**UNIT-I: ECOSYSTEMS**:

- Definition, Scope, and Importance of ecosystem.
- Classification, natural and artificial ecosystems,
- structure - abiotic and biotic component,
- functions of an ecosystem,
- food chains,
- food webs
- and ecological pyramids.

Activities: Case studies, poster making.

**Definition**: The living community of plants and animals in any area together with the non-living components of the environment such as soil, air and water, constitute the ecosystem

# DEFINITION OF ECOSYSTEM

- Self regulating system between biotic and abiotic component exchanging energy and matter.
- ECOLOGY: Earnst Haeckel – 1869
- Eco - home & logy – study of organisms in their home interacting with their surroundings or study of ecosystems.
- Biosphere : All ecosystems together constitutes as Biosphere.

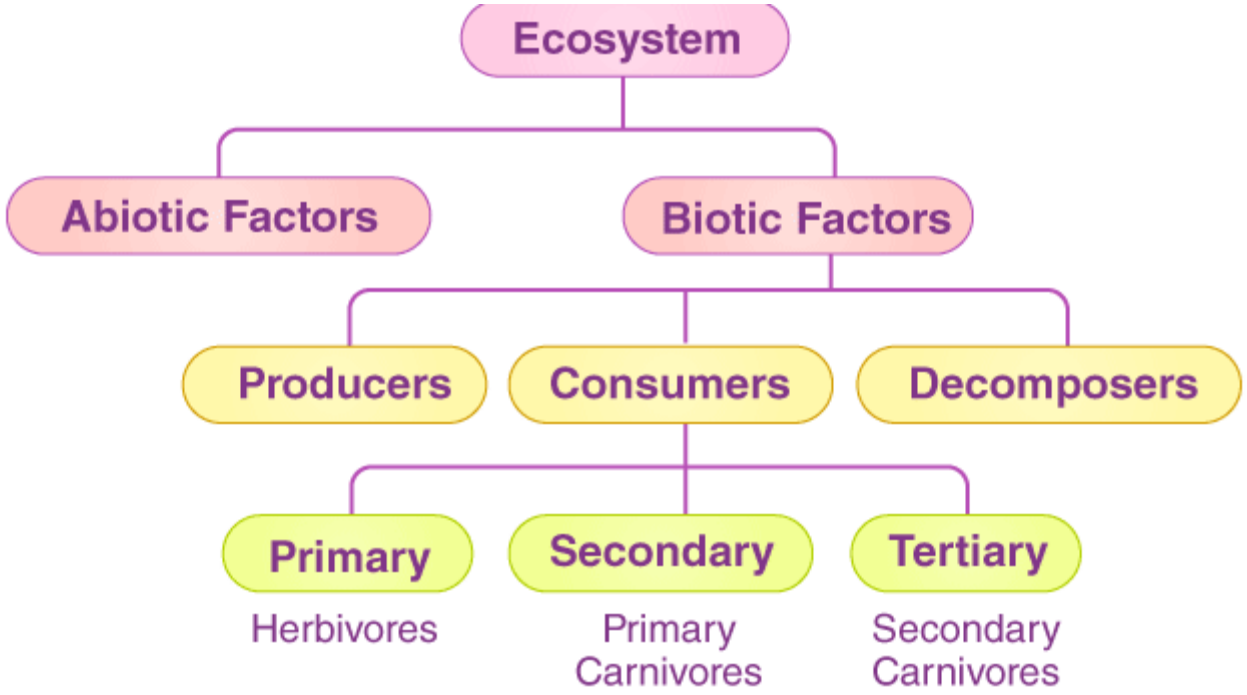
# SCOPE AND IMPORTANCE

- Provides home for flora and fauna
- Provides various commercial products like drugs, medicines etc for human welfare
- Regulates the flow of water and nutrients.
- Helps to conserve soil and build soil organic matter
- Helps to purify air and water.

## CONCEPT OF ECOSYSTEM:

- Ecosystem completely works based on exchanging energy and matter.
- Matter – essential nutrients – cyclic manner from biotic to abiotic component and vice versa
- Energy – Sun – primary source used partly for growth and maintenance and some energy is dissipated as heat.

# STRUCTURE OF ECOSYSTEM



# STRUCTURE OF ECOSYSTEM

Biotic structure : plants, animals and microbes together constitutes biotic component

Based on their nutritional behaviour further classified into 3 groups

A) Producers – green plants – photosynthesis(chlorophyll pigment)

**They can be two types:**

- Photo Autotrophs: (Eg: Green plants)
- Chemo autotrophs (chemosynthetic – S – bacteria)

– to convert dissolved $H_2S$ and $CO_2$ into organic compounds.

B) Consumers: - (organisms which feeds on another organisms)

i) **Herbivores** ($1^0$ – consumers), plant eaters – they feed on producers Eg.rabbit, insects etc

ii) **Carnivores** (meat eaters)

$2^0$ - consumers – eg: frog

$3^0$- consumers – eg: snakes , big fishes etc

iii) **Omnivores** – eg: human, rat, many birds

iv) **Detritivores (saprotrophs)** – feeds on dead content, wastes of living forms , partially decomposed matter

Eg: crabs, ants, earthworms etc.

C) **Decomposers:** they derive nutrition by break down from complex organic molecules to simpler organic compounds and then to inorganic nutrients.

