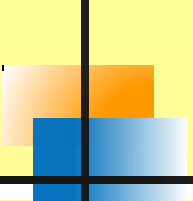
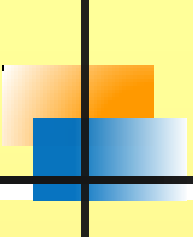

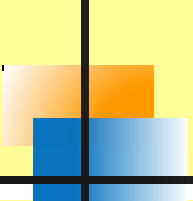


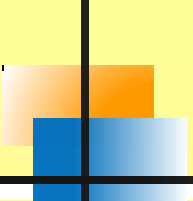
# **ECOSYSTEM STRUCTURE AND FUNCTION**

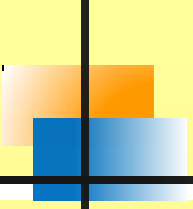
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- **The term Ecology was introduced by Reiter in 1868 and E. Haeckel in 1869 defined it as 'the study of natural environment including the relations of organisms to one another and to their surroundings'.**
  - **R. Mishra is known as 'Father of Indian Ecology'. He defined ecology as the 'Interaction of form ,functions and factors.**
  - **Autecology is the branch of ecology, which is concerned with the study of an individual organism.**
  - **Synecology is the branch of ecology , which deals with the study of a group of organisms that are associated together as a unit.**
  - **Species is an uniform interbreeding population spread over time and space.**
  - **Vegetation is the sum total of plant population covering a region or the collective and continuous growth of plants in space.**

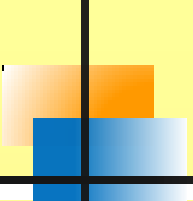
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- **Flora is the species content of the region irrespective of the numerical strength of each species.**
  - **Population is a group of individual organisms of the same species in a given area.**
  - **Community is a group of population of different species in a given area.**
  - **Factor is any external force , substance or condition that affects organisms in any way.**
  - **Environment is the sum of all factors.**
  - **Habitat is a place , where an organism lives. It represents a particular set of environmental conditions suitable for its successful growth.**
  - **Adaptation is any feature of the organism or its parts, which is of definite significance in allowing that organism to exist under the conditions of its habitat.**

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- **Ecad of a plant species is population of individuals , which although belong to the same genetic stock but differ in vegetative characters such as size, shape , number of leaves, stems etc.**
    - **Variations in Ecads are environmentally induced , temporary or reversible.**
    - **One type of Ecad may change into another with the change in its habitat.**
    - **Ecads are the population of same species.**
    - **Ecads are also known as ecophene , habitat forms or environmentally induced variations.**
    - **If different Ecads are transplanted in same habitat , all would become similar in appearance.**
  - **Ecotype is a population of individual of a species , which are genetically different.**
    - **Ecotypes are interfertile.**
    - **Ecotypes come under the same taxonomic species.**
    - **Variations in ecotypes are permanent irreversible and genetically fixed.**

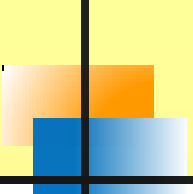
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- **Ecotypes are also known as ecological races or physiological races.**
  - **If different ecotypes are grown in identical habitat, their differences will not change.**
  - **In the same species there may occur different morphologic forms which may be Ecads, ecotypes or ecospecies in nature.**
  - **Ecospecies are one or more ecotypes in a single coenospecies.**
    - **It is a unit of classification which contains one or more ecotypes.**
    - **Ecospecies are interfertile.**
    - **Ecospecies do not cross or at least do not produce viable offspring if crossed with ecotypes of other ecospecies.**
  - **Ecotone is a transition zone present between two different types of communities.**
  - **Life form is the sum of the adaptation of the plant to climate.**
  - **Biological Spectrum is the percentage distribution of species among the various life forms of a flora.**
  - **Biological Clocks are those plant species which possess physiological mechanisms that indicate particular seasons of the year.**

