Environment:- The term environment simply means surroundings e.g. everything surrounding us:- air, plants, animals etc

* It may be natural or man-made and may be physical, chemical or biological.
* It is thus a complex of all the things encompassing an organism which not only interact with the organism but also among themselves.
* Growth, behaviour and life history of an organism are influenced by the environment in which they live.
* Habitat: The preferred environment of an organism is usually referred to as habitat. (i) Terrestrial (ii) Aquatic
* Ecology: Term ecology is derived from greek words i.e.

  Oikos = home/habitat

  Logos = study.

  → It is used to denote the relationship between the organisms and the environment.

  → Ecology is the study of organisms at home i.e. in their natural habitats.

  → *Ernst Haeckel (1869): For the first time used the term.

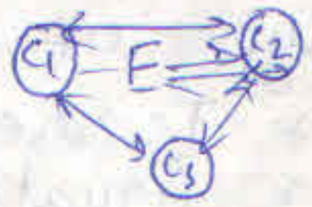
  → *Eugene P. Odum: defined ecology as the study of structure and functions of ecosystem and the science of totality of man and environment.

ECOSYSTEM: → A.G. Tansley in 1935 first proposed the term ecosystem. He defined it as: system resulting from the integration of all the living and non-living factors of the environment. Eco ⇒ Environment

System ⇒ interacting and interdependent complex.

~~* Organisms of any community besides interacting among themselves, always have functional relationship with the environment.~~

~~* This structural and functional system of communities and environment is called ecosystem.~~



* Basic functional unit in ecology.
* ~~Includes both biotic and abiotic components.~~
* Microecosystem: a drop of pond water.
* Large : Ocean

BIOSPHERE:- The planet Earth is a vast ecosystem. For convenience it is studied under various smaller ecosystems e.g.

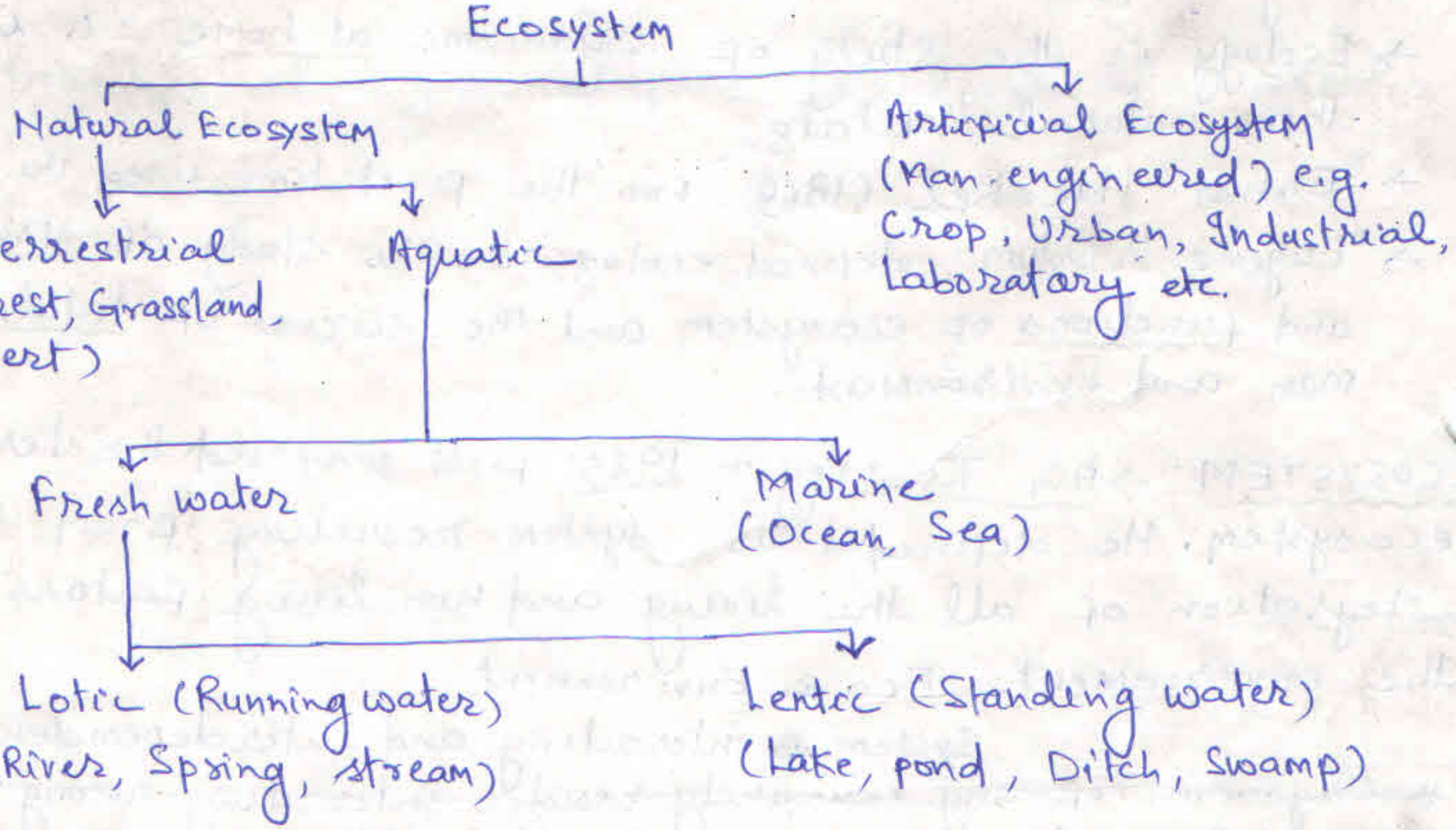
- * Forest
- * Desert
- * Grassland
- * Cropland
- * Freshwater
- * Marine etc.

