ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY

Environmental science

Environmental= Living + Non-living things.

- Study of the environment (Biotic and Abiotic components)

TYPES OF ENVIRONMENT

- Natural environment
  - Soil, water, air, trees, noise, etc.,
- Man-made environment
  - House, road, park, etc.,

SCOPE & IMPORTANCE OF ENVIRONMENT

An Environment is everything that is around us, which includes both living and nonliving things such as soil, water, animals and plants, which adapt themselves to their surroundings. It is nature's gift that helps in nourishing life on Earth.

The environment plays an important role in the existence of life on the planet earth. The word Environment is derived from the French word "Environ" which means "surrounding." An ecosystem refers to all the living and non-living things present in the environment and it is a foundation of the Biosphere, which determines the health of the entire planet earth.

Ecology and Environmental science are the branches of life science, which mainly deal with the study of organisms and their interactions with other organisms and their environment.

Environment plays an important role in healthy living and the existence of life on planet earth. Earth is a home for different living species and we all are dependent on the environment for food, air, water, and other needs. Our forests, rivers, oceans and soils provide us with the food we eat, the air we breathe, the water we irrigate our crops with. We also rely on them for numerous other goods and services we depend on for our health, happiness and prosperity. These natural assets are often called the world's 'natural capital'. Therefore, it is important for every individual to save and protect our environment.

Components of environment

- Abiotic or non-living components
- Biotic or living components
- Energy components

ABIOTIC COMPONENTS

- Atmosphere
- Lithosphere
- Hydrosphere

Functions of atmosphere

- It sustains life on the earth.
- It observes the cosmic rays and other electro magnetic radiation coming from the sun.
- It balances heat of earth by absorption of IR and UV rays.
- It plays important role in carrying water from the ocean to the land through hydrological cycle.
- Oxygen supports living beings, CO_2 is essential for photosynthesis of plants.

Structure of atmosphere

- Troposphere (0 – 18kms)
- Stratosphere (18 – 50kms)
- Mesosphere (50 – 85kms)
- Thermosphere (or) ionosphere (85 – 500kms)
- Exosphere (upto 1600kms)

Energy components

- Energy flow across biotic and abiotic components.

E.g:

- solar energy,
- nuclear energy,
- geochemical energy,
- thermo electrical energy, etc.,

Scope of environmental studies

- To get awareness and sensitivity to the total environment.
- To motivate the active participation in environmental protection and improvement.
- To know the necessity of conservation of natural resources .
- To evaluate environmental programmes in terms of social, economic, ecological and aesthetic factors.

Need for public awareness

- Man has overexploited the natural resource which leads to many environmental problems such as acid rain, ozone layer depletion, green house effect, landslides, cancer, and other health problems.
- Lack of awareness and less number of people participation leads to poor pollution management which leads to climate instability and unhealthy eco-system

ECO-SYSTEM
Siesta Lake, Yosemite National Park, California

ECOSYSTEM

- An ecosystem is formed by the interaction between all living and non-living things.

BIOME

- Set of ecosystem which are exposed to same climatic conditions with similar life cycle, climatic conditions and physical structure.

❖ Biome (**small ecosystem**).

ABIOTIC COMPONENTS

- Solar energy provides practically all the energy for ecosystems.
- Inorganic substances, e.g., sulfur, boron, tend to cycle through ecosystems.
- Organic compounds, such as proteins, carbohydrates, lipids, and other complex molecules, form a link between biotic and abiotic components of the system.

BIOTIC COMPONENTS

living organisms of an ecosystem.

Classification of Biotic components are:

AUTOTROPHS

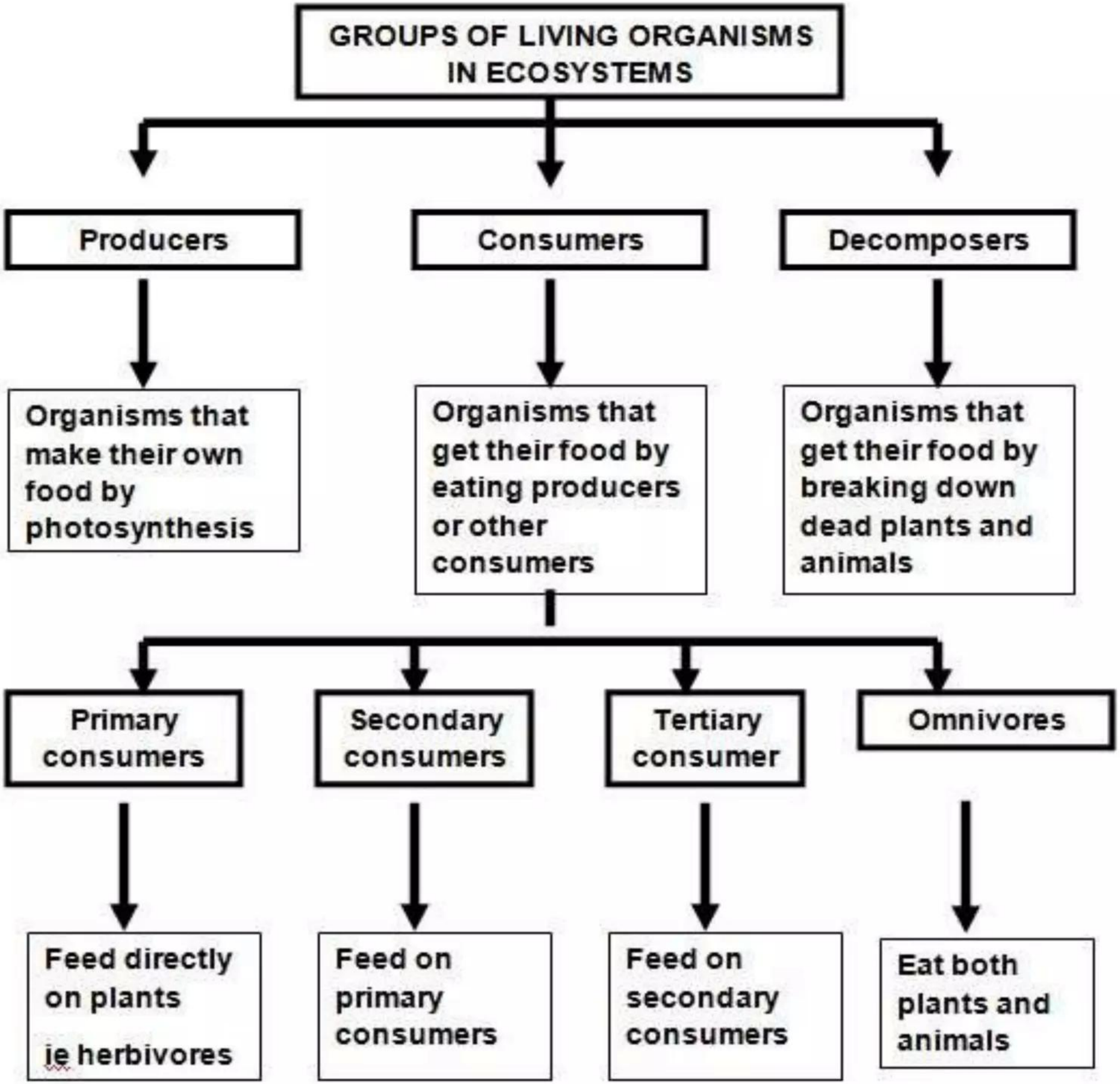
Organisms that produce their own food from an energy source, such as the sun, and inorganic compounds.

HETEROTROPHS

Organisms that consume other organisms as a food source.