Eg : various bacteria and fungi

# II. ABIOTIC STRUCTURE:

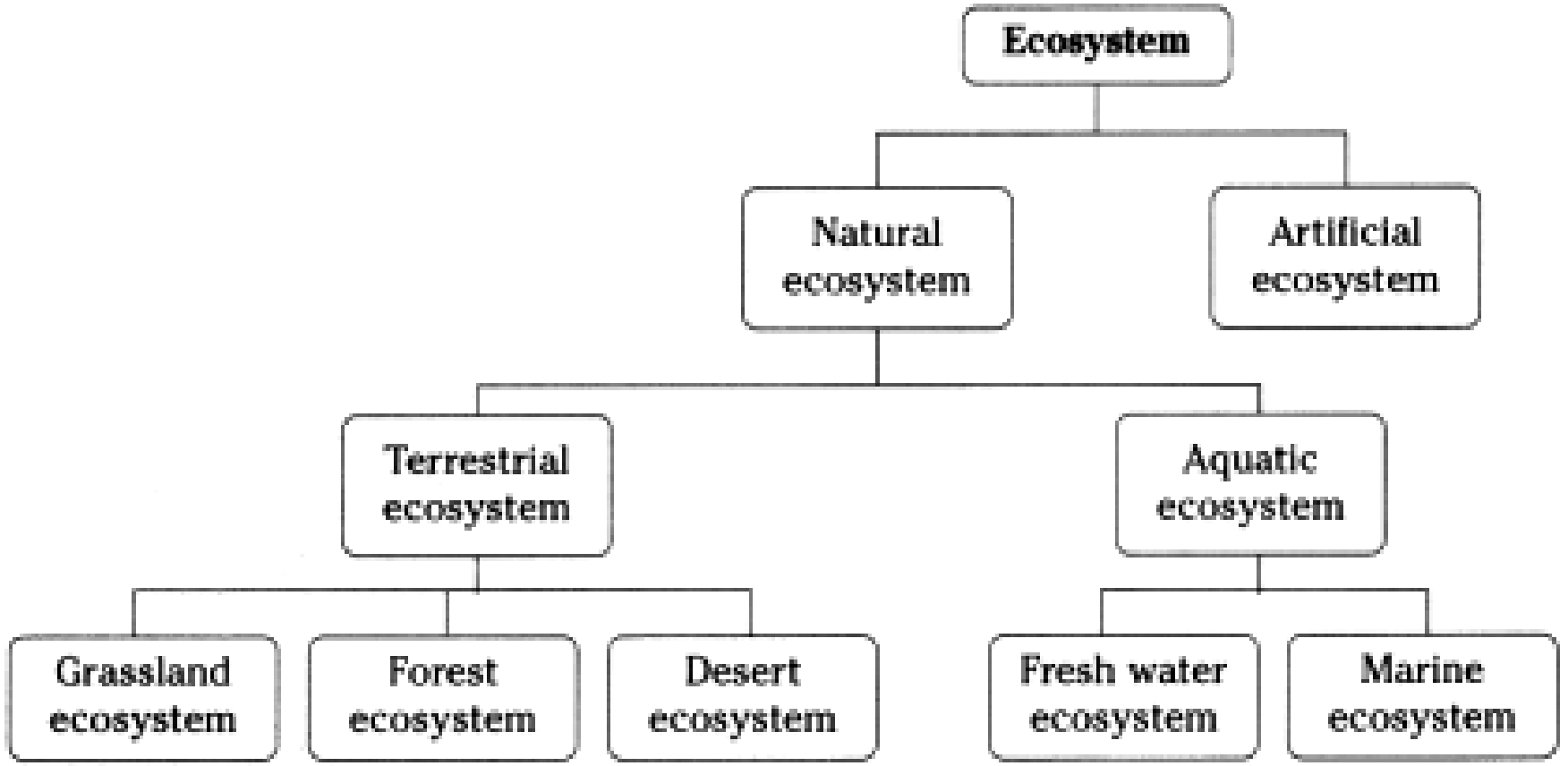
Comprises two factors –

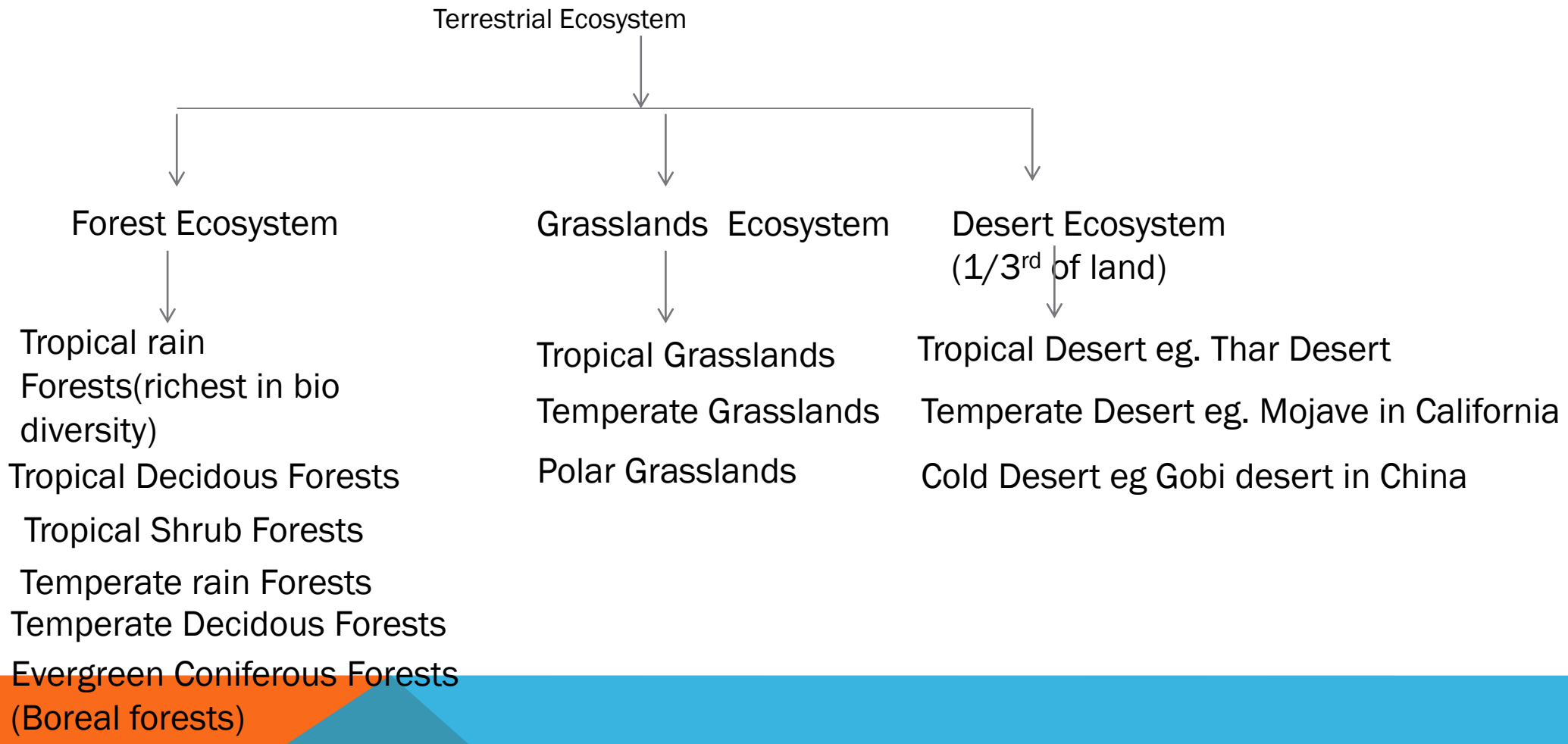
1. **physical factors** – sunlight, temperature, rainfall tendency, wind currents, water availability, water currents, Edaphic (soil) factors etc.
2. **Chemical factors** – essential nutrients, level of toxic substances, salts and organic substances availability

# CLASSIFICATION OF ECOSYSTEM:

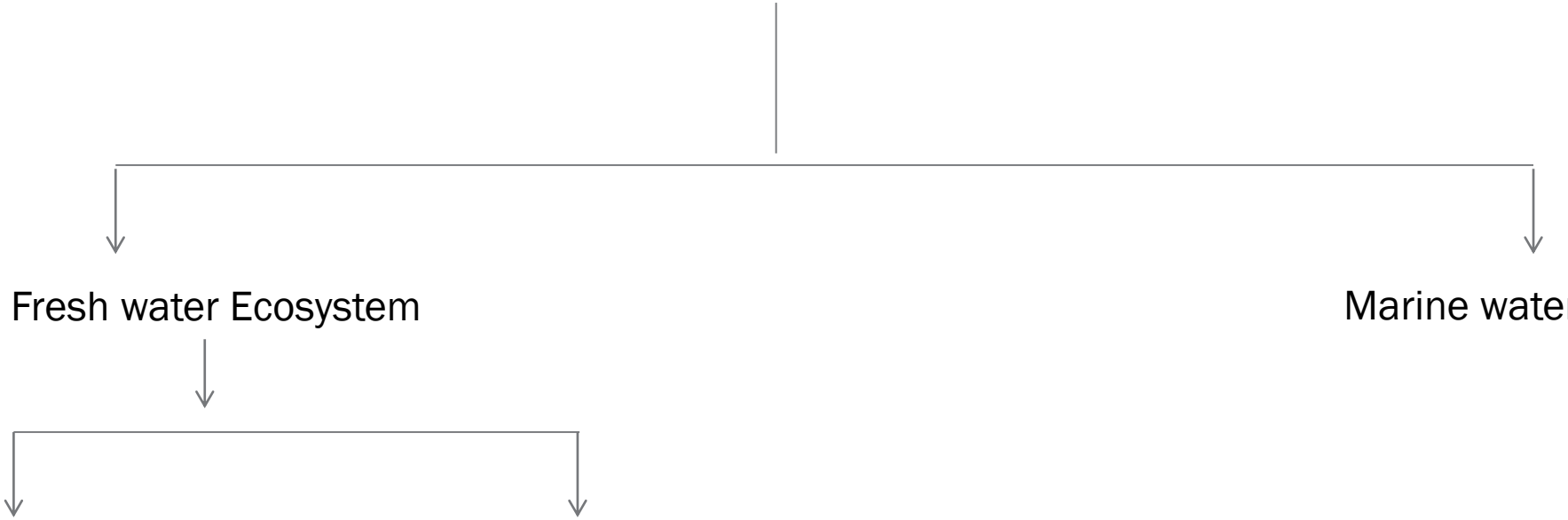
Based on Creation:

Based on Habitat:




Terrestrial Ecosystem
Forest Ecosystem
Grasslands Ecosystem
Desert Ecosystem
(1/3rd of land)
Tropical rain Forests(richest in bio diversity)
Tropical Decidous Forests
Tropical Shrub Forests
Temperate rain Forests
Temperate Decidous Forests
Evergreen Coniferous Forests (Boreal forests)
Tropical Grasslands
Temperate Grasslands
Polar Grasslands
Tropical Desert eg. Thar Desert
Temperate Desert eg. Mojave in California
Cold Desert eg Gobi desert in China

# AQUATIC ECOSYSTEM



## POND ECOSYSTEM

- Small  fresh water body
- Water is stagnant
- They are seasonal in nature
- Used by villagers for various anthropogenic activities

## LAKE ECOSYSTEM

Big fresh water bodies with standing water.

**Mainly studied in 3 different layers**

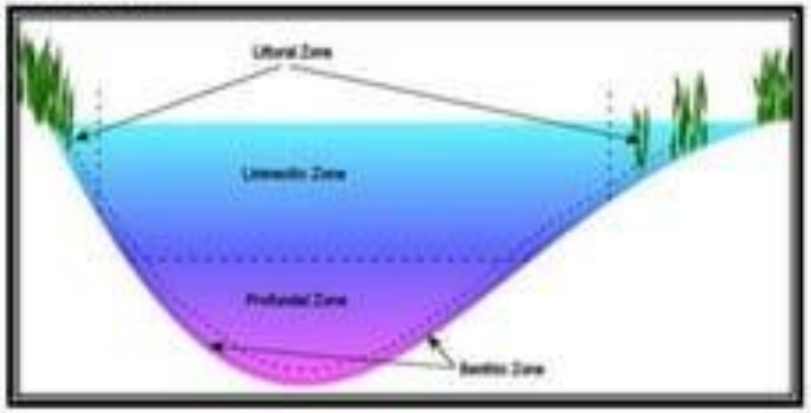
1. **Littoral Zone (shallow water zone)**
2. **Limnetic Zone( open water zone)**
3. **Profundal Zone(deep water area)**

## Biotic component

- Planktons (photo and zoo planktons)
- Nektons(that swims eg fishes)
- Neustons(that rest or swims on the surface)
- Benthos(attached to bottom sediments eg: snails)
- Periphytons(that are attached or clinging to other plants eg: crustaceans)