Zone on earth where life exists. Largest ecosystem and encompasses almost everything.

ECOSYSTEM CHARACTERISTICS: All the ecosystems have some basic chara:-

1. Major structural and functional unit of ecology.
2. Structure depends on species diversity. More complex - More sp. diversity
   Forest / Desert / Tundra (Poles)
3. Functions: (i) energy flow and (ii) material cycling through and within the system.
4. Energy required to maintain an ecosystem depends on structure. More complex: less energy needed.
5. Matures from less complex → More complex state. Process is known as succession.

TYPES OF ECOSYSTEM:



1. Natural Ecosystems: These operate under natural conditions without any major interference by man. On the basis of type of habitat these are further divided as:
   - * Terrestrial: forest, grassland, desert etc.
   - * Aquatic: (a) Fresh water: Lotic (running)/Lentic (standing
     (b) Marine: oceans, seas, estuary.
2. Artificial (Man-engineered) Ecosystems: Maintained artificially by man e.g. cropland ecosystem.

STRUCTURE OF THE ECOSYSTEM → All the ecosystems consist of two major components i.e.

(i) Biotic (living) Components
(ii) Abiotic (non-living) components.

* Biotic components :- All the living organisms come under biotic components. On the basis of nourishment or trophic level, they are further subdivided as:

(a) Autotrophs (self nourishing): e.g. green plants, photosynthetic or chemosynthetic bacteria. These can convert the light energy of Sun into potential chemical energy i.e. organic compounds, which are needed for their own growth and development.
  * O_2, a by product of photosynthesis is needed by all living organisms for respiration.
  * Green plants are also known as producers because they produce food for all the other organisms.

(b) Heterotrophs (other nourishing):
  * They are dependent directly or indirectly upon autotrophs for their food.
  * Also known as consumers because they consume the materials built up by producers. They are further divided into two:

(i) Macroconsumers (Phagotrophs; phago = to eat).
These organisms ingest food and digest it inside their bodies. They may be:
  * Herbivores : Plant eating
  * Carnivores : Animal eating
  * Omnivores : Eating all kind of food.