MEMBERS OF BIOTIC COMPONENTS

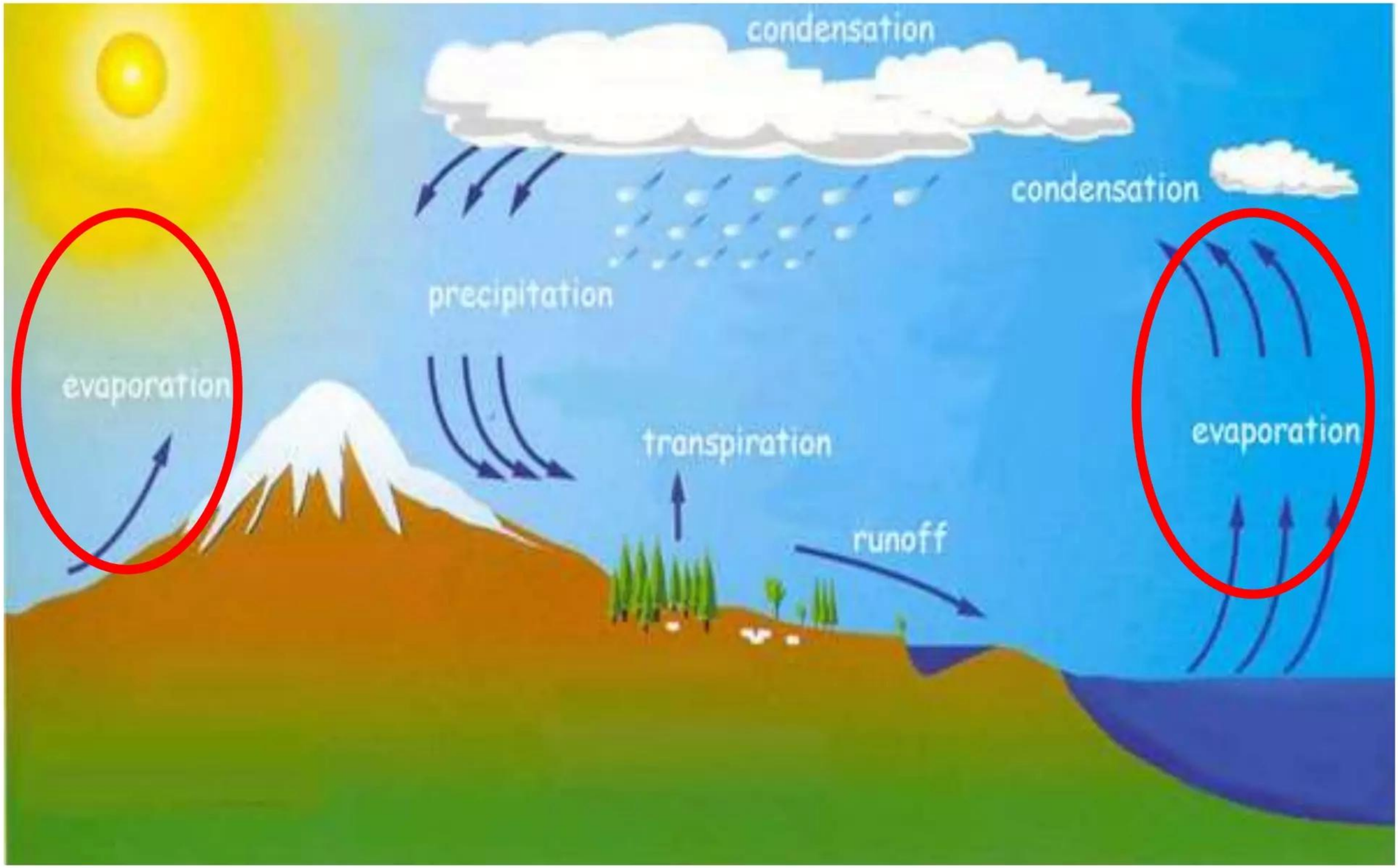
- PRODUCERS.
- CONSUMERS.
  - Primary Consumers
  - Secondary Consumers
  - Tertiary Consumers
- DECOMPOSERS.


GROUPS OF LIVING ORGANISMS IN ECOSYSTEMS
Producers
Consumers
Decomposers
Organisms that make their own food by photosynthesis
Organisms that get their food by eating producers or other consumers
Organisms that get their food by breaking down dead plants and animals
Primary consumers
Secondary consumers
Tertiary consumer
Omnivores
Feed directly on plants
ie herbivores
Feed on primary consumers
Feed on secondary consumers
Eat both plants and animals

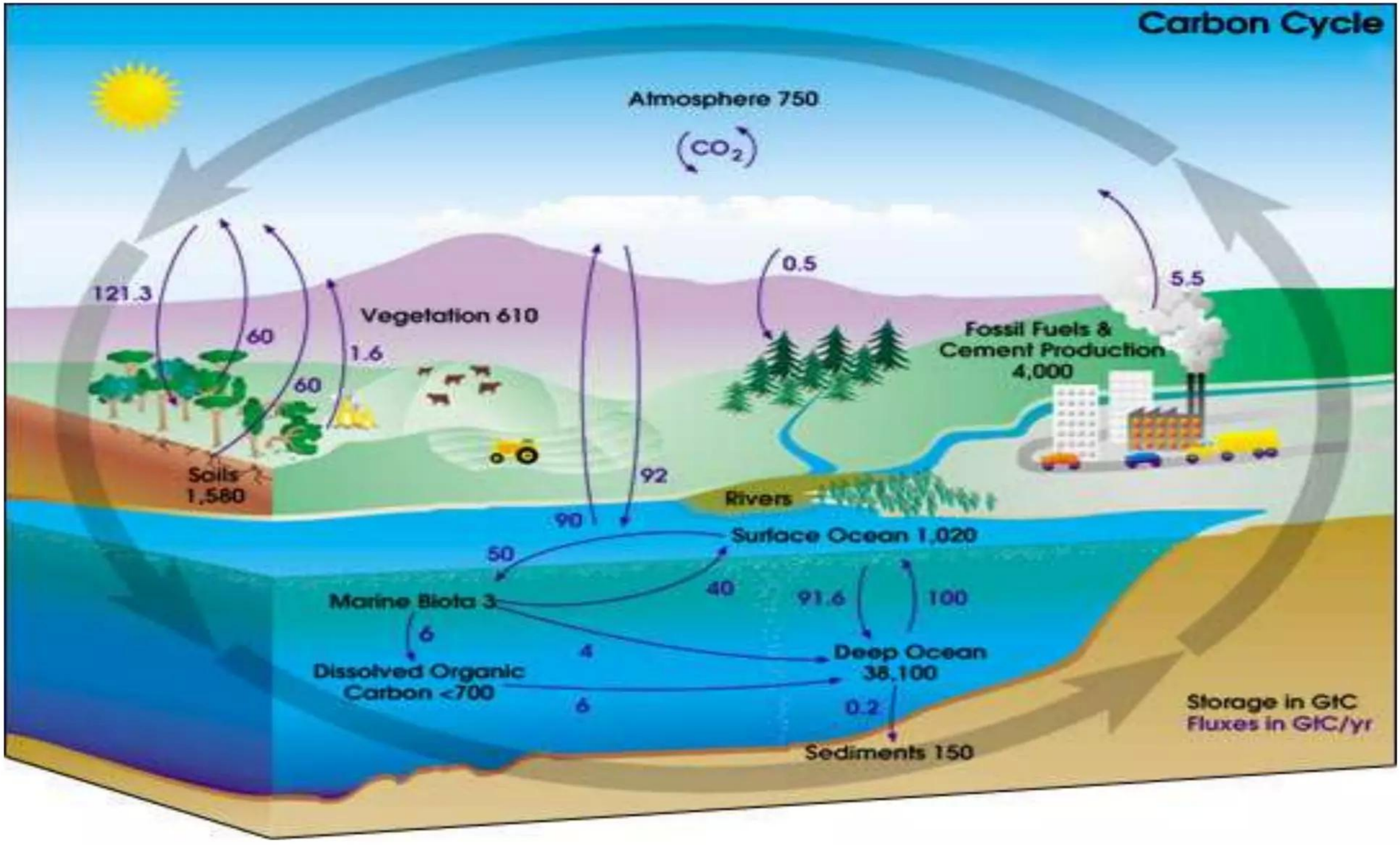
ENERGY FLOW IN ECOSYSTEM

- Energy is defined as the capacity to do work. For living organisms, it is the basic force responsible for running all the metabolic activities. The flow of energy from producer level to top consumer level is called energy flow.
- The flow of energy in an ecosystem is unidirectional. It flows from producer level to consumer level.
- The process of energy flow involves transfer of energy from autotrophs to various components of heterotrophs and help in maintaining bio diversity.
- The main source of energy in the ecosystem is sunlight. About 80% of energy is lost during flow of energy from one tropic level to the next one.