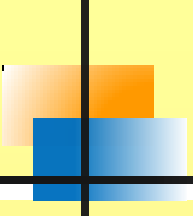
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- **Ecological succession is a natural process by which different groups or communities colonize the same area over a period of time in a definite sequence.**
  - **Climax Community is the final terminal community that can maintain itself more or less indefinitely in equilibrium with the prevailing environment.**
    - **As per monoclimax theory there is only one climax community which is chiefly controlled by the climate.**
    - **As per polyclimax theory there may be more than one type of climax communities differing widely from each other in the same climatic conditions at a time.**
  - **Biome is a complex of several types of communities maintained under more or less similar climatic conditions.**
    - **Various types of biomes are Tundra, North Coniferous forest , Deciduous forest , tropical Rain forest, Chaparral , Tropical Savanna, Grassland and Deserts**
    - **Permafrost is concerned with Tundra.**
    - **Chaparral is a broadleaf shrubs and Sclerophyllus woodland located in regions of Mediterranean climate.**

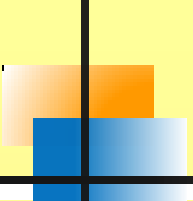
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- **Ecosystem is a whole biotic community in a given area plus its abiotic environment.**
  - **Biosphere is the atmosphere i.e. air, land and water that sustain life on the planet earth.**
  - **Standing state is the amount of inorganic substances such as P, S, N, C ,H etc., present at a given time in the environment of an ecosystem.**
  - **Standing crop is the amount of living material present in a component population at any time.**
  - **Biomass is the standing crop expressed in terms of weight of the living matter present or the total weight of the organisms constituting a given trophic level of population or inhabiting a well defined area.**
  - **Ecological pyramids are the graphic representations of the trophic structure and function at successive trophic levels of an ecosystem which may be shown in terms of their number , biomass or energy content.**

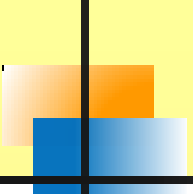
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- **Food Chain is the transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten.**
  - **Food Web in an ecosystem is an interlinking pattern of a number of food chains making a web-like arrangement.**
  - **Productivity is the rate of production which means the amount of organic matter accumulated in the living component of an ecosystem in unit time.**
  - **Biogeochemical cycles are more or less circular pathways , through which the chemical elements ,including all the essential elements of the protoplasm circulate in the biosphere from environment to organisms and back to the environment are known as biogeochemical cycles.**
  - **Ecological Niche of an organism includes the physical space occupied by it, its functional role in the community and the conditions of existence.**
    - **Each species has its own unique niche.**
    - **Two species cannot occupy exactly same niche and coexist.**



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- **Closely related species of competitors will have similar requirements along the niche dimensions so that their niche will overlap one another partially or fully.**
  - **If the niche of one species completely overlaps that of another then one of the species will be eliminated.**
  - **If the niche overlaps partially , co-existence is possible in two ways-**
    - ❖ **One species fully occupies its own fundamental niche excluding the second species from parts of its fundamental niche and leaving it to occupy a smaller realised niche.**
    - ❖ **Both species have restricted realised niches, each utilising a smaller range of particular niche dimensions than they would in the absence of other species.**
  - **Ecological equivalents are the organisms that occupy the same or similar ecological niches in different geographical regions.**
  - **Conservation is the planning and management of resources so as to secure their wide use and continuity of supply while maintaining and enhancing their quality ,value and diversity.**
  - **Pollution is an undesirable change in the physical , chemical or biological characteristics of our air , land and water that may or will harmfully affect human life directly or indirectly.**