→ Primary consumers: insects: grasshopper, goat, cow, deer rabbit, man (eating plant products)
→ Secondary consumer : Frog
→ Tertiary consumer : Snake
→ Top consumers : Lion, Tiger, Leopard, vulture etc.
(They are not killed and eaten by any other animals)

(ii) Micro-consumers (Saprotrophs / Osmotrophs)
Sapro = To decompose
Osmo = To pass through a membrane

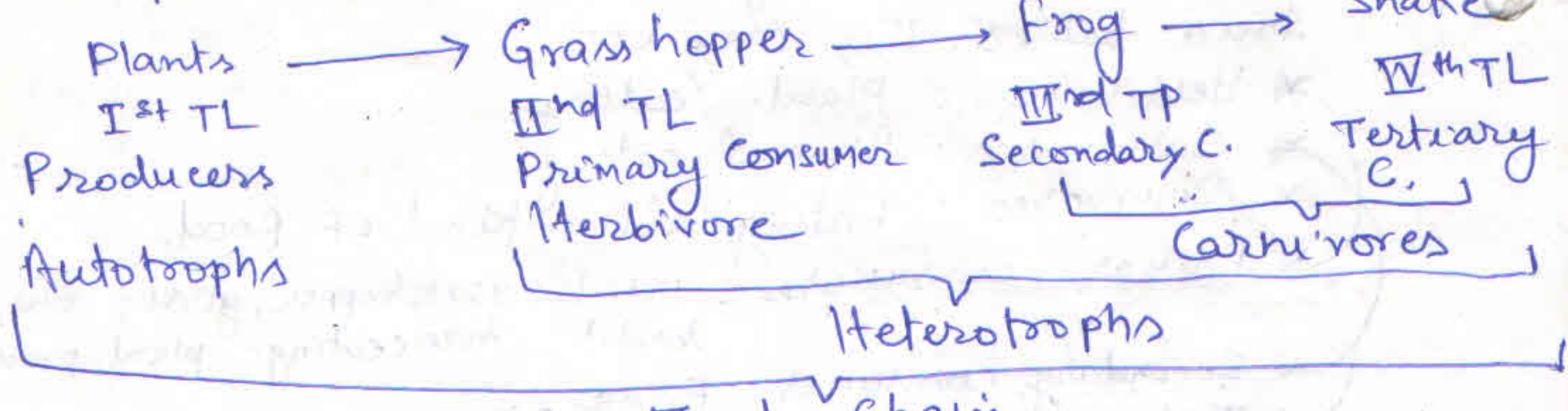
These organisms secrete digestive enzymes to breakdown food into simpler substances and then absorb the digested food. e.g.

* parasitic and saprophytic bacteria
* Actinomycetes and fungi.
* Also known as decomposers because of their role in decomposition of dead organic matter.
* Parasites are not decomposers
* Decomposers breakdown complex compounds of dead or living protoplasm, absorb some of the decomposition products and release inorganic nutrients back to soil and atmosphere. Thus again making them available to primary producers.

Biophages: Feeding on living organisms. parasites

Saprophages: Feeding on dead organic matter.

* Such a division of organisms based on the type of nutrition gives rise to trophic structure of the ecosystem.
* In producer-consumer arrangement, each food level is known as trophic level.
* Standing Crop: Amount of living material in different trophic levels.



* In nature several food chains are linked together and intersecting each other to form a network known as food web.

Abiotic Components: These comprises:

(i) Climatic Factors: → Precipitation, temperature, light, ~~and~~ etc.

(ii) Inorganic Substances: → Elements i.e. C, N, H, O, P, S which are involved in material cycles.

(iii) Organic compounds: → carbohydrates, proteins, lipids and humic substances that link abiotic and biotic components.

Biogeochemical cycle: Minerals and atmospheric gases keep on cycling between biotic and abiotic systems. These are known as biogeochemical cycles.