The Water Cycle

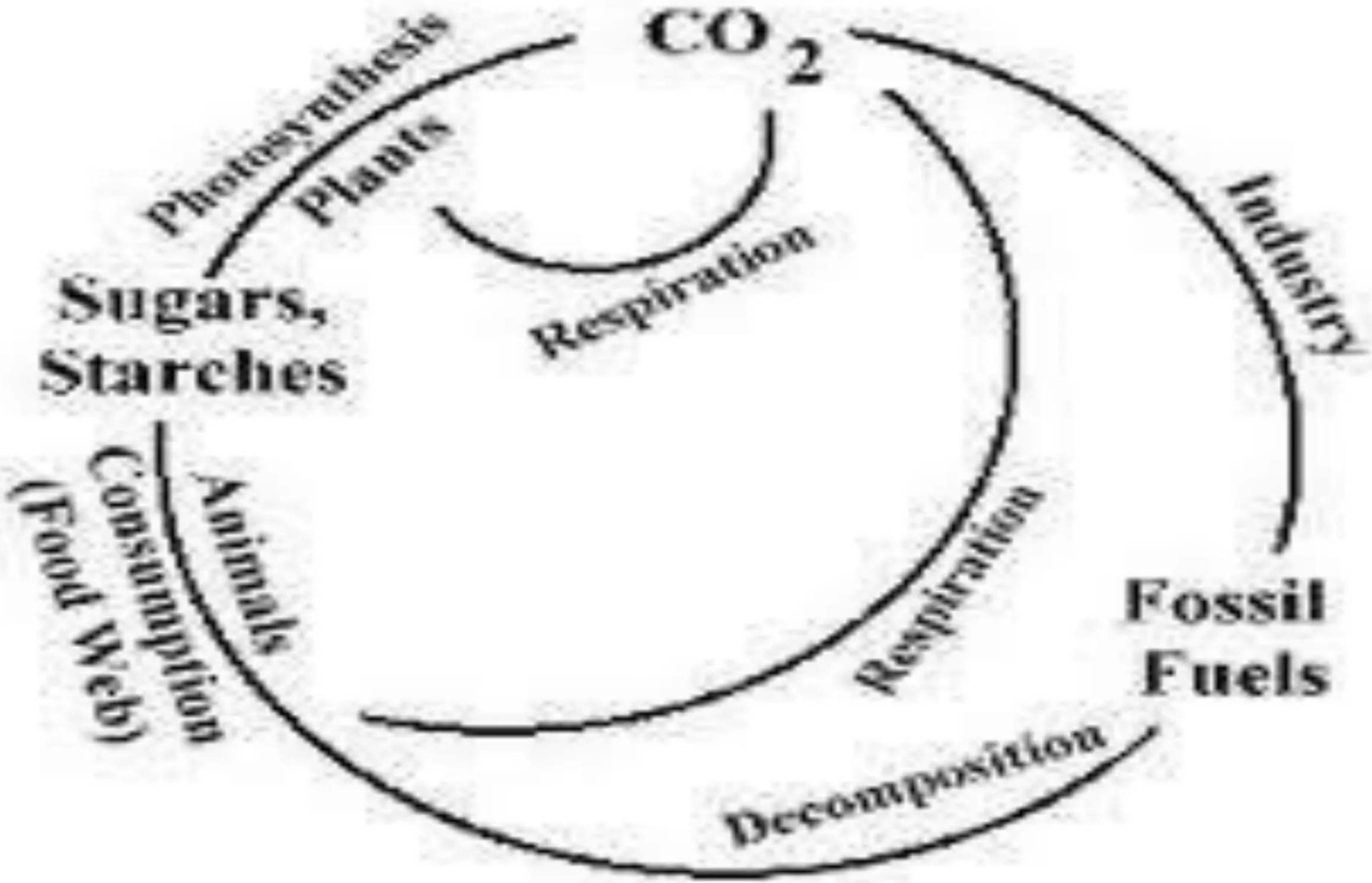


Global Carbon Cycle

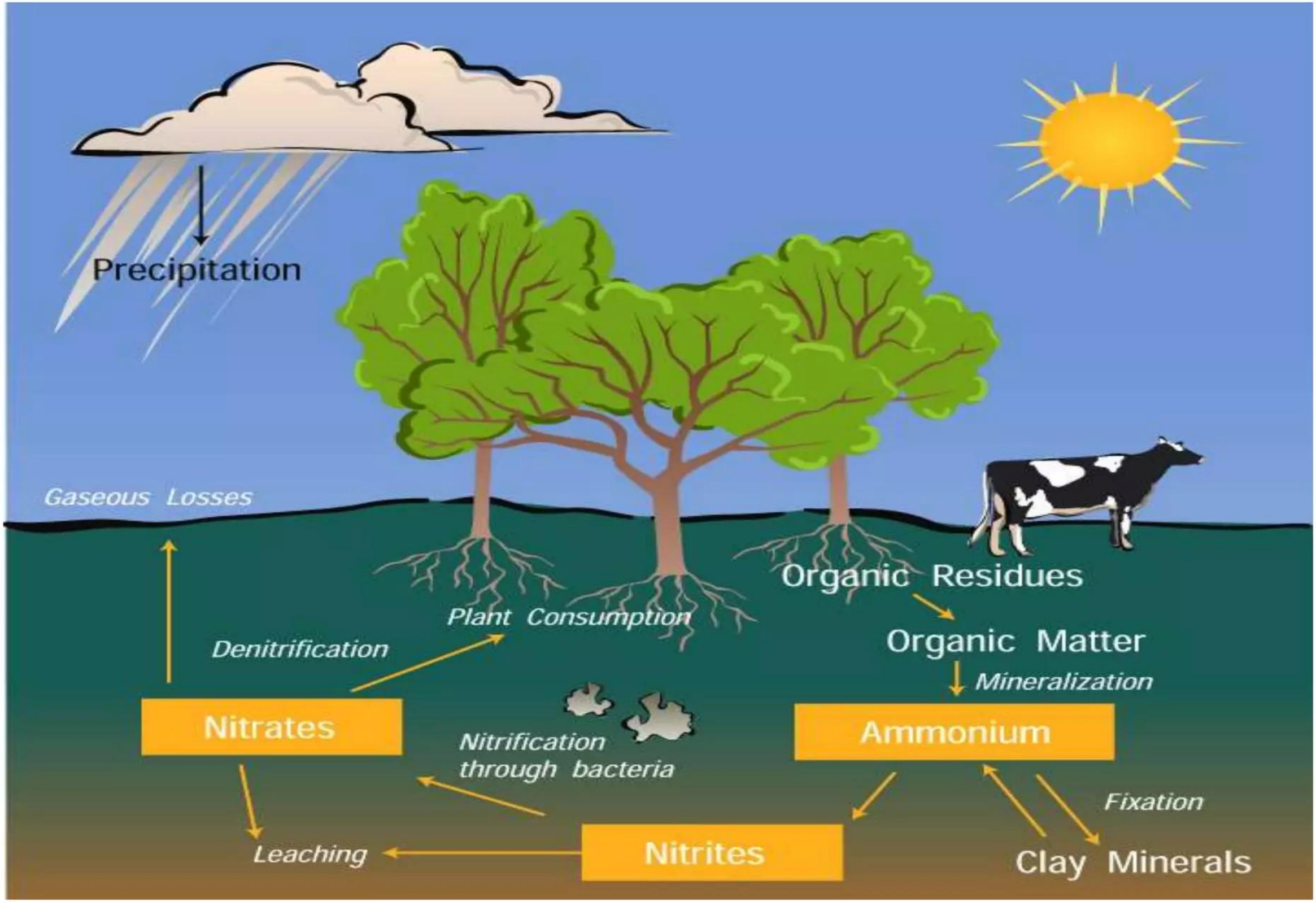


Carbon is exchanged between the active pools due to various processes – photosynthesis and respiration between the land and the atmosphere, and diffusion between the ocean and the atmosphere.