## ZONES OF POND AND LAKES

- LITTORAL ZONE
- LIMNETIC ZONE
- PROFUADAL ZONE
- BENTHIC ZONE



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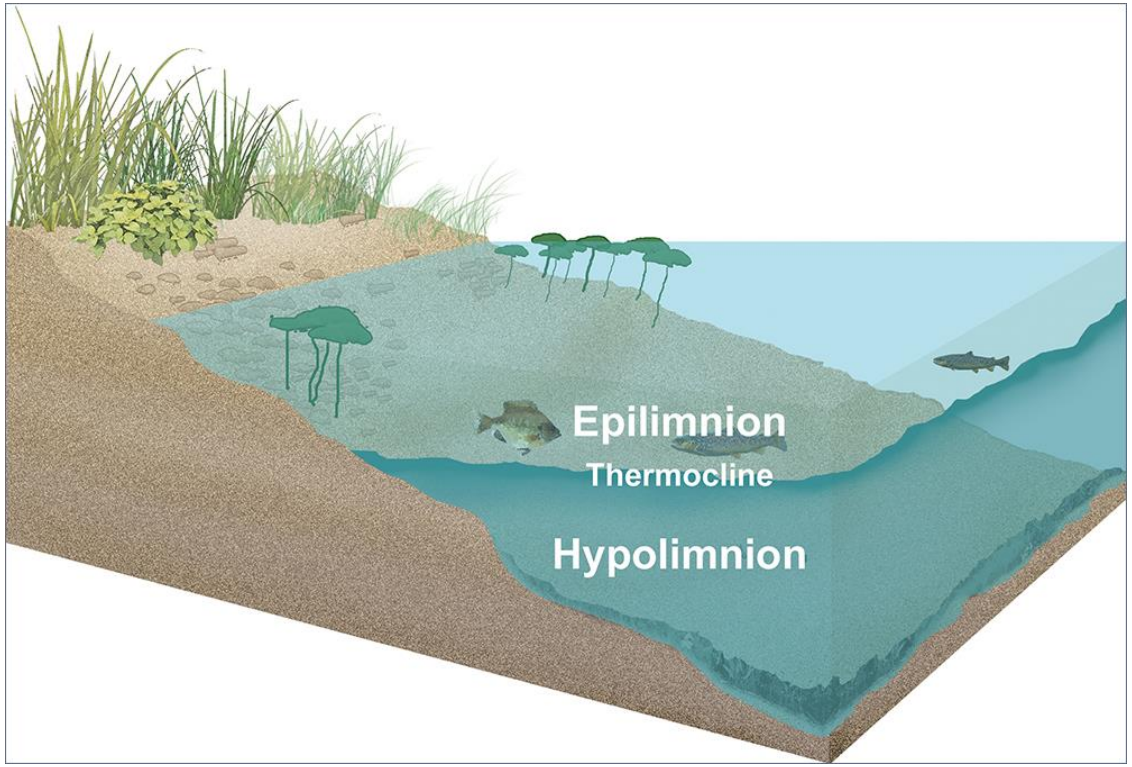
- Periphytons(that are attached or clinging to other plants eg: crustaceans)

# LAKE ECOSYSTEM

## STRATIFICATION:

Based on temperature differences:

1. Epilimnion (warm, circulating water surface)
2. Hypolimnion(cold , viscous, non - circulating bottom layers)
3. Thermocline(in between 2 layers)



# Types of lakes(based on nutrient availability)

1. Oligotrophic lakes(low nutrition)
2. Eutrophic lakes(overnourished)
3. Dystrophic lakes(low $P^H$, high humic acid content)
4. Endemic lake(ancient , deep with endemic fauna)
5. Desert Salt lake(high salt concentration)
6. Volcanic lake (water from magma after volcanic eruptions
7. Meromectic lake(rich in salts)
8. Artificial lake(created due to construction of dam)

River Ecosystem:

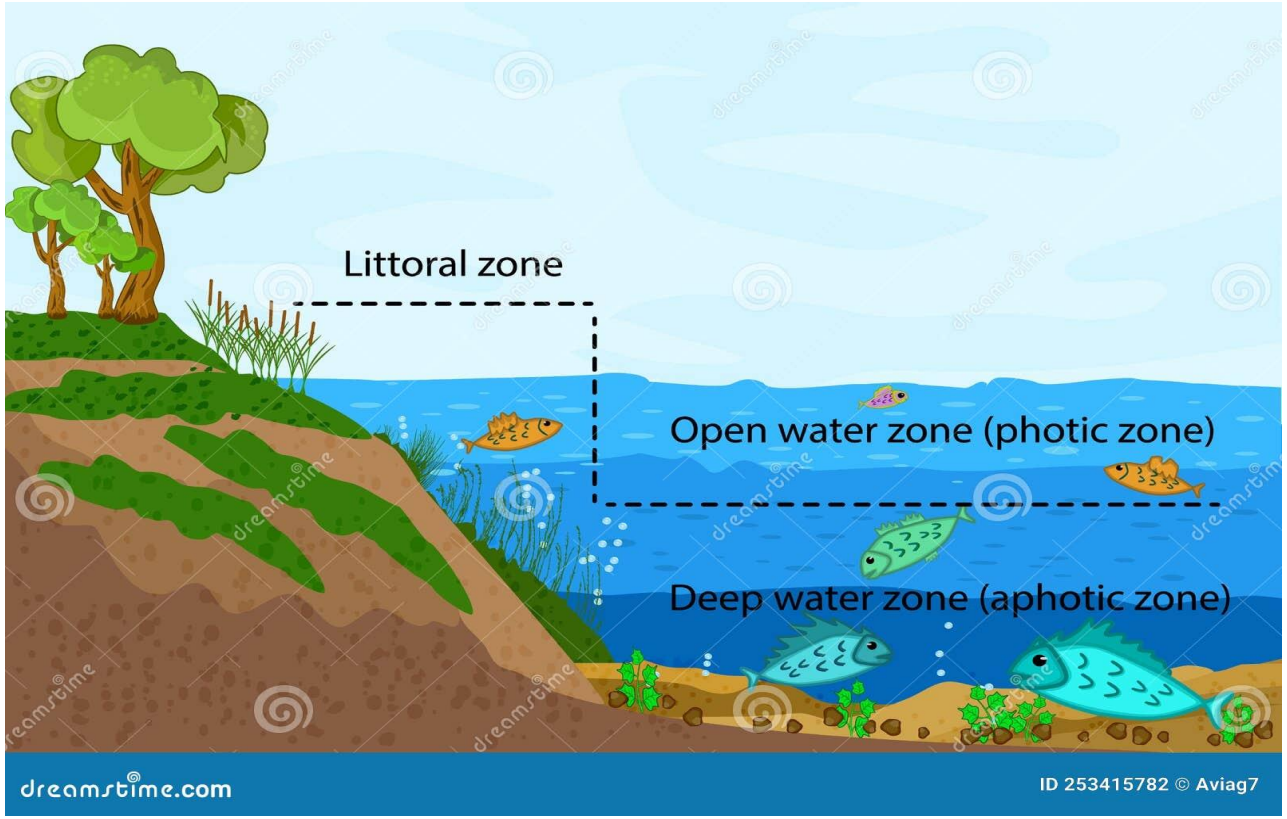
Mountain highlands

Gentle slopes

Third phase – silt deposition – rich in biodiversity

# MARINE ECOSYSTEM

- Gigantic reservoirs – 70% of earth's surface
- About 2,50,000 marine sps act as food for humans
- Provides huge varieties of sea- products and drugs.
- Also provides Fe, P, Mg, oil, natural gas etc
- Major sinks of $CO_2$ - regulates biogeochemical cycles, water cycle – regulating earth's climate.



# ZONATION :

1. Coastal Zone
2. Open Sea

a) Euphotic zone(abundant sunlight- high photosynthetic activity)

b) Bathyal zone(dim sunlight , geologically active)

c) Abyssal zone(dark zone, 2000m – 5000m deep – incomplete ecosystem)

## ESTUARY:

- Partially enclosed coastal area- fresh water(river) and salty sea water meet.
- Organisms known here are called as Euryhaline and Eurythermal.
- Rich in biodiversity
- Eg: Migratory sps of fishes like eels , salmons (half year spend in fresh water and half year spend in salt water)

# FUNCTIONS OF ECOSYSTEM:

1. Food chain
2. Food webs
3. Biogeochemical cycles
4. Energy flow
5. Ecological pyramids

## FOOD CHAINS

**Definition**

*"There sequence of eating and being eaten in an ecosystem is known as food chain"*

*(or)*

*"Transfer of food energy from the plants through a series of organisms is known as food chain"*