Kinds of Ecosystems:-

1. Biosphere/ecosphere
2. Mega-ecosystem: Lakes, oceans and seas
3. Macro-ecosystem: Forests
4. Meso-ecosystem: Cold-deciduous forest.
5. Limnetic ecosystem: Rivers
6. Semiterrestrial eco.: Areas of wet soil, air, and plants.
7. Terrestrial eco.: Systems of aerated soil, plants and air.
8. Noosystem: A system that directly gets affected by man.

ECOSYSTEM FUNCTIONING

The function of the ecosystem is to allow flow of energy and cycling of materials which ensures stability of the system and continuity of life. The ecosystem dynamics can be analysed in terms of:

(i) Food Chains
(ii) Food Pyramids
(iii) Energy Flow
(iv) Nutrient cycles (biogeochemical cycles)
(v) Development and evolution of ecosystem and
(vi) Homeostatis and stability of ecosystem i.e. control (Cybernetics).

FOOD CHAINS:→ The transfer of food energy from the source in plants through a series of organisms with repeated stages of eating and being eaten is known as F. chain.

* At each stage of food transfer 80-90% of the potential energy is lost as heat. Hence Lesser amount of energy is passed than received by the organisms. Hence number of steps are usually limited to 4/5. in a food chain.

Grass → Grasshopper → Frog → Snake → Vulture

* Producers: green plants occupying Ist trophic level.
* Herbivores: plant eaters IInd Trophic level: Primary consumers
* Carnivores (I): Eating herbivores: IIIrd Trophic level: Secondary consume
* Carnivores (II): Eating carnivores: IVth Trophic level: Tertiary consumers.
* Omnivores: Eat plants as well as animals: May occupy more than one T.L. in food chain.
* The organisms at each trophic level tend to be larger in size than those at lower T. level.

TYPES:-

① Grazing food chain:→ It starts from green plants and ends with carnivores passing through herbivores.
* Most common in terrestrial and aquatic ecosystems.
* Directly depend upon solar influx. e.g.

Phytoplankton → Zooplankton → Fish → Men.

Grass → Rabbit → Fox.

② Detritus food Chain:→ It starts from dead organic matter o decaying animal and plant bodies to the micro-organisms an

then to detritus feeding organisms (detritivores/saprovores) and their predators.

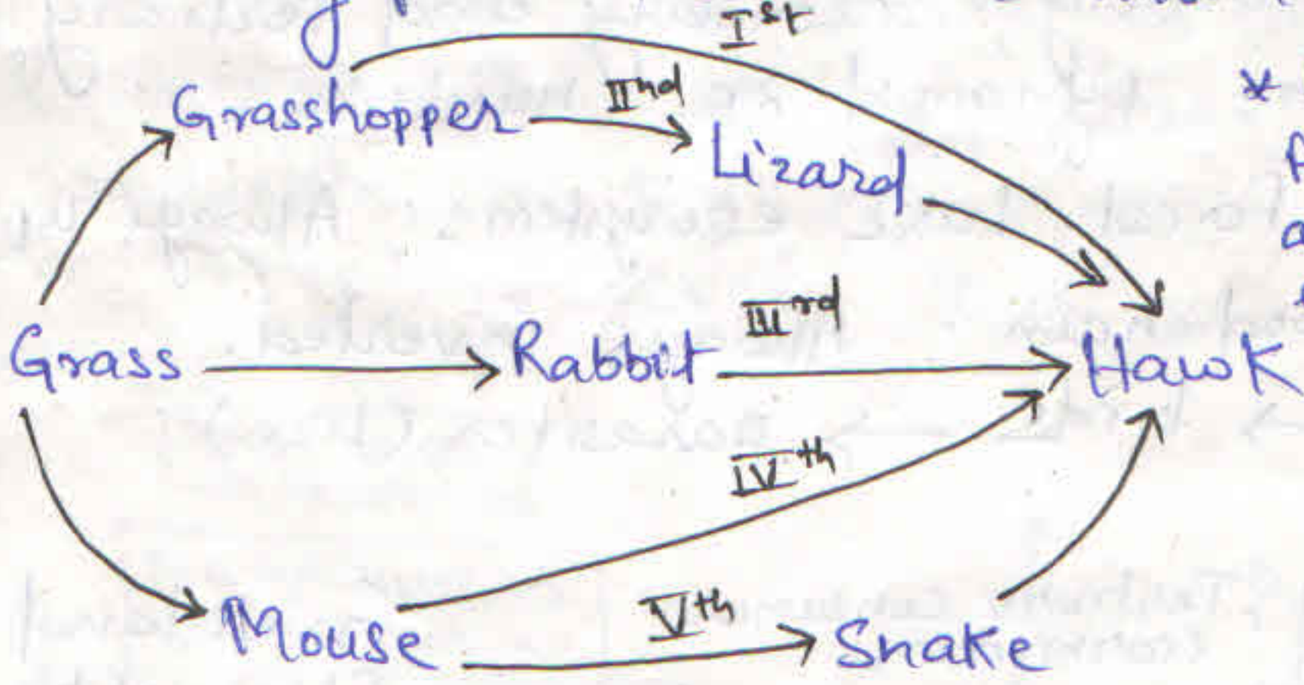
* Less dependent on solar energy
* Depends on influx of organic matter. e.g.