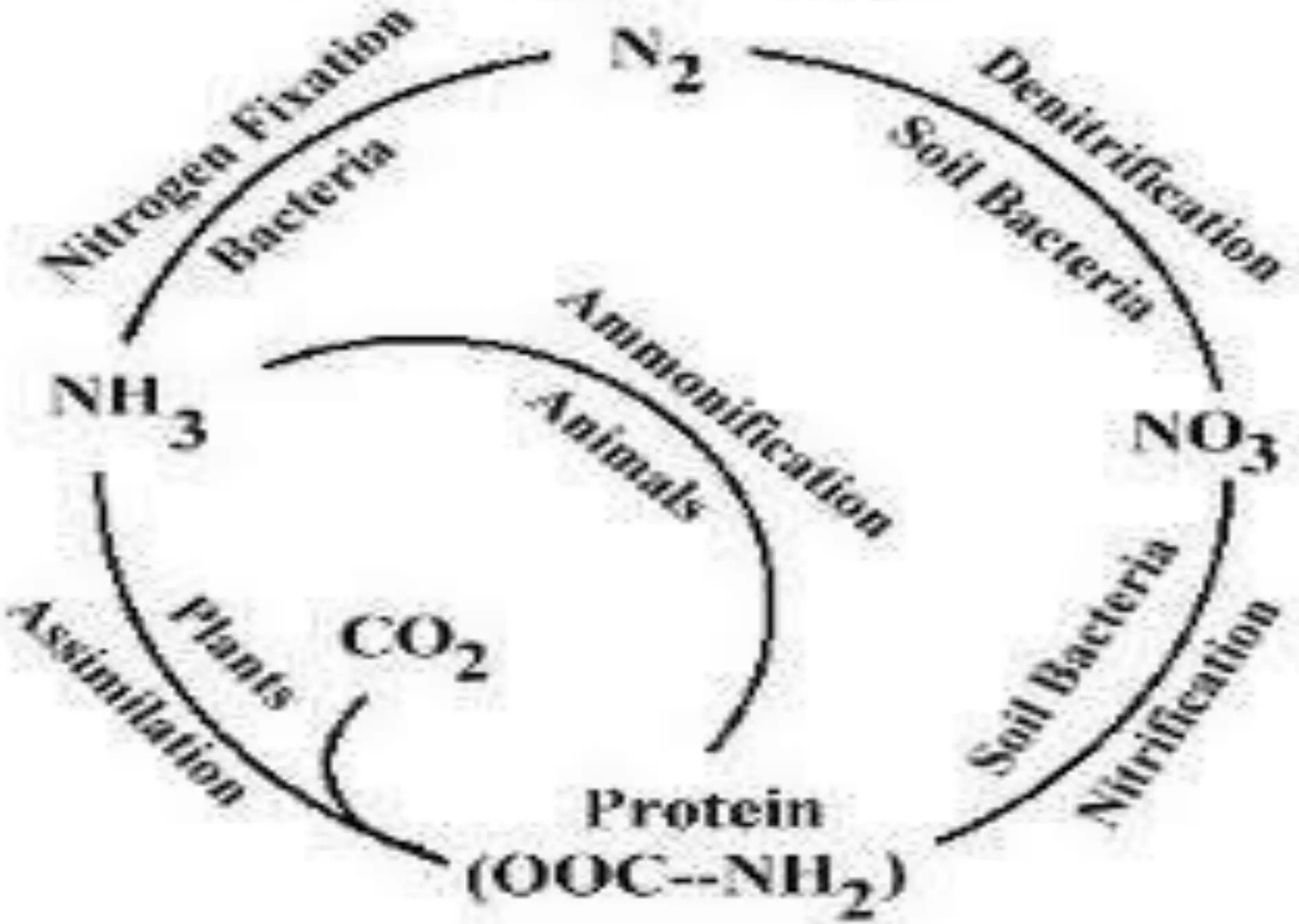
Carbon Cycle

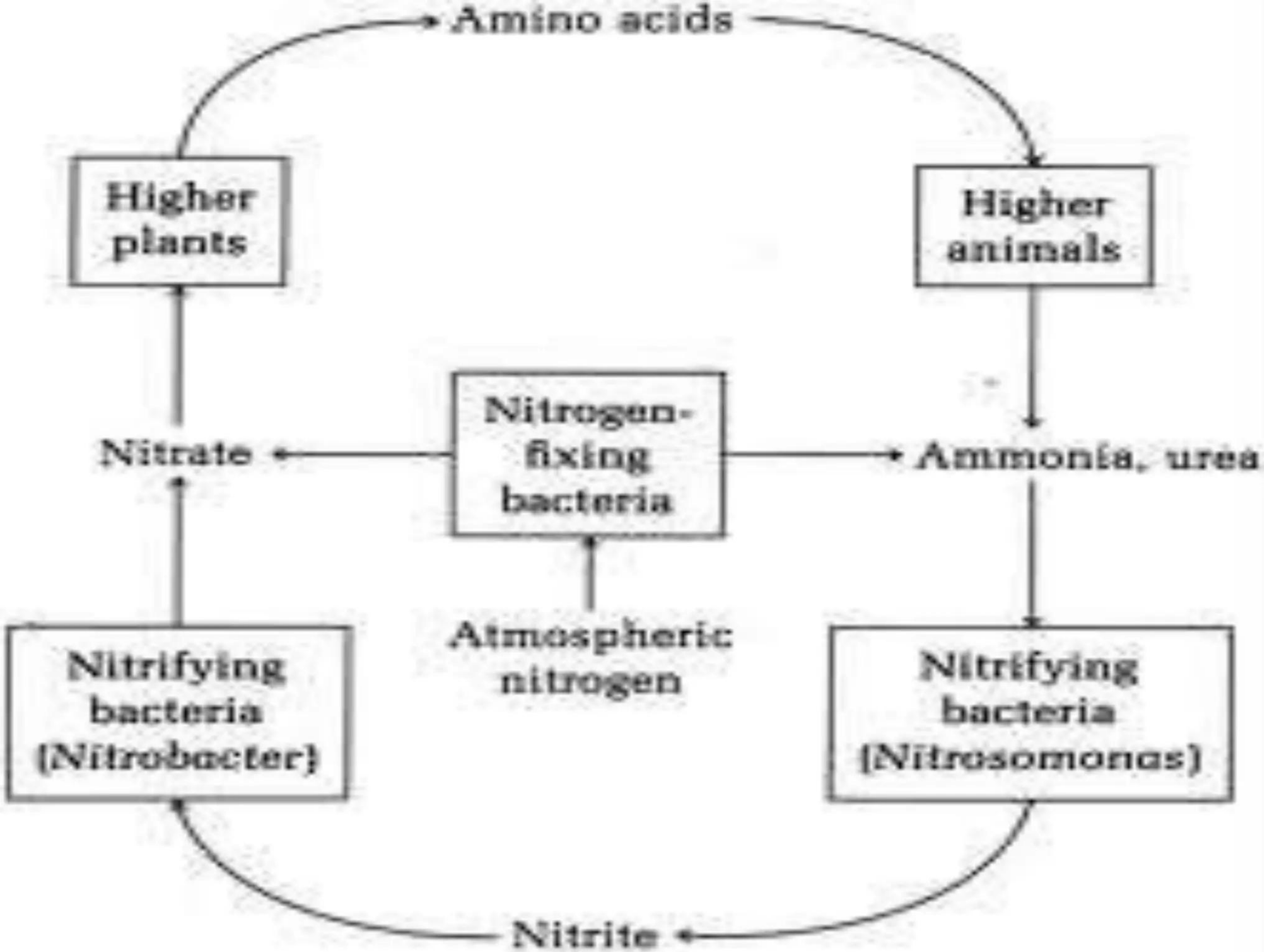


The N cycle over land



Nitrogen Cycle




Amino acids
Higher plants
Higher animals
Nitrogen-fixing bacteria
Nitrate
Ammonia, urea
Atmospheric nitrogen
Nitrifying bacteria (Nitrobacter)
Nitrifying bacteria (Nitrosomonas)
Nitrite