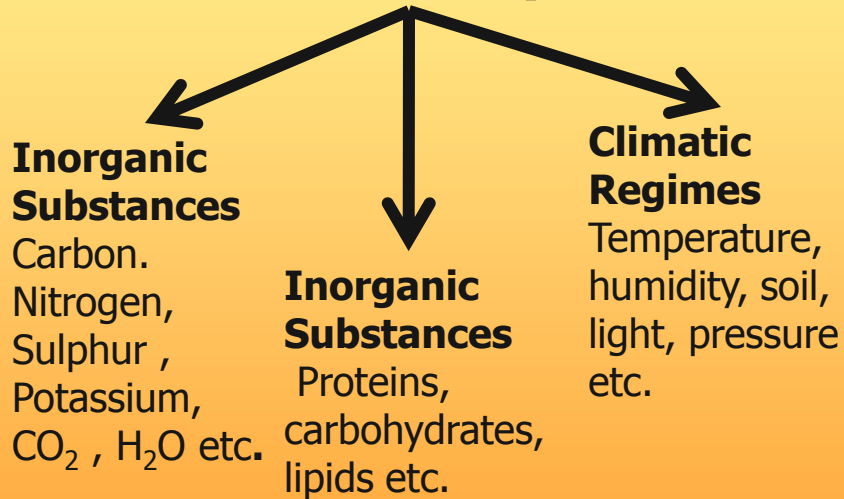
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- **Ecosystem is a whole biotic community in a given area plus its abiotic environment.**
  - **Natural ecosystem develops in nature without human support or interference. Example- Forest Ecosystem.**
  - **Man made or Anthropogenic Ecosystem is created and maintained by human beings . Example- Agriculture, Aquarium , Garden etc.**
  - **Nano-Ecosystem is very small sized ecosystem. Example- Kitchen garden , Fish pot etc.**
  - **Micro-ecosystem is small ecosystem . Example- Pond.**
  - **Meso-ecosystem is moderate size ecosystem. Example- Forest.**
  - **Macro or Mega-ecosystem is a large ecosystem. Example- Ocean.**
  - **Running water ecosystem is called Lotic. Example - Spring , stream and rivers.**

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- **Standing water ecosystem is called Lentic. Example –Lake , pond , pools, puddles , ditch, swamp etc.**
  - **According to Southwick (1976), those ecosystems that do not contain all the four basic components like abiotic substances , producers , consumers and decomposers are called as incomplete ecosystems. Example – Abyssal depth of the seas and caves lack producers but contain only the consumers and decomposers, while those having all four basic components are called complete ecosystems.**
  - **System which directly gets affected by man is called noosystem.**
  - **Every ecosystem has non-living and living components.**
  - **Abiotic components include basic inorganic compounds of an organism habitat or an area like carbon dioxide, water, nitrogen , calcium, phosphorus etc. that are involved in the material cycles.**

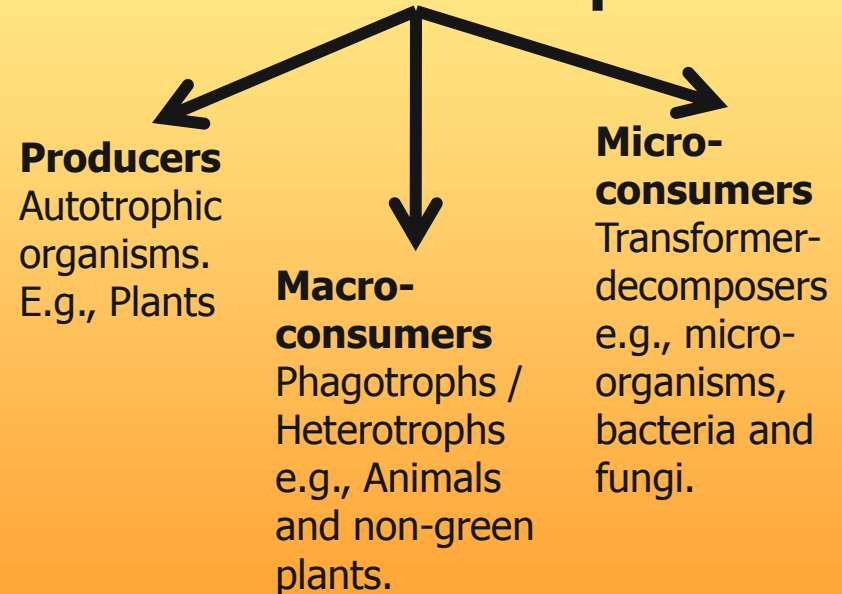
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- **Biotic components include autotrophic components , heterotrophic components and decomposers.**
  - **Autotrophic component is mainly constituted by the green plants, algae and all photosynthetic organisms.**
  - **Chemosynthetic bacteria, Photosynthetic bacteria, algae , grasses , mosses, shrubs , herbs and trees manufacture food from simple inorganic substances by fixing energy and are therefore called producers.**
  - **Heterotrophic components can not make their own food. They consume the matter built by the producers and are therefore called as consumers. They may be herbivores, carnivores or omnivores.**
  - **Herbivores are called as 'Primary consumers'**
  - **Carnivores and Omnivores are called 'Secondary consumers'.**
  - **They are collectively called 'Macroconsumers'.**