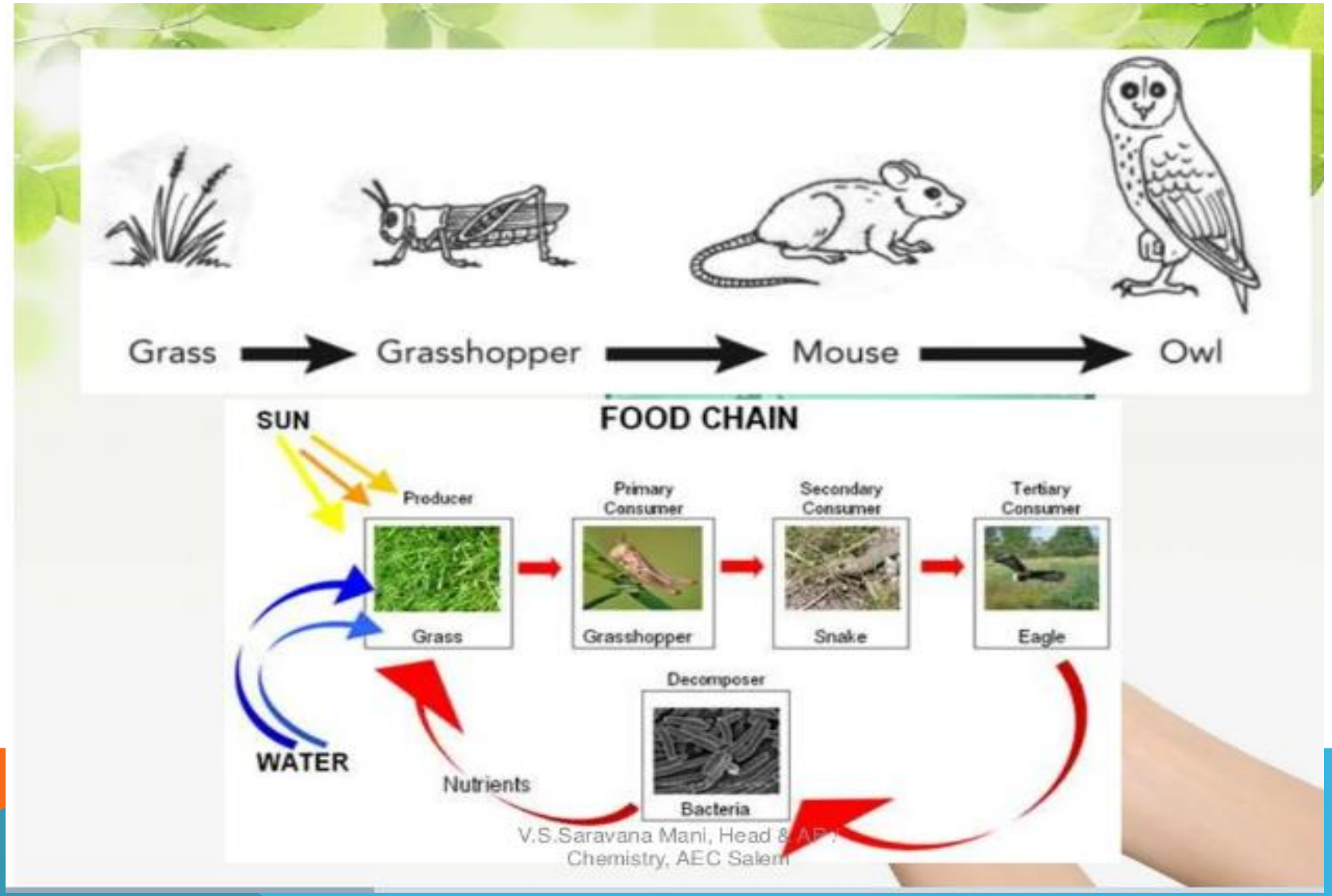
When the organisms die, they are all decomposed by microorganism (bacteria and fungi) into nutrients that can again be used by the plants. At each and every transfer, nearly 80-90% of the potential energy gets lost as heat. A food chain always starts with plant life and ends with animal.

**Herbivores**

Animal that eat only plants are called herbivores.

**Carnivores**

Animals that eat other animals are called carnivores.


Grass → Grasshopper → Mouse → Owl
SUN
FOOD CHAIN
Producer
Primary Consumer
Secondary Consumer
Tertiary Consumer
Grass
Grasshopper
Snake
Eagle
Decomposer
Bacteria
WATER
Nutrients
V.S.Saravana Mani, Head & AP I
Chemistry, AEC Salem

**Food chain in a pond**

**Food chain in a forest**

**Tropic Levels (T1,T2, T3, T4, T5) (or) Feeding levels**

The various steps through which food energy passes in an ecosystem is called as tropic levels.

The tropic levels are arranged in the following way as

Where ,

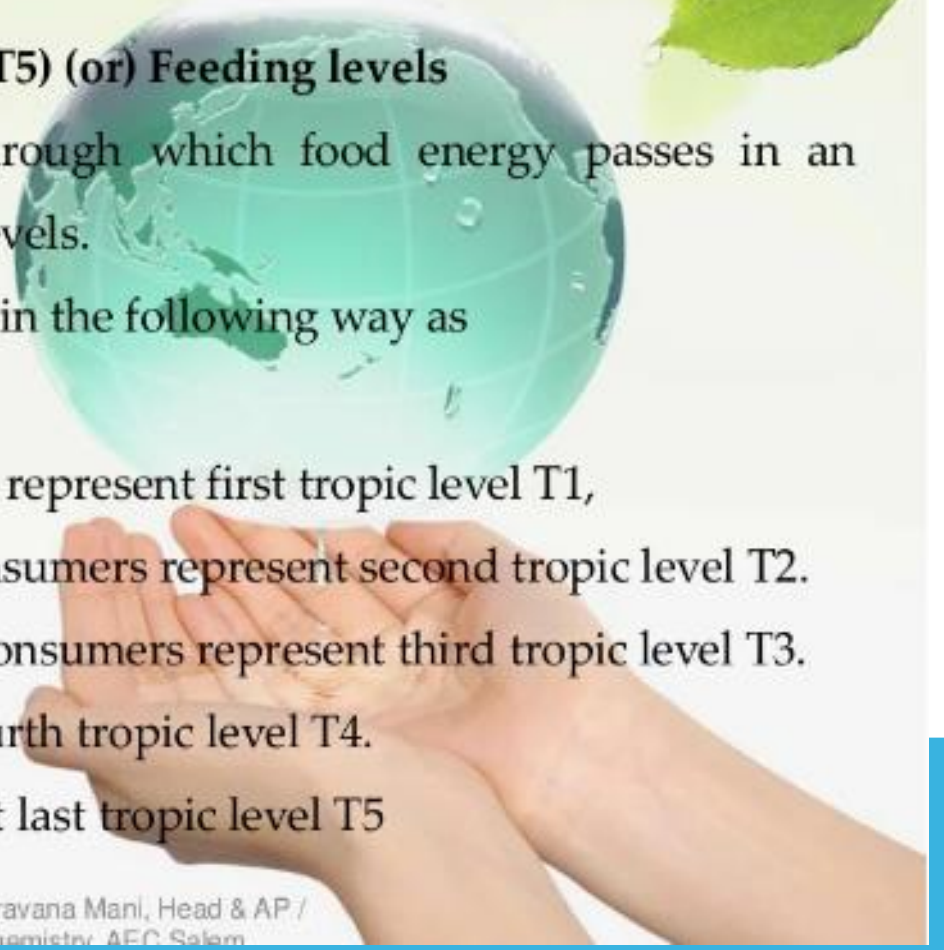
The green plants or producers represent first tropic level T1,

The herbivores or primary consumers represent second tropic level T2.

The carnivores or secondary consumers represent third tropic level T3.

The tertiary consumers are fourth tropic level T4.

Finally decomposers represent last tropic level T5



**Types of food chain**

Food chains are classified into two main types

1. Grazing food chain
2. Detritus food chain

**1.Grazing food chain**

Found in Grassland ecosystems and pond ecosystems. Grazing food chain starts with green plants (primary procedures) and goes to decomposer food chain or detritus food chain through herbivores and carnivores.

**2.Detritus food chain**

Found in Grassland ecosystems and forest ecosystems. Detritus food chain starts with dead organic matter (plants and animals) and goes to decomposer food chain through herbivores and carnivores.