The P cycle

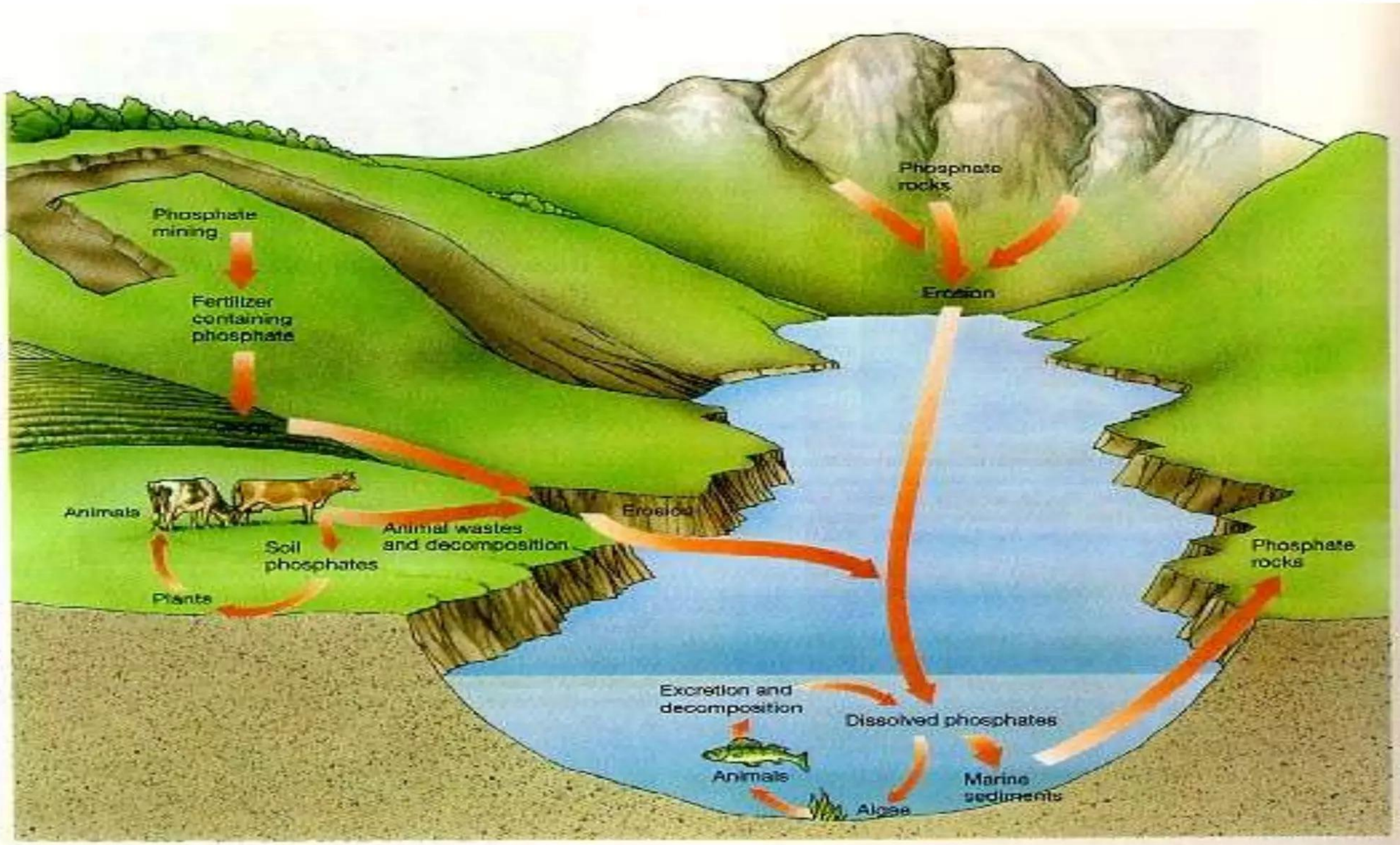
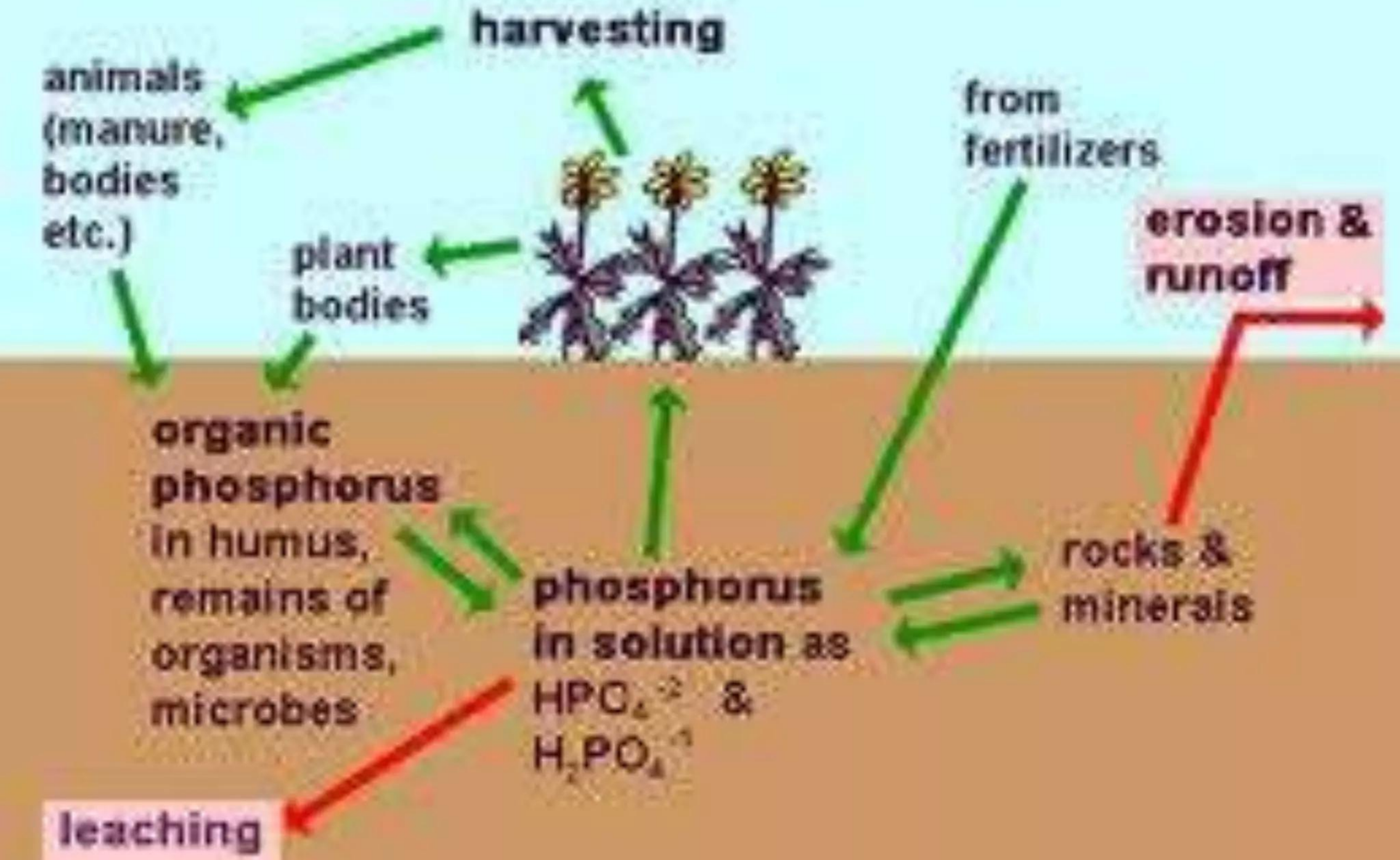
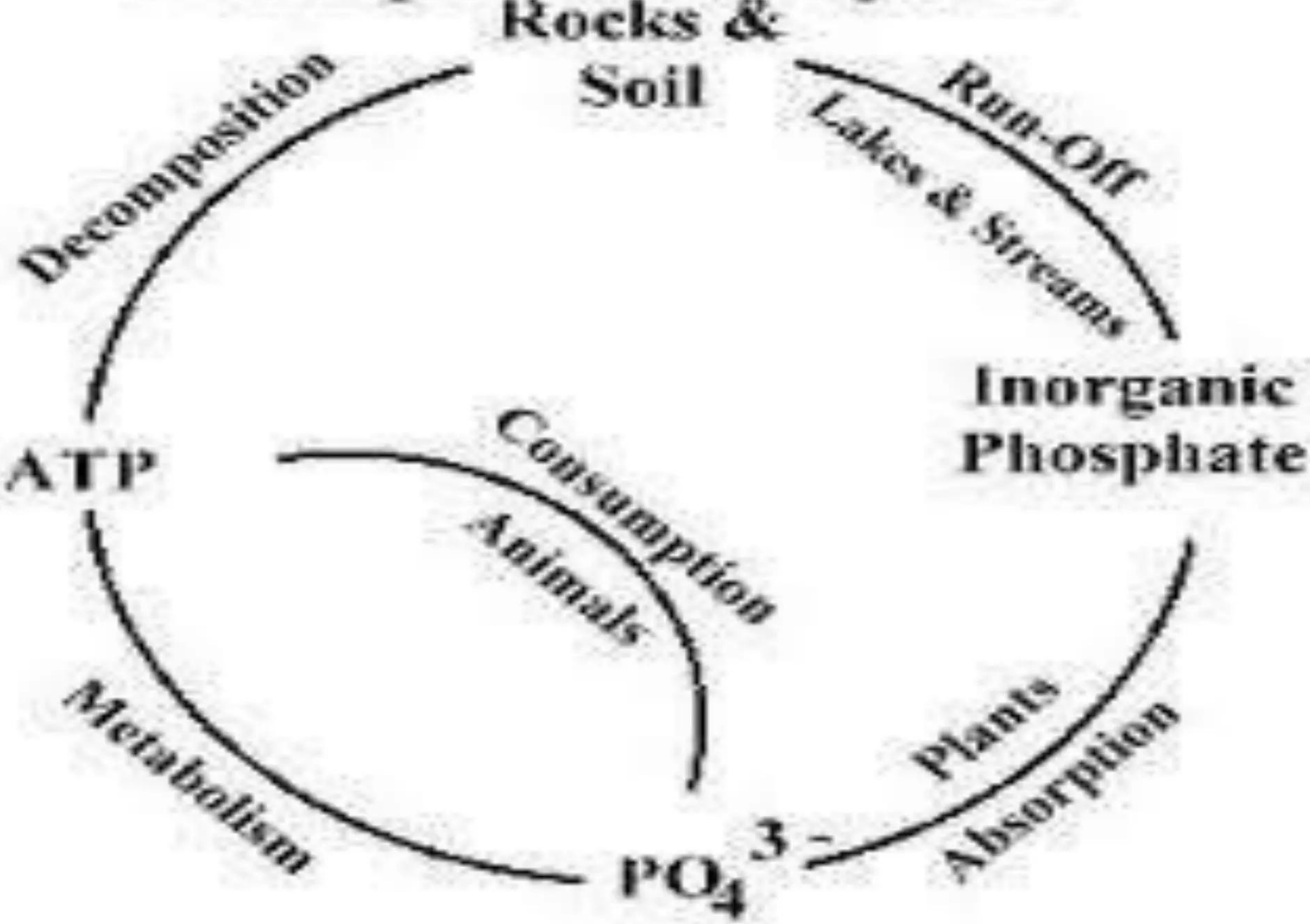


Figure 54–5 The phosphorus cycle in terrestrial and aquatic environments. Recycling of phosphorus (as phosphate, PO_4^{3-}) is slow because no biologically important form of phosphorus is gaseous. Phosphate that becomes part of marine sediments may take millions of years to solidify into rock, uplift as mountains, and erode again to become available to living things.