- **Decomposers are heterotrophic organisms chiefly bacteria and fungi that breakdown the complex compounds of dead protoplasm , absorbs some of the products and release simple substances usable by the producers.**

## **The Abiotic Components**



## **The Biotic Components**



- The series of organisms eating one and being eaten by the other is called the food chain. A simple food chain consists of three steps-


**Plant → Herbivore → Carnivore**

- But when more than three links are involved in a food chain then it is changed to five steps-

**Plant → Herbivore → Carnivore<sub>1</sub> → Carnivore<sub>2</sub> → Carnivore<sub>3</sub>**

- Food chains can be traced in any ecosystem

Type	Producer	Primary Consumer	Secondary Consumer	Tertiary Consumer	Quaternary Consumer
Aquatic	Phytoplankton	Zooplankton	Fish	Fish	Man
Aquatic	Phytoplankton	Fish	Frog	Raccoon	----
Terrestrial	Grass	Grasshopper	Frog	Snake	Hawk
Terrestrial	Corn	Pig-steer	Man	Human Parasites	----
Terrestrial	Dead Leaves	Fungi	Squirrel	Hawk	----
Terrestrial	Leaves Bark	Rabbit	Lion	----	----

- 
- **In nature basically two types of food chains are recognised.**
    - **Grazing Food Chain**
    - **Detritus Food Chain**
  - **Food chains are not isolated units but are hooked together in food webs.**
  - **In an ecosystem interlinking pattern of a number of food chains forms a web-like arrangement known as a food web.**

### Grazing

The chain begins with producers as the first trophic level.

Energy for the food chain comes from sun.

Food chain adds energy into the ecosystem.

The food chain binds up inorganic nutrients.

### Detritus

The chain begins with detritivores and decomposers as the first trophic level.

Energy for the food chain comes from organic remains or detritus.

It retrieves food energy from detritus and prevents its wastage.

The food chain helps in releasing inorganic nutrients to the cycling pool.



## Differences between Food Chain and Food Web

### Food Chain

It is straight single pathway, through which food energy travels in the ecosystem.

Members of higher trophic level feed upon a single type of organisms of lower trophic level.

Presence of separate or isolated food chains adds to the instability of the ecosystem.

It does not add to adaptability and competitiveness of the organisms.

### Food Web

It consists of number of interconnected food chains, through which food energy passes in the ecosystem.

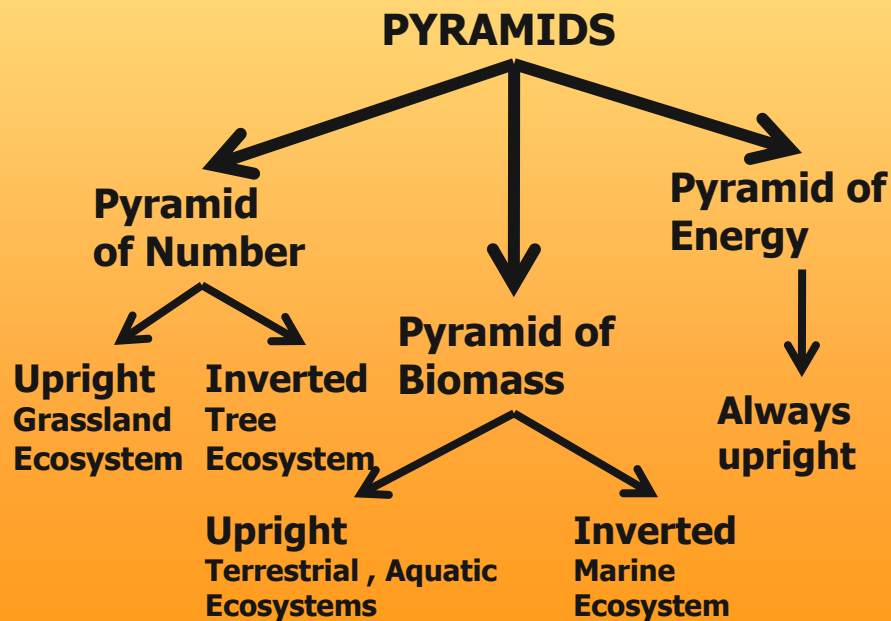
Members of higher trophic level can feed as a number of alternative organisms of the lower trophic level.