Dead Organic Matter (Plant/animal)
- → Earthworm → Frog → Snake → Bird
- → Bacteria/Fungi → Small Fish → Large Fish → Bird

Detritus: Organic wastes and dead matter derived from grazing food chain.

Detrivores: Feeding on detritus e.g. Algae, Fungi, Bacteria Actinomycetes and Protozoans, insects, mites, crustaceans, rotifers, nematodes and some vertebrates.

FOOD WEB :→ Food chains normally do not operate as isolated sequences but are interconnected with each other forming some sort of interlocking pattern which is known as food web.



* A food web, unlike a food chain has several alternative pathways for energy flow.

In an ecosystem an organism may operate at more than one trophic level i.e. it derives its food from more than one source and in turn may serve as a source of food for several organisms of higher trophic level.

* Food webs are very important to maintain the stability of an ecosystem in nature.
* A balanced ecosystem is essential for the survival of all living organisms of the system.

ECOLOGICAL PYRAMIDS :→ Charles Elton (1927) gave the concept of ecological pyramids. The trophic structure and also trophic function may be shown graphically by means of ecological pyramids in which first or producer level forms the base and successive levels the tiers which make up the apex.

This phenomenon results because of :-

(i) Smaller animals have a higher reproductive potential than the larger animals.

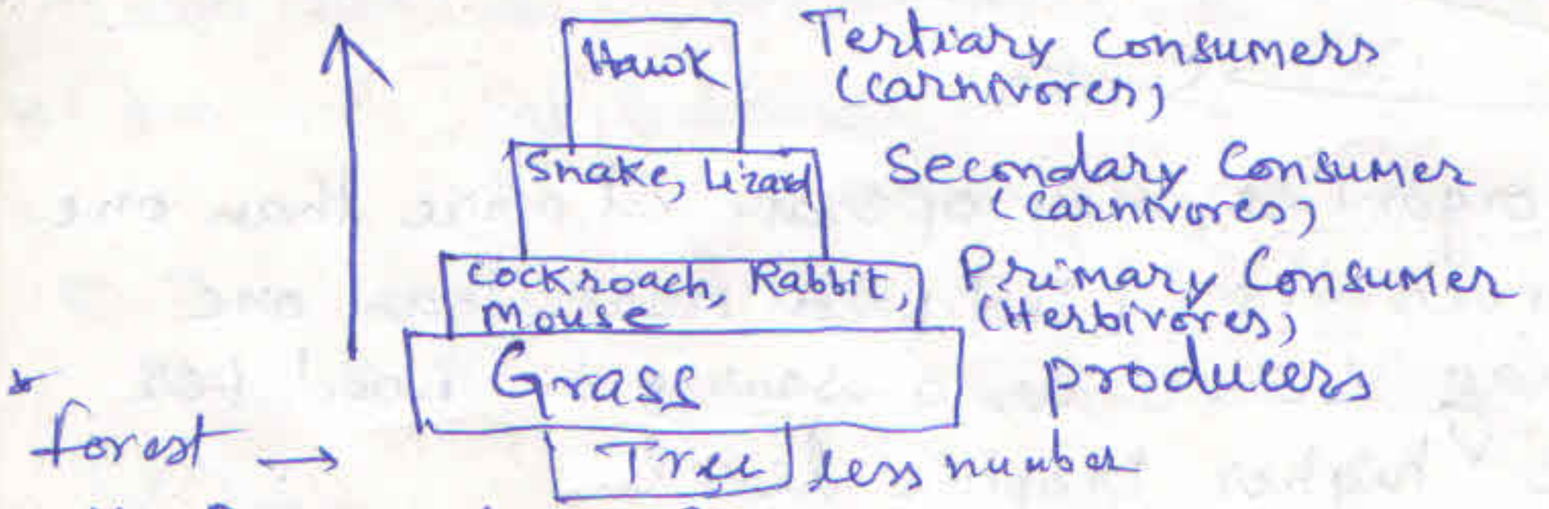
(ii) Smaller animals usually fall prey to larger animals.