The Phosphorus Cycle



Phosphorus Cycle



Tropic Levels

A tropic level is the position occupied by an organism in a food chain. Tropic levels can be analyzed on an energy pyramid.

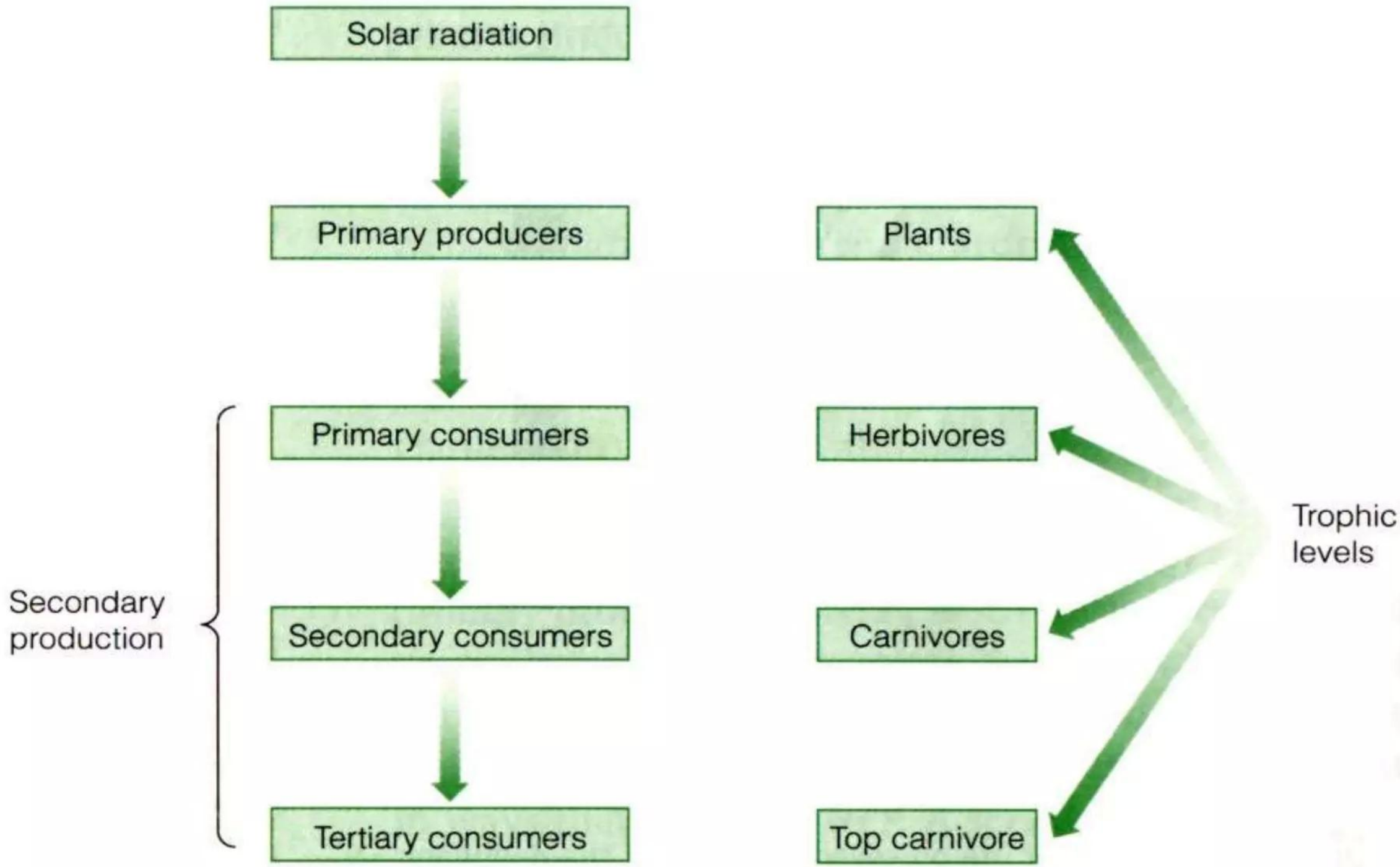
- **Producers - First tropic level.**
- **Primary consumers - Second tropic level.**
- **Secondary consumers - Third tropic level.**
- **Tertiary consumers - Top tropic level.**

Tertiary Consumer
(Carnivore)

Secondary Consumers
(Carnivores or Omnivores)

Primary Consumers
(Herbivores)

Producers
(Autotrophs)



The schematic structure of a food chain. Each trophic level may contain many species.

ECOLOGICAL SUCCESSION

In a particular area, one community of species may be replaced by another community; the progressive replacement of one community by another till the development of stable community in a particular area is called as ecological succession.

TYPES OF SUCCESSION

1. Primary succession.

If an area in any of the basic environments (such as terrestrial, fresh-water or marine) is colonized by organisms for the first time, the succession is called primary succession.

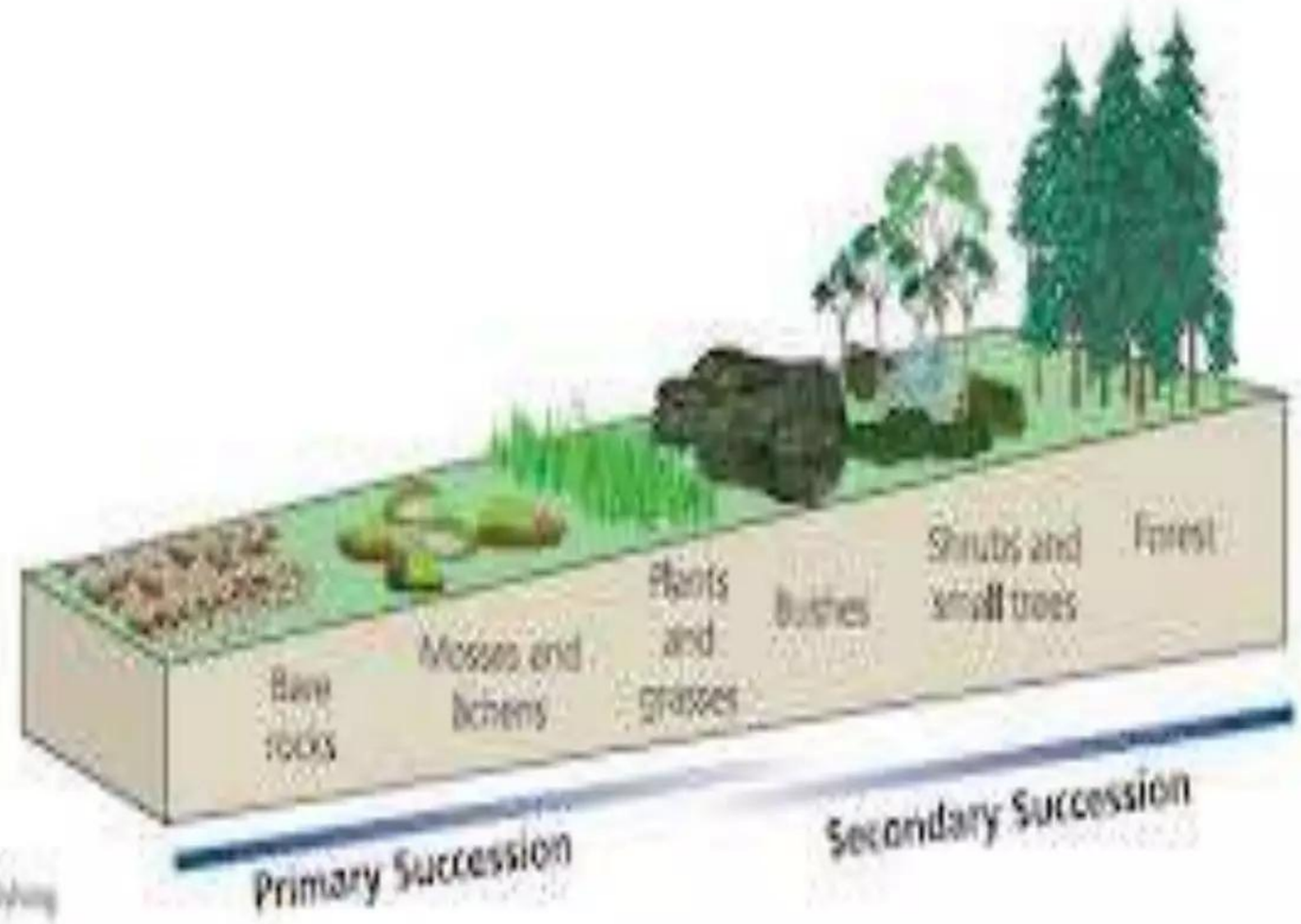
2. Secondary succession.