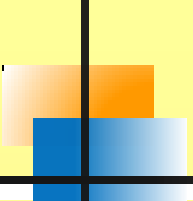
Presence of food webs increases the stability of the ecosystem.

Food webs increase adaptability and competitiveness of the organism.

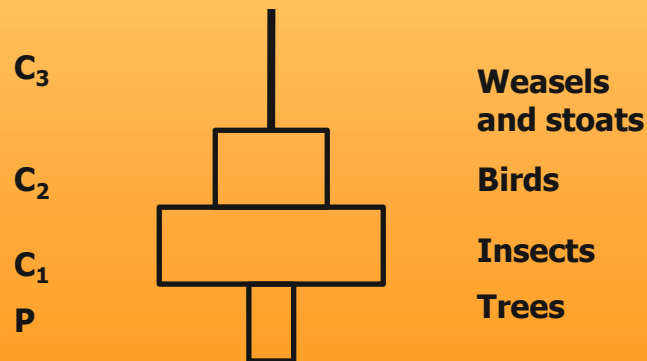


- **Ecological pyramids are the graphic representations of the trophic structure and functions at successive trophic levels of an ecosystem, which may be shown in terms of their number , biomass or energy content.**
- **The concept of pyramid was proposed by Charles Elton in 1927. So they are known as Eltonian Pyramids.**
- **There are three types of pyramids-**

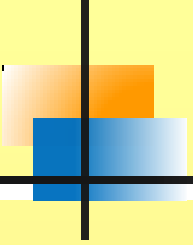


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- **Pyramid of Number represents number of individuals/unit area of various trophic levels.**
  - **Producer forms the base of pyramid and top carnivore is the top of pyramid.**
  - **Pyramid of Number manifests relationship between the different trophic levels of food chain.**
  - **Pyramid is straight and upright with number of individuals in successive higher trophic levels decreasing from base to the apex.**
  - **Maximum number of individuals occur at the producer level, which support small number of herbivores.**
  - **Herbivores support few carnivores Top carnivores are very few in number.**
  - **In a tree ecosystem an inverted pyramid is obtained because tree provides food to several herbivores birds.**
  - **Birds support still larger population of parasites.**

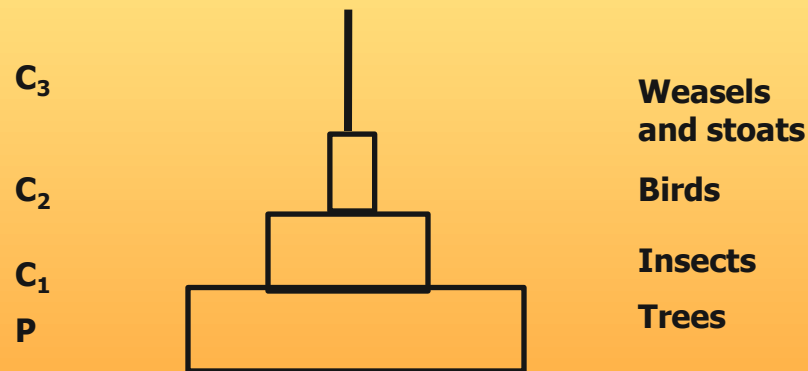
- A spindle-shaped pyramid is formed , when a large tree supports large number of herbivores birds which are eaten by small number of eagles or falcon.
- Pyramid is upright for grassland and pond pyramid is inverted for parasitic ecosystem.
- Pyramid of Number display the number of individual organisms at each trophic level.
- The pyramid above has few producers, but they may be of a very large size. This gives an 'inverted pyramid' although not all pyramids of number are like this.