TYPES :>

(i) Pyramid of Number ⇒ in which the number of individual organisms at each trophic level is depicted. (number m-2)

E.P.: There is some sort of relationship between the number, biomass and energy content of the primary producers, consumers of the first and second orders and so on to top carnivores in the ecosystem. This relationship may be represented graphically by means of pyramids. i.e. E.P.

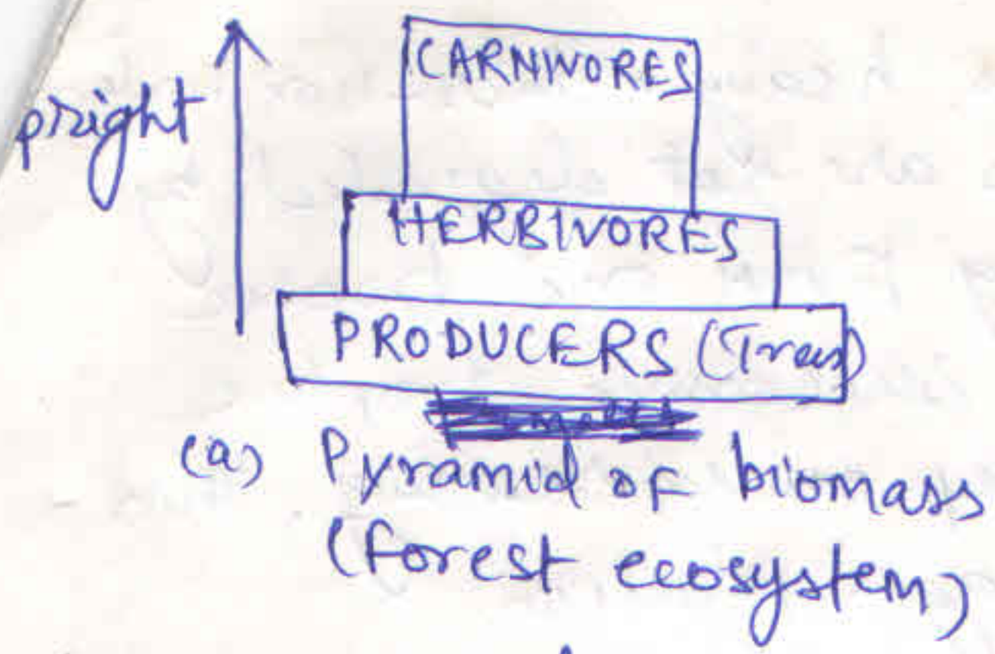
* The relationship between the number of producers, consumers of primary, secondary and tertiary orders constitutes the pyramid of numbers.
* Grass land, Forest, Lake ecosystems: Always upright position.
* Parasitic food chain: Always inverted.
  single plant → birds → parasites (lice)