## FOOD WEB

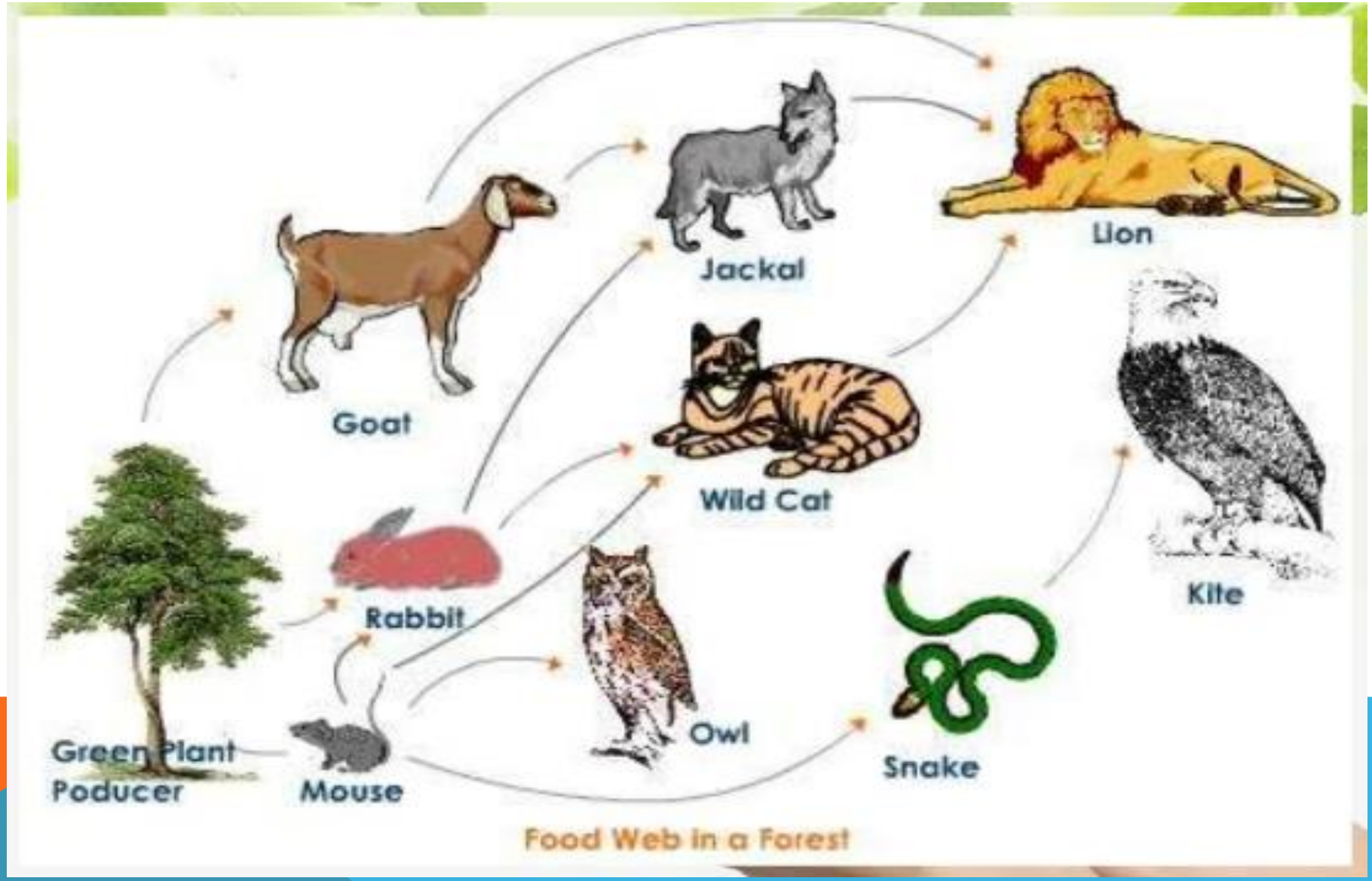
**Definition**

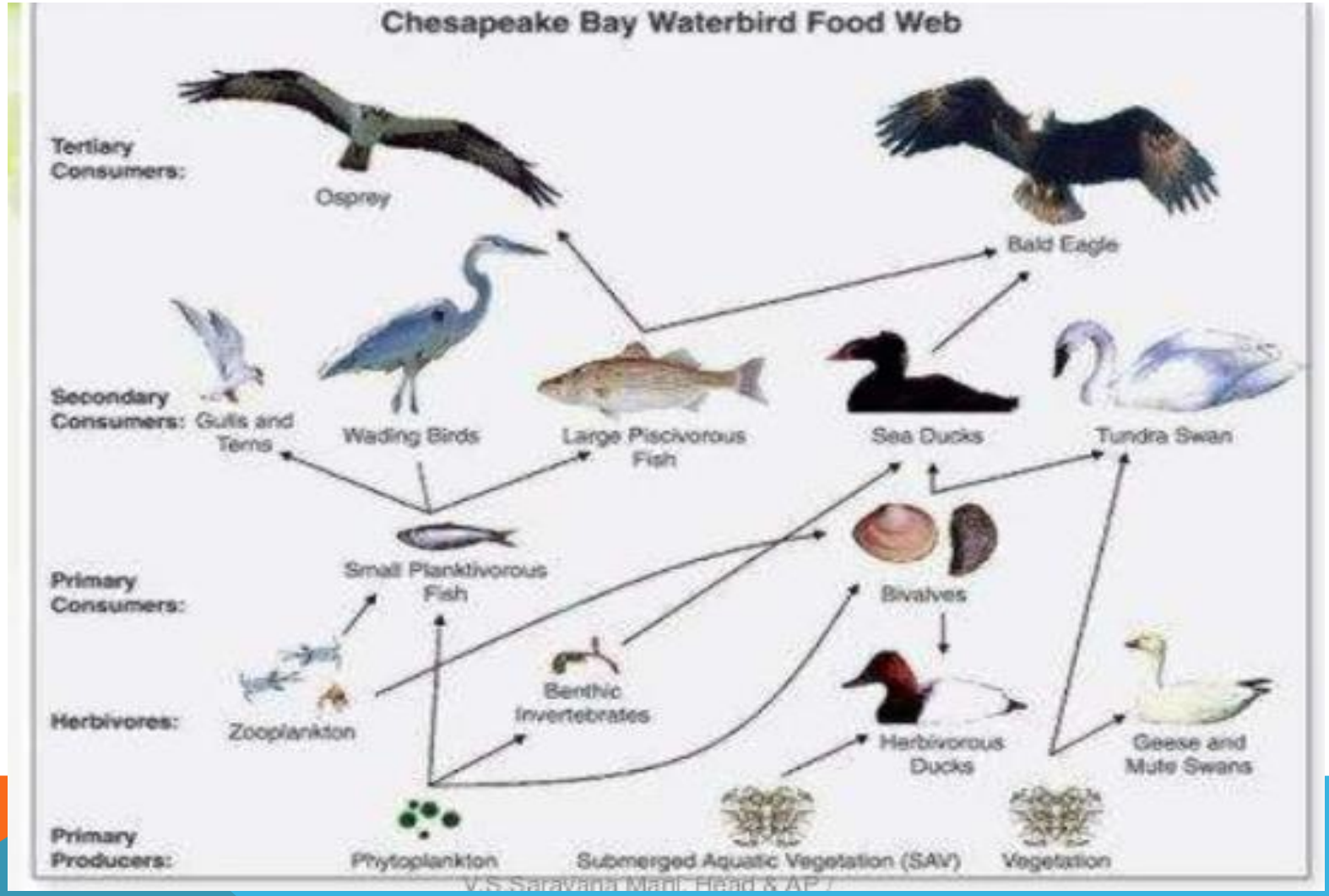
The interlocking pattern of various food chains in an ecosystem is known as food web. In a food web many food chains are interconnected, where different types of organisms are connected at different tropic levels, so that there is a number of opportunities of eating and being eaten at each tropic level

**Example**

Grass may be eaten by insects, rats, deer's, etc., these may be eaten by carnivores (snake, tiger).

Thus there is a interlocking of various food chains called food webs


Jackal
Lion
Goat
Wild Cat
Kite
Rabbit
Green Plant
Poducer
Mouse
Owl
Snake
Food Web in a Forest


Chesapeake Bay Waterbird Food Web
Tertiary Consumers:
Osprey
Bald Eagle
Secondary Consumers:
Gulls and Terns
Wading Birds
Large Piscivorous Fish
Sea Ducks
Tundra Swan
Primary Consumers:
Small Planktivorous Fish
Bivalves
Herbivores:
Zooplankton
Benthic Invertebrates
Herbivorous Ducks
Geese and Mute Swans
Primary Producers:
Phytoplankton
Submerged Aquatic Vegetation (SAV)
Vegetation

**Difference between food chains and food web**

In a linear food chains if one species gets affected (or) becomes extinct, then the species in the subsequent tropic levels are also affected. But, in a food web, if one species gets affected, it doest not affect other tropic levels so seriously.

There are number of options available at each tropic level.

**Significance of food chains and food webs**

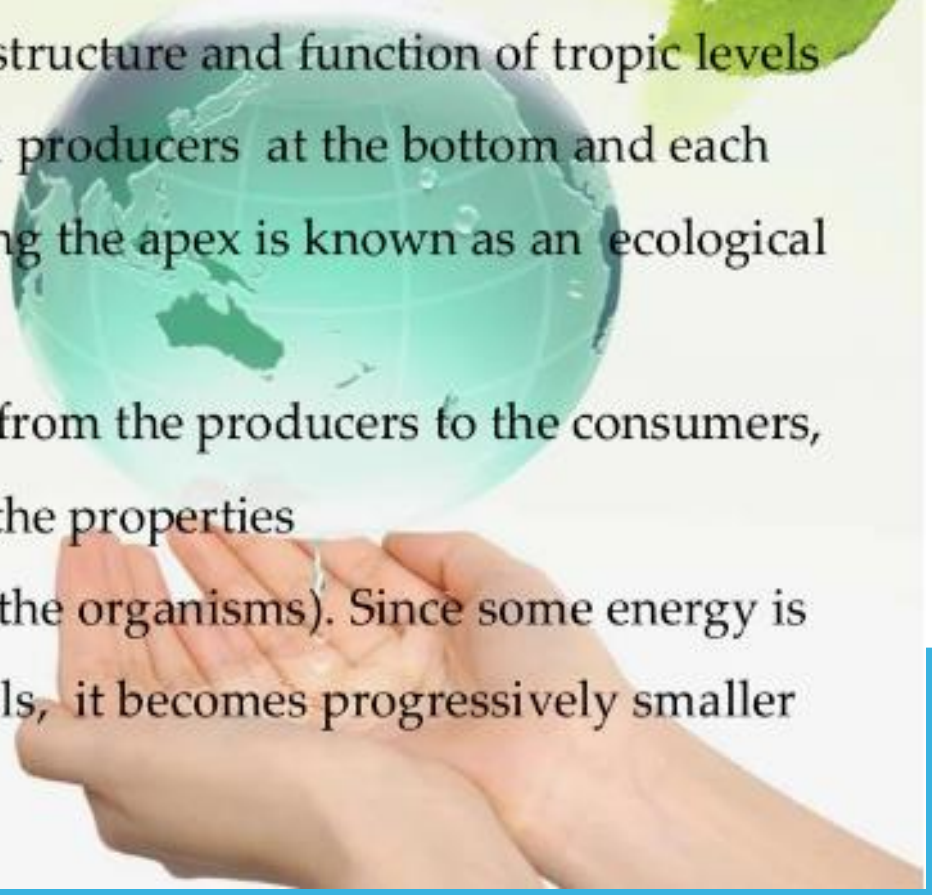
1. Food chains and food webs play a very important role in the ecosystem. Energy flow and nutrient
2. cycling takes place through them.
3. They maintain and regulate the population size of different tropic levels, and thus help in maintaining ecological balance.
4. They have the property of bio-magnification. The non – biodegradable materials keep on passing from one tropic level to another. At each successive tropic level, the concentration keep on increasing. This process is known as bio-magnification.