If the area under colonization has been cleared by whatsoever agency (such as burning, grazing, clearing, felling of trees, sudden change in climatic factors, etc.) of the previous plants, it is called secondary succession.

3. Autogenic succession.

After the succession has begun, in most of the cases, it is the community itself (as a result of its reactions with the environment) modifies its own environment and, thus, causing its own replacement by new communities. This course of succession is known as autogenic succession.

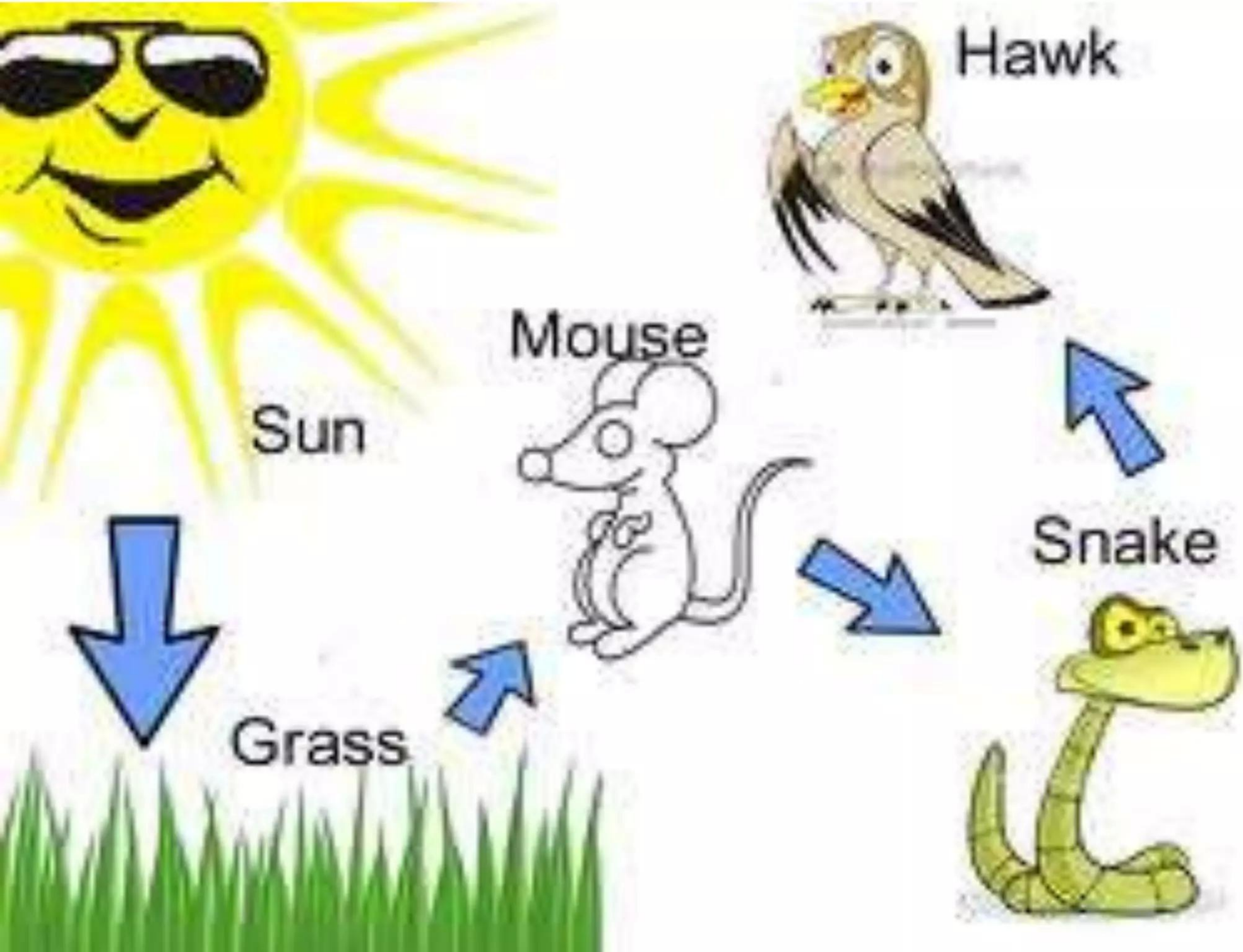
Ecological Succession

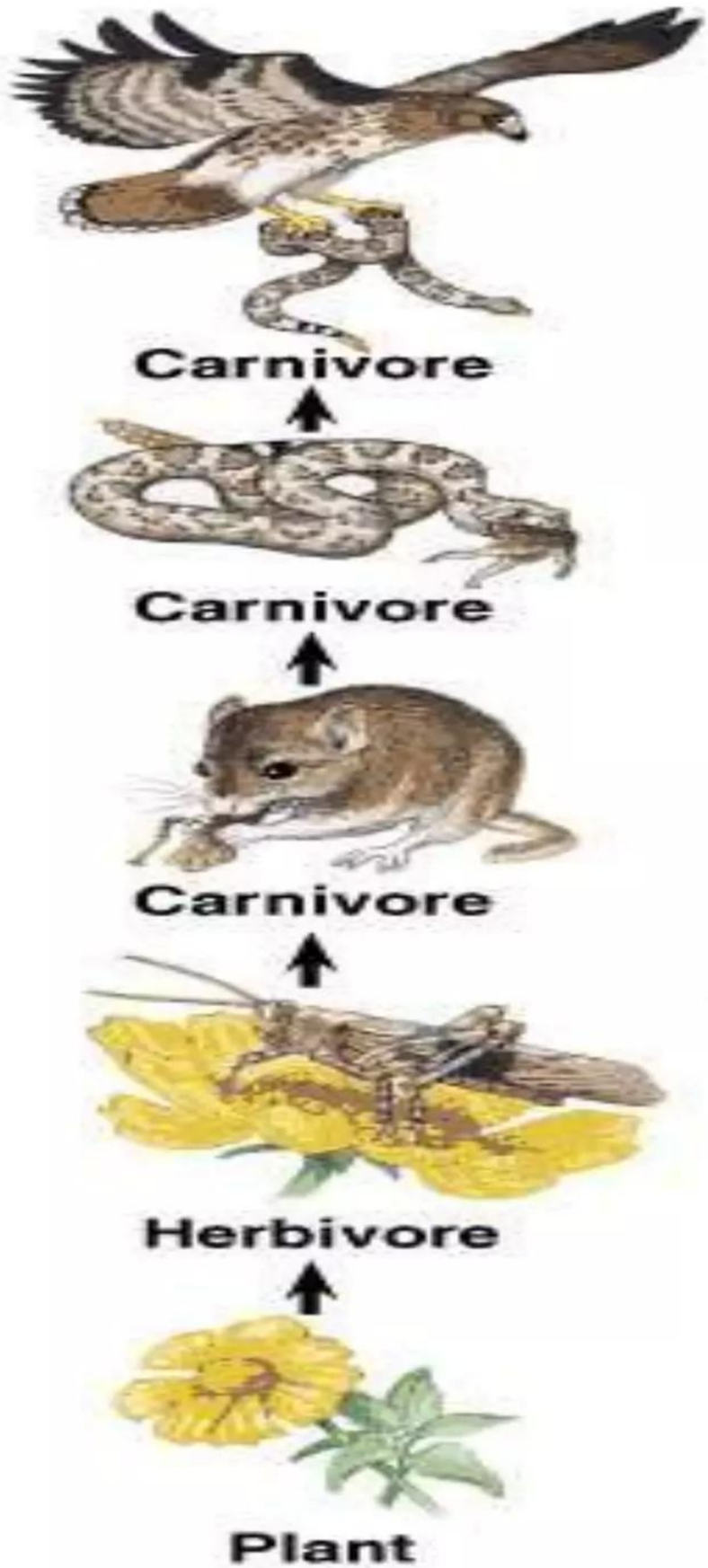


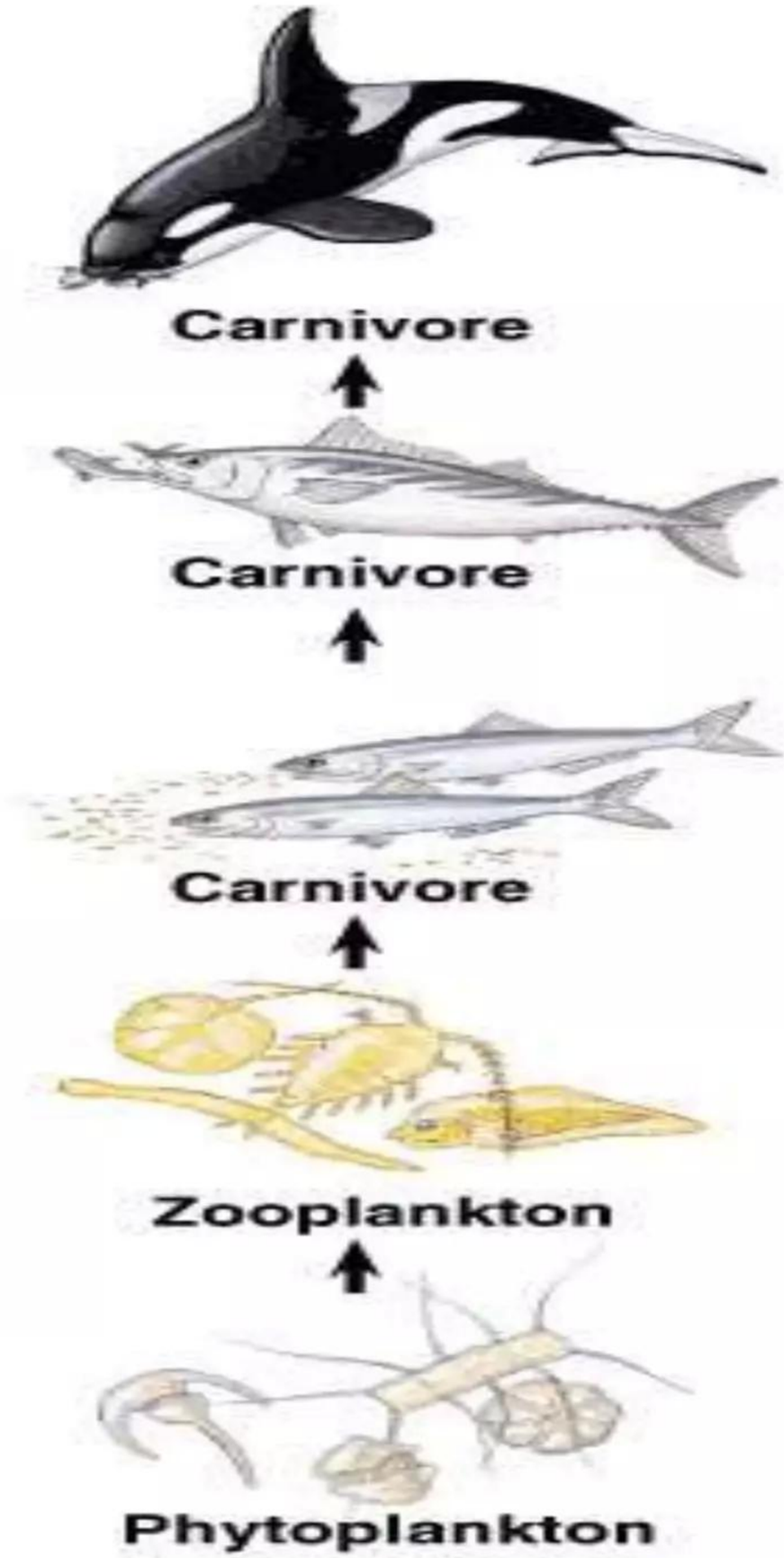
FOOD CHAIN IN ECOSYSTEM

- In an ecosystem one can observe the transfer or flow of energy from one tropic level to other in succession.
- **A tropic level** can be defined as the number of links by which it is separated from the producer, or as the which position of the organism in the food chain.
- Thus, primary producers trap radiant energy of sun and transfer that to chemical or potential energy of organic compounds such as carbohydrates, proteins and fats.