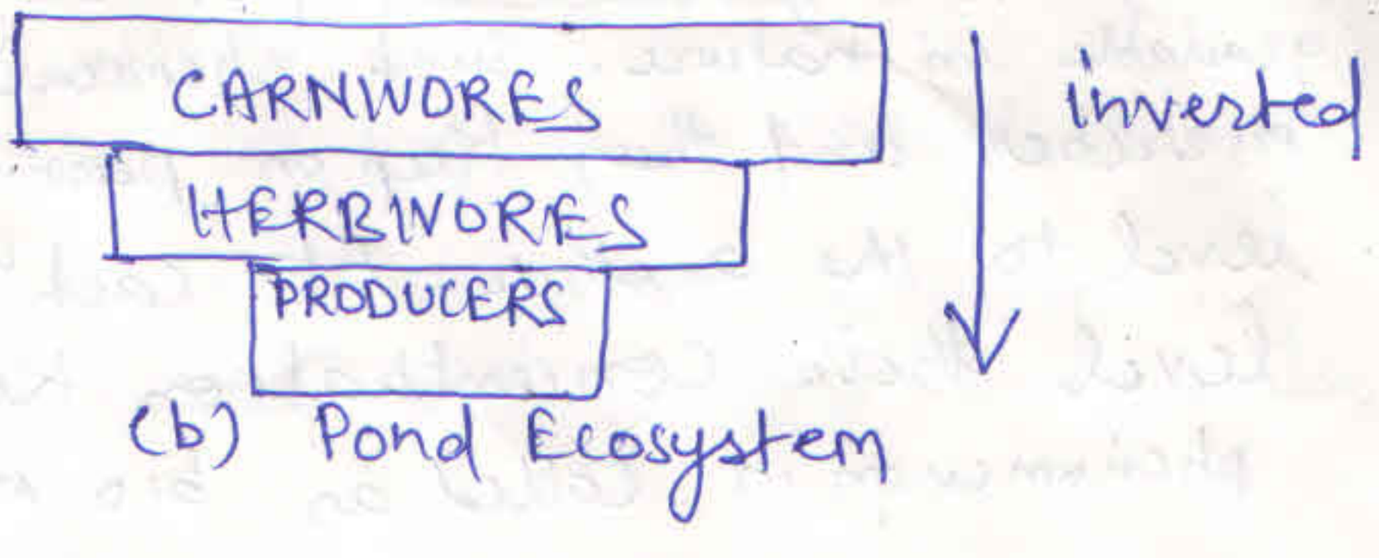
Grass land Ecosystem (Upright)

* forest →

(ii) Pyramid of Biomass: Here the relationship between different trophic levels is presented in terms of weight of organisms (biomass).
* In grass land / forest ecosystems, there is gradual decrease in biomass of organisms at successive levels from producers to consumers. Hence, these are in upright position.
* In a pond, producers are small organisms, so their biomass is also less But primary and secondary consumers are bigger, so their biomass is more Hence inverted pyramid.



(a) Pyramid of biomass (forest ecosystem)