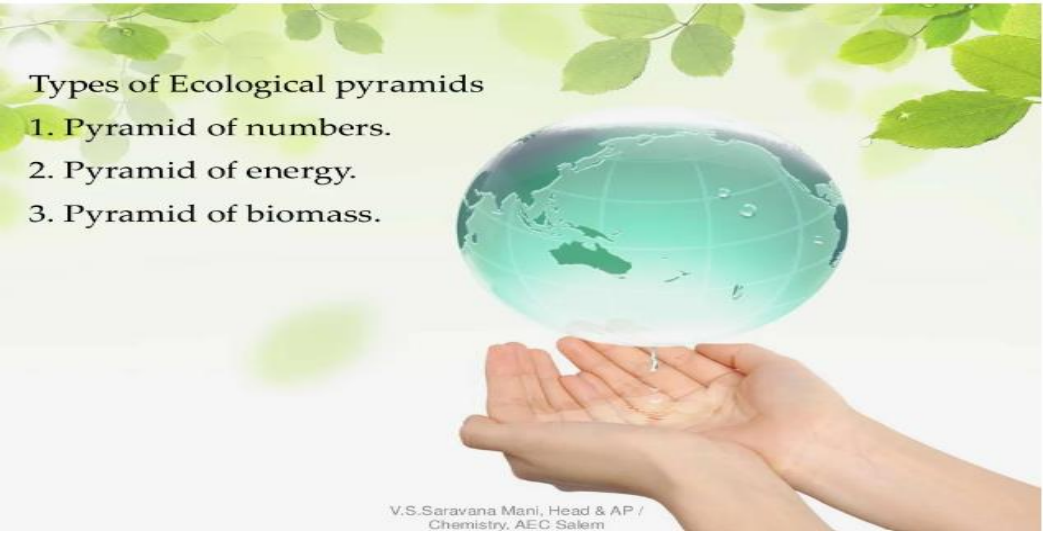
## ECOLOGICAL PYRAMIDS

**Definition**

"Graphical representation of structure and function of tropic levels of an ecosystem, starting with producers at the bottom and each successive tropic levels forming the apex is known as an ecological pyramids."

In food chain starting from the producers to the consumers, there is a regular decrease in the properties (ie.,, biomass and number of the organisms). Since some energy is lost as heat in each tropic levels, it becomes progressively smaller near the top.






## Pyramid of numbers:

Represents the number of individual organisms at each trophic level.

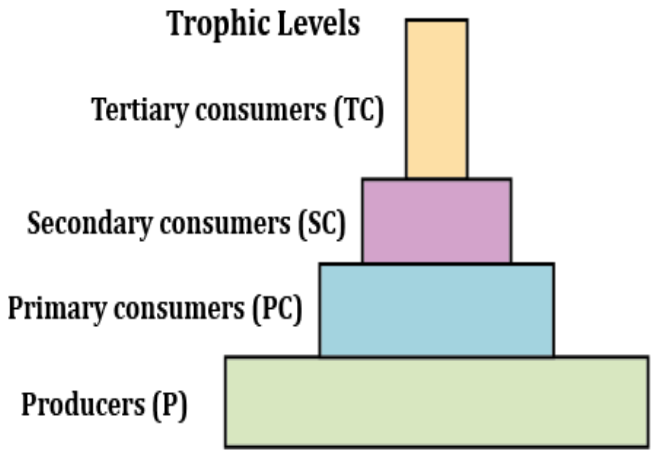



Fig : Pyramid of number in a grassland ecosystem

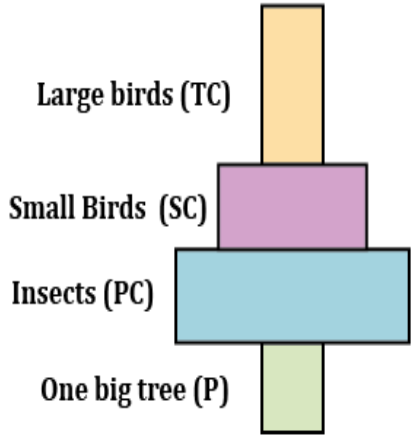
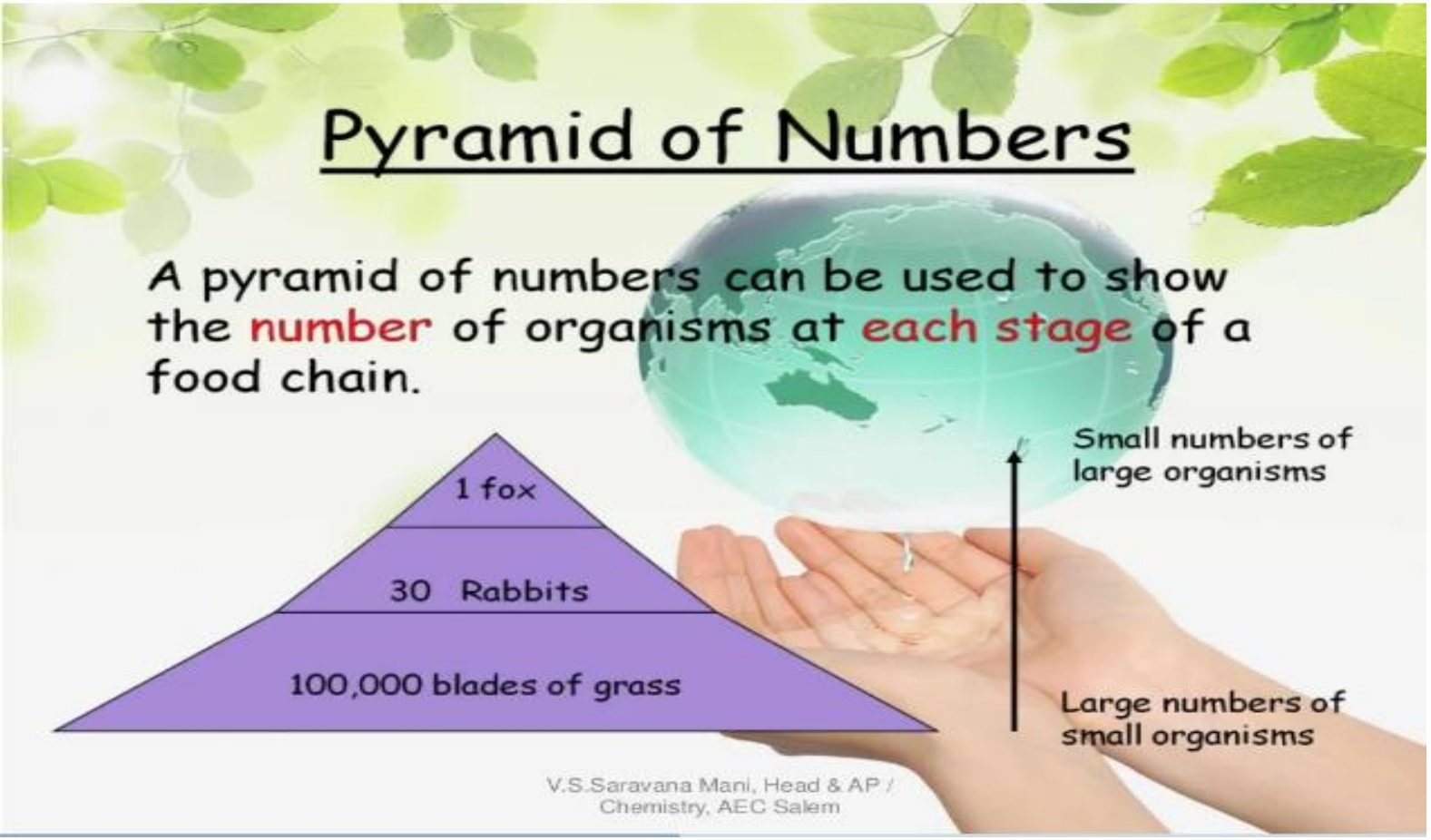
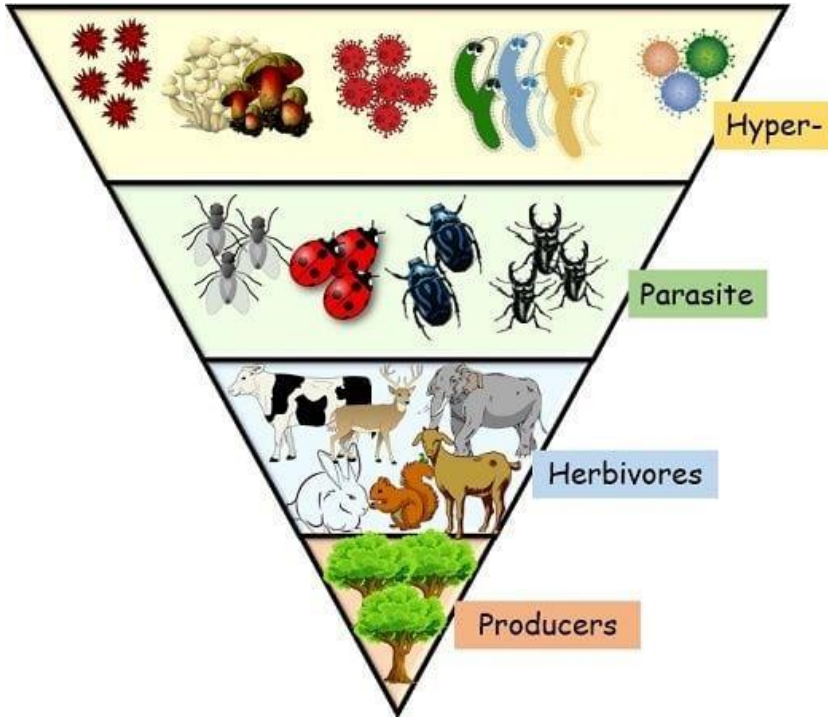
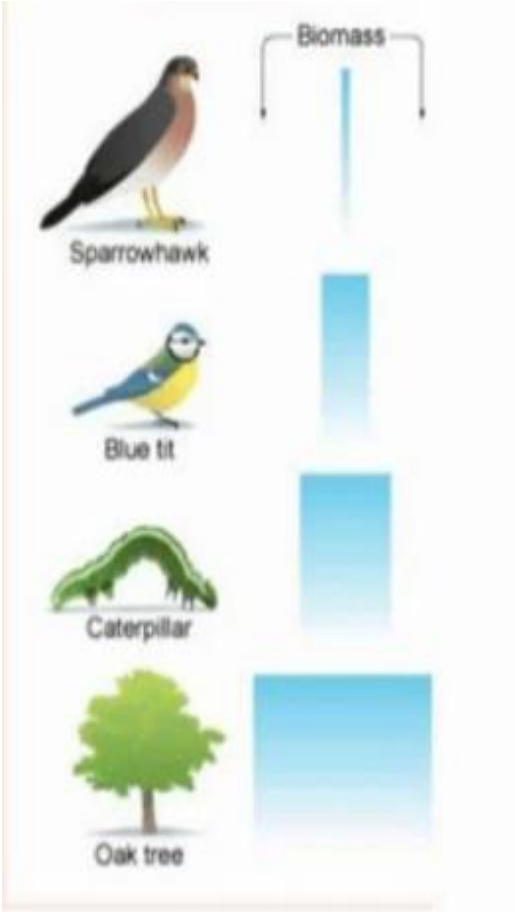