- When a herbivore animal eats a plant (or when bacteria decompose it) and these organic compounds are oxidized, the energy liberated is just equal to the amount of energy used in synthesizing the substances (first law of thermodynamics), but some of the energy is heat and not useful energy (second law of thermodynamics).

- If this animal is eaten by another one, along with transfer of energy from a herbivore to carnivore a further decrease in useful energy occurs as the second animal (carnivore) oxidizes the organic substances of the first (herbivore or omnivore) to liberate energy to synthesize its own cellular constituents.
- Such transfer of energy from organism to organism sustains the ecosystem and when energy is transferred from individual to individual in a particular community, as in a pond or a lake or a river, we come across the food chains.


Hawk
Mouse
Sun
Snake
Grass





A terrestrial food chain **A marine food chain**

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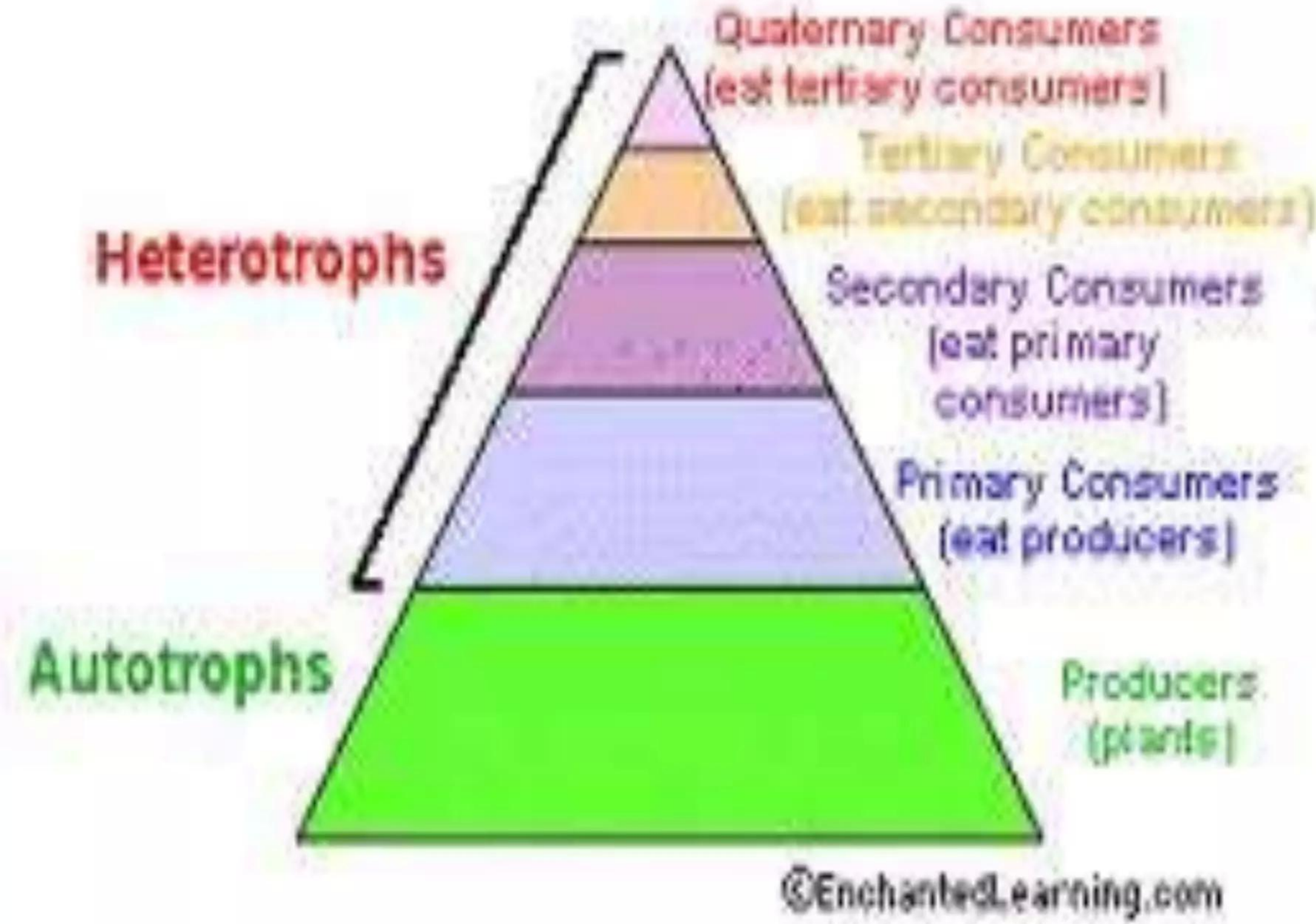