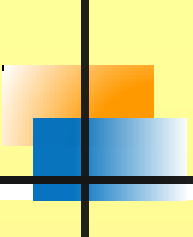
**Pyramids of Numbers in a Forest Community**

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- **Pyramid of Biomass represents biomass present sequentially in per unit area of different trophic levels.**
  - **Maximum biomass occurs in producers and there is a progressive decrease from lower to higher trophic level.**
  - **Herbivorous animals have a greater chance of being supported in large number than ones carnivorous animals.**
  - **In aquatic ecosystem , the pyramid of biomass is inverted to spindle shaped.**
  - **Biomass of trophic level depends upon the**
    - **Longevity of member**
    - **Reproductive potential**
  - **Biomass is high in organism with long life span.**
  - **Biomass of phytoplankton is less than that of zooplankton.**
  - **Primary consumers have larger biomass than the others.**
  - **Pyramid is upright for terrestrial ecosystem.**

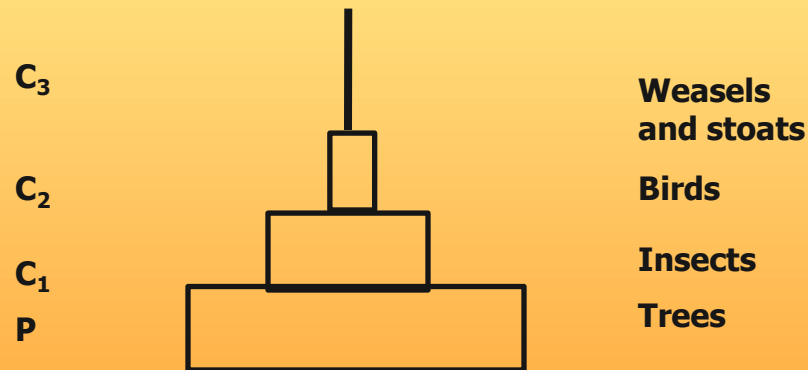
- **Biomass pyramids measure the weight of biological material at each trophic level.**
- **Water content of organisms varies so 'dry weight' is often used .**
- **Organism size is taken into account so meaningful comparisons of different trophic levels are possible.**



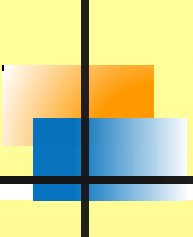
**Pyramids of Biomass in a Forest Community**

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- **Pyramid of Energy** represents amount of energy trapped / unit area and time in different trophic levels of a food chain.
  - **Producers** form the base of pyramid and the top carnivores form its tip.
  - **Maximum energy content** is present in the producers.
  - **It is always upright.**
  - **The energy decreases** as it passes to higher trophic level.
  - **In pond ecosystem** ,it is estimated that phytoplankton trap  $31080 \text{ kJ/m}^2/\text{yr}$  of solar energy; zooplankton and other herbivores feed on these and possess  $7980 \text{ kJ/m}^2/\text{yr}$  of energy content; they support primary carnivore with an energy content of  $2100 \text{ kJ/m}^2/\text{yr}$ .
  - **Secondary carnivores** consume small fishes and have an energy content of  $126 \text{ kJ/m}^2/\text{yr}$ .

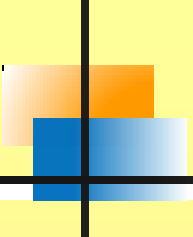
- **Pyramids of energy are often very similar to biomass pyramids.**
- **The energy content at each trophic level is generally comparable to the biomass which means similar amount of dry biomass tend to have about the same energy content.**

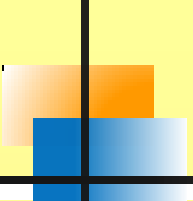


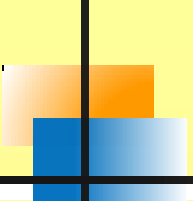
**Pyramids of Energy in a Forest Community**

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- **There are so many interactions among organisms ,which can be classified as-**
    - **Positive interaction . Examples- Commensalism, Symbiosis or Mutualism, Proto-cooperation.**
    - **Negative Interaction . Examples- Predation , Parasitism , Amensalism , Competition.**
    - **Neutral Interaction. Examples- Neutralism.**
  - **Secondary carnivores consume small fishes and have an energy content of 126 kj/m<sup>2</sup>/yr.**
  - **Scavenging is the process in which animals feed on dead flesh. Example Vultures.**
  - **Scavengers help in removing the dead bodies and prevent wastages of food. Example- Hyenas.**
  - **It ensures that no food goes unutilised by one organism or other. Example – Jackals, Crow.**