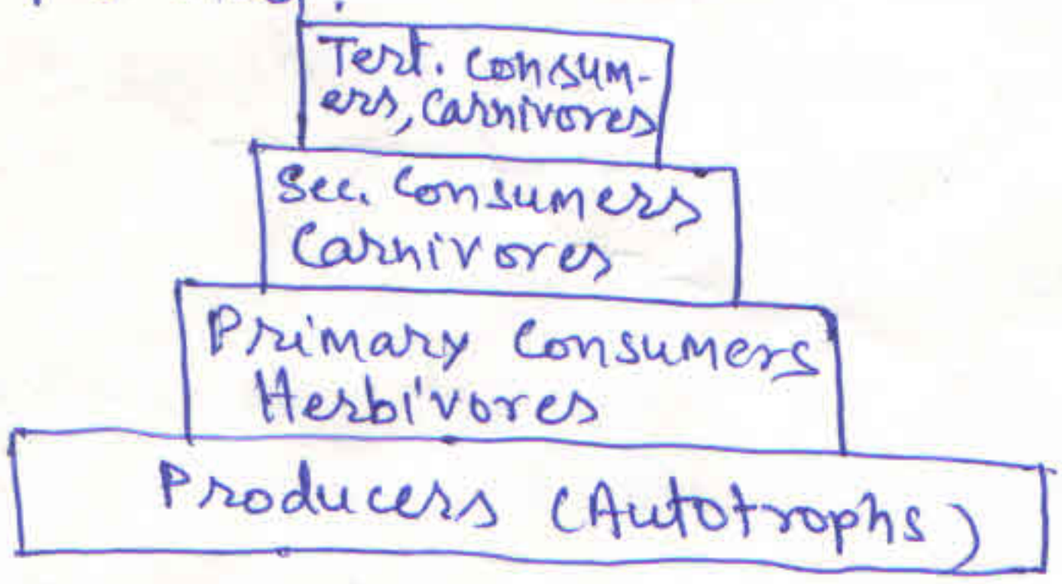


(b) Pond Ecosystem

* The pyramids of number and biomass may be upright or inverted depending upon the nature of food chain, however, pyramids of energy are always upright.

(iii) Pyramid of Energy :> It represents the total quantity of energy utilized by different trophic level organisms of an ecosystem per unit area over a set period of time (per m^2 per year).

* Primary producers of an ecosystem trap the radiant energy of the Sun and convert it into potential chemical energy. Thus energy flows through foodchain from producers to top carnivores, decreasing at successive trophic levels, thus an upright pyramid is formed.



Pyramid of Energy (Always upright)

* Pyramid of energy gives best picture of the functional role of communities in an ecosystem.
* Number and biomass pyramids are pictures of standing states i.e. organisms present at any moment.

Q. Why food web is important / why not F. chains operate in isolation in nature?

Q. Complex ecosystems (Forest / estuary) are more stable as compared to simple ecosystems (Desert / Polar regions) why?

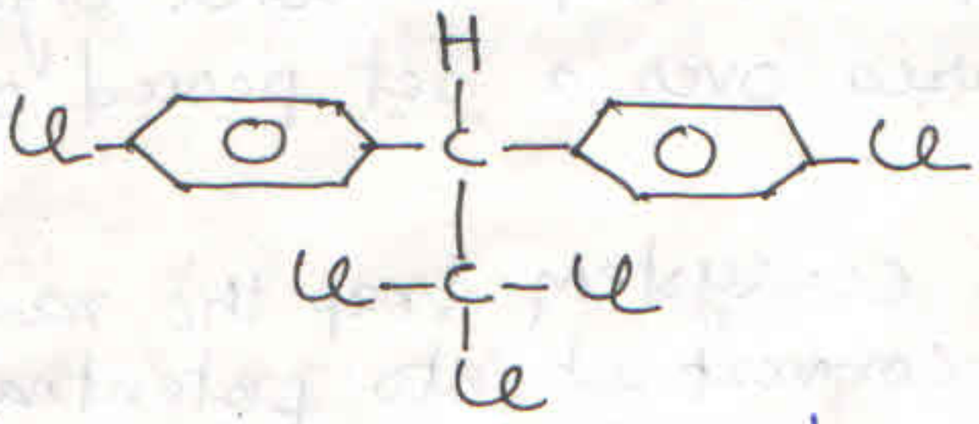
Q. Energy flow and Nutrient cycling takes place through F.C. & F.W.

Q. Food chains maintain ecological balance.

Q. Biological magnification :→ pesticides, heavy metals - non-biodegradable in nature. Such chemicals are not degraded by microbes and thus keep on passing from one trophic level to the another. At each successive trophic level their concentration keep on increasing. This phenomenon is called as bio-magnification

DDT- biomagnification: insecticide → birds (Osprey) → population decline → premature hatching and death of young (Thinning of Egg shells)

DDT spray —ones→ phytoplankton → zooplankton → fish → birds



Dichloro-diphenyl-trichloro-ethane

* Animals at higher trophic level are at a greater risk