Fig : Pyramid of number on a tree ecosystem




Parasitic Food Chain – Inverted Pyramid




## Pyramids of Biomass

It represents the total amount of biomass (mass or weight biological material or organism) present in each tropic levels.

A forest ecosystem

The above figure shows that there is a decrease in the biomass from the lower tropic level to the higher tropic level. This because the trees (producers) are maximum in the forest, which contribute a huge biomass. The next tropic levels are herbivores (insects, birds) and carnivores (snakes, foxes). top of the tropic level contains few tertiary

consumers S and tigers), the biomass of which is very low.

# Pyramid of Biomass

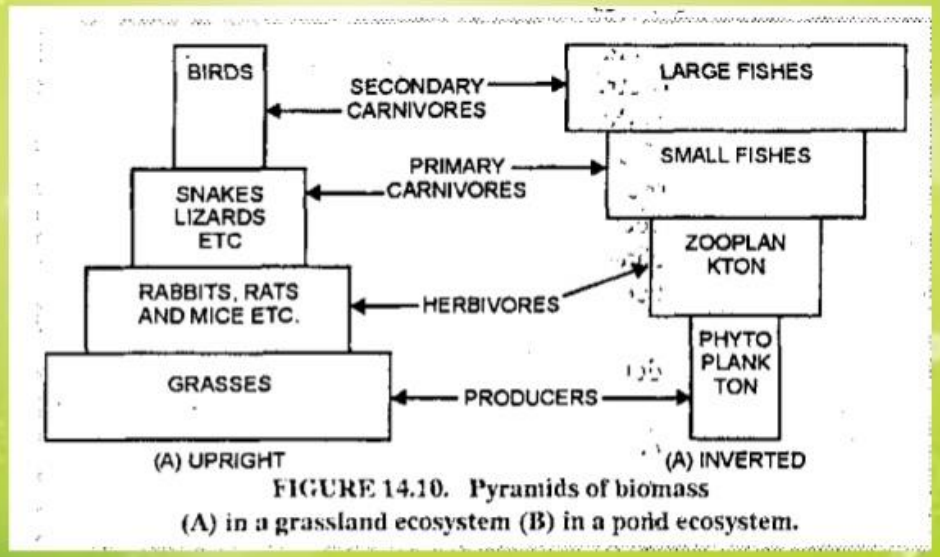
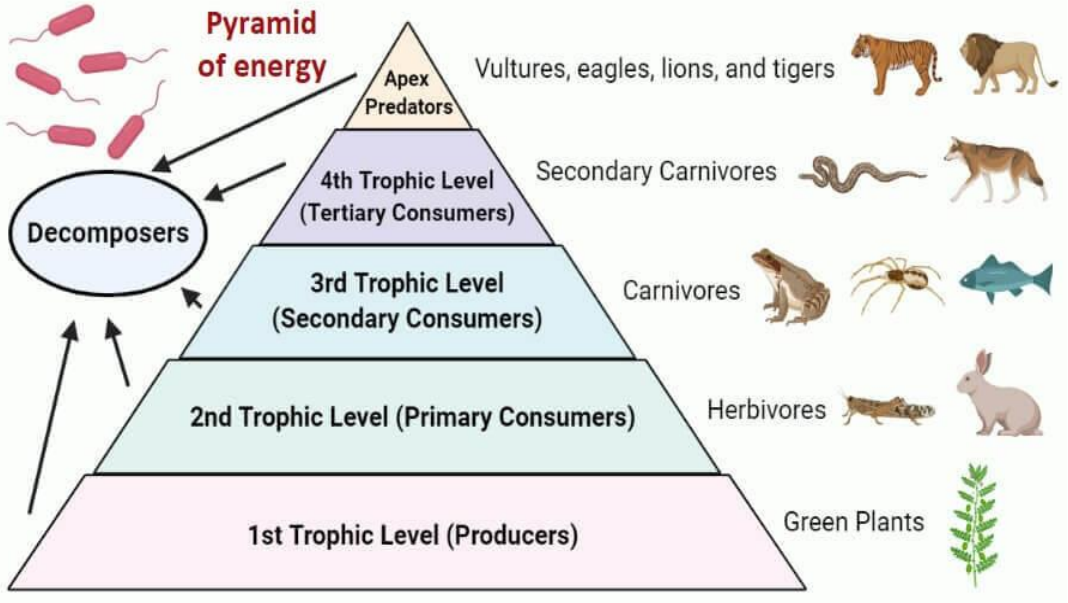
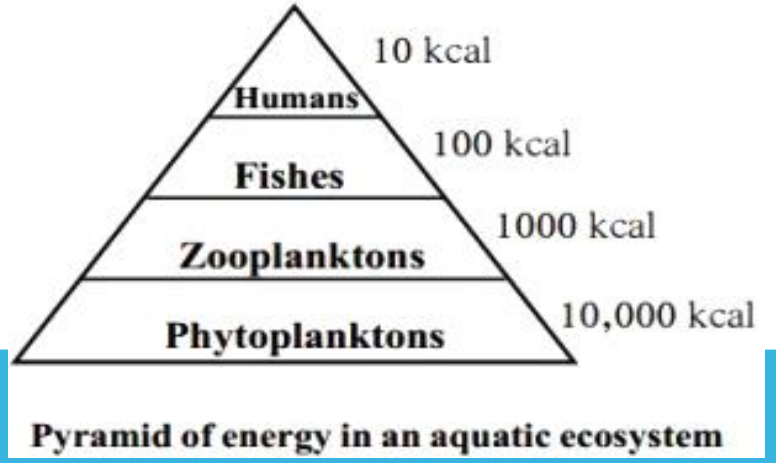



FIGURE 14.10. Pyramids of biomass
(A) in a grassland ecosystem (B) in a pond ecosystem.