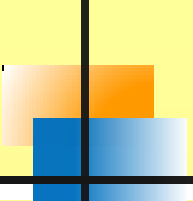
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- **Commensalism is a biological association between members of two different species, in which one is benefited while the other is neither harmed nor more than marginally benefited. Examples – Sea Anemone and *Pagurus*, Echineis and Shark, Barnacles on Whales, *E.coli* in Human colon, Epiphytes.**
  - **Proto-cooperation is the interaction / relationship between two diverse species beneficial to both. Examples – Birds that remove bits of flesh from teeth of crocodiles, Birds that follow cattle and eat insects, Tick bird and cattle, Shrimps that eat up parasites of fish.**
  - **In Social parasitism one species exploits others for its reproductive success. Example – Cuckoos lay their eggs in nest of crows, which incubate them and nurse the chicks.**
  - **In Amensalism one species adversely affects the other. Examples – *Penicillium notatum* secretes antibiotic that inhibits bacterial growth.**

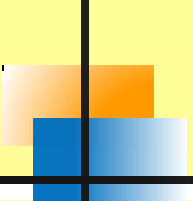
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- **Inhibitor secretes growth inhibitor. Examples – Roots of sunflower secrete weedicide.**
  - **Competition is of two types interspecific and intraspecific. It benefits organisms , determine distribution of closely related species. Examples- Competition between trees , shrubs and herbs in a forest. Darwin's Finches in Galapagos Islands.**
  - **In Mimicry organism modifies its form ,appearance , structure and behaviour to resemble animate /inanimate object to escape from predator or to enhance his opportunity to capture prey. It may be protective or aggressive. Example – Cryptic: J Stick insect resemble dry stem , leaf insect appear like leaf . They are not detected by predatory birds.**
  - **Protective mimicry may be of concealing or of warning type. Examples- Warning: Monarch butterfly and Viceroy butterfly . Praying mantis (*Mantis religiosa*).**
  - **Aggressive mimicry can be – concealing and Alluring. Example - Carnivorous spider resembling an Orchid Rodents of grasslands.**

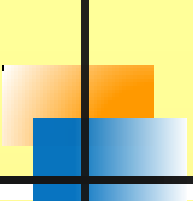
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- **Neutral Interactions** is when a species remains unaffected by another species sharing the same habitat.

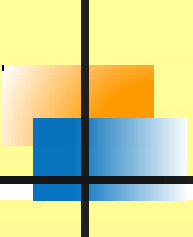
### **Animal ———> Plant Interactions**

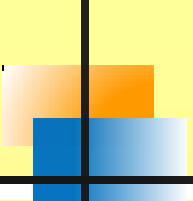
- **Animals pollinate flowers , disperse their fruits and seeds , mineralize soil by their urine and faeces. Plants provide food, O<sub>2</sub> and Shelter to animals.**
- **The study of interaction between living organisms and their environment is called Ecology.**
- **The term “oekologie” ecology was coined by Ernst Haeckel.**
- **Tropical Rain Forest has the highest annual net primary productivity.**
- **The population of an insect species shows an explosive increase in number during rainy season followed by its disappearance at the end of the season . Its population growth curve is of J-type.**
- **Synecology is the study of community in relation to environment.**

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- **The term biocoenosis was proposed by Karl Mobius.**
  - **The ultimate source of energy in an ecosystem is Sunlight.**
  - **Geometric representation of age structure is a characteristic of population.**
  - **If the mean and median pertaining to a certain character of a population are of the same value then it is a normal distribution.**
  - **Light loving plants are known as Haliophytes.**
  - **Sciophytes are found in caves.**
  - **Topography governs the structure of earth's surface.**
  - **Pedology is the study of soils.**
  - **The most common source of water in plants from soil is capillary water.**
  - **The niche of a species is meant for the habitat and specific functions of a species.**
  - **Critical minimum and maximum values of an environmental factor is called as limits of tolerance.**