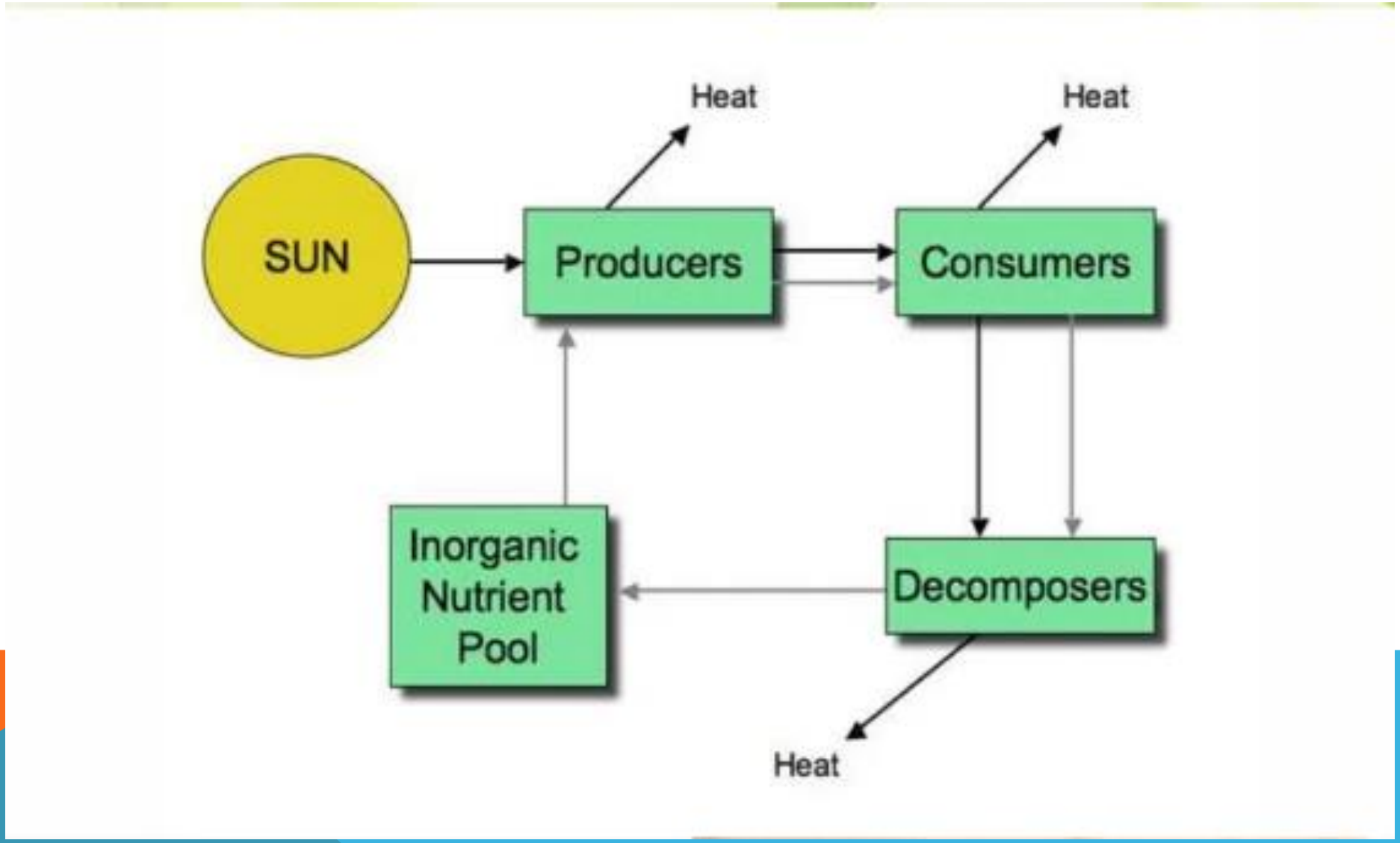

Pyramid of energy in an aquatic ecosystem

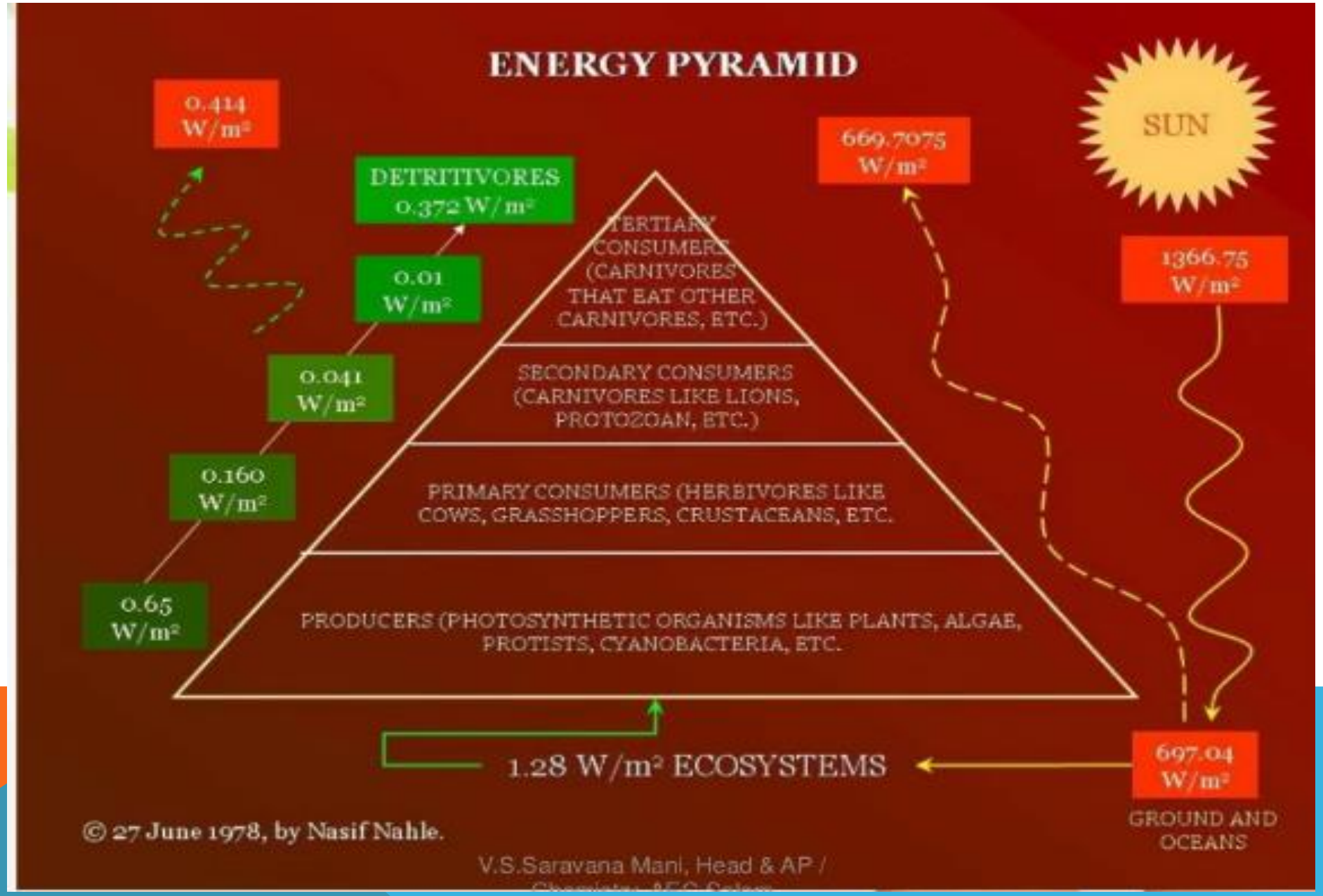
## ENERGY FLOW IN THE ECOSYSTEMS

Energy is the most essential requirement for all living organism. Solar energy is the only source to our planet earth. Solar energy is transformed to chemical energy in photosynthesis by the plants (called as primary producers). Though a lot of sunlight falls on the green plants, only 1% of it is utilized for photosynthesis. This is the most essential step to provide energy for all other living organisms in the ecosystem.

Some amount of chemical energy is used by the plants for their growth and the remaining is transferred to consumers by the process of eating.

Thus the energy enters the ecosystems through photosynthesis and passes through the different tropic levels feeding levels.


Heat
Heat
SUN
Producers
Consumers
Inorganic
Nutrient
Pool
Decomposers
Heat


ENERGY PYRAMID
0.414 W/m²
DETRITIVORES 0.372 W/m²
0.01 W/m²
0.041 W/m²
0.160 W/m²
0.65 W/m²
669.7075 W/m²
SUN
1366.75 W/m²
TERTIARY CONSUMERS (CARNIVORES THAT EAT OTHER CARNIVORES, ETC.)
SECONDARY CONSUMERS (CARNIVORES LIKE LIONS, PROTOZOAN, ETC.)
PRIMARY CONSUMERS (HERBIVORES LIKE COWS, GRASSHOPPERS, CRUSTACEANS, ETC.
PRODUCERS (PHOTOSYNTHETIC ORGANISMS LIKE PLANTS, ALGAE, PROTISTS, CYANOBACTERIA, ETC.
1.28 W/m² ECOSYSTEMS
697.04 W/m²
GROUND AND OCEANS
© 27 June 1978, by Nasif Nahle.
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