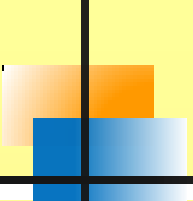
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- **Praying Mantis is a good example of camouflage.**
  - **In commensalism weaker partner is benefited.**
  - **Symbiosis is expressed by Lichens.**
  - **Mycorrhiza is a symbiotic association of plant roots and certain fungi.**
  - **The formula for exponential population growth is  $dN/dt = rN$ .**
  - **Fresh weight is not used for construction of ecological pyramids.**
  - **Niche overlap indicates two different parasites on the same host.**
  - **The term ecosystem was coined by Tansley.**
  - **Grassland ecosystem has highest gross primary productivity.**
  - **Ecosystem has two components biotic and abiotic.**
  - **Energy storage at consumer level is called secondary productivity.**
  - **Food chain is transfer of food energy from producers to consumers.**

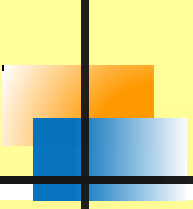
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- **Food chain is a series of population which starts with producers. It is concerning with biotic components , energy flow and transfer of nutrients.**
  - **There is more competition for survival between same animals of same niche.**
  - **An ecosystem is a complex interacting system of communities and their physical environment.**
  - **Biological equilibrium is an equilibrium among the producers, consumers and decomposers.**
  - **The pyramid of number of individuals per unit area in a grassland ecosystem will be upright.**
  - **Some organisms resemble other organisms and thus escape from enemies. This phenomenon is known as mimicry.**
  - **The pyramid of energy is always upright.**
  - **Desert can be converted into grassland by Psammophytes.**
  - **Ocean is the most stable ecosystem.**
  - **Plankton are floating microscopic plants and animals.**

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- **Plants growing in saline soil water are called halophytes.**
  - **All living organisms on or around the earth constitute biosphere.**
  - **Aquatic photo diffraction produces zones euphotic , disphotic and aphotic.**
  - **Law of limiting factors in photosynthesis was given by Blackman.**
  - **Energy enters ecosystem through producers.**
  - **At 40° North and south latitude heat gain through insulation approximately equals heat loss through terrestrial radiation.**
  - **More than 70 % of world's freshwater is contained in Polar ice.**
  - **The world Environment Day is observed on 5<sup>th</sup> June.**
  - **10% of energy is available to one trophic level from one level lower to it.**
  - **The pyramid of biomass in the pond ecosystem is inverted.**

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- **The transition zone between two communities is known as Ecotone.**
  - **Lichens are well known combination of an alga and fungus , where fungus has a symbiotic relationship with alga.**
  - **Plant Lice and leaf represent an organism and its ecological niche.**
  - **Acclimatization is adaptation to new environment.**
  - **In a pond ecosystem , food chain starts with phytoplankton.**
  - **Vertical distribution of different species occupying different levels is called stratification.**
  - **The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called primary productivity.**
  - **Gross primary productivity minus respiration losses is called net primary productivity.**



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- **Keystone species is a species , which makes up only a small proportion of the total biomass of a community ,yet has a huge impact on the community's organization and survival.**
  - **Sun is the only source of energy for all ecosystems on Earth except deep-sea hydrothermal ecosystem.**
  - **Each trophic level has a certain mass of living material at a particular time. It is called standing crop.**
  - **An ecosystem , which can be easily damaged but can recover after sometime if damaging effect stops will be having low stability and high resilience.**
  - **The gradual and fairly predictable change in the species composition of a given area is called ecological succession.**
  - **The species that invade a bare area are called pioneer species.**
  - **The maximum growth rate occurs in exponential phase.**
  - **In desert the diurnal temperature of the soil surface vary most.**
  - **Crop field and aquarium are man made ecosystems.**
  - **Saprophytes in an ecosystem belong to decomposer.**

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- **Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts through leaching.**
  - **Humification and Mineralization occur during decomposition in soil.**
  - **Humification leads to accumulation of dark coloured humus.**
  - **The humus is further degraded by some microbes and release of inorganic nutrients occurs by the process of mineralization.**
  - **Broad leaved forests of oak are found in temperate deciduous forest.**
  - **The pyramid of biomass in sea is inverted.**
  - **The pyramid of number in tree ecosystem is inverted.**
  - **Hydrarch succession takes place in wetter areas and the succession serves progress from hydric to mesic conditions.**
  - **Xerarch succession takes place in dry areas.**
  - **Mineral movement will be blocked when decomposers are removed from earth.**



**Thanks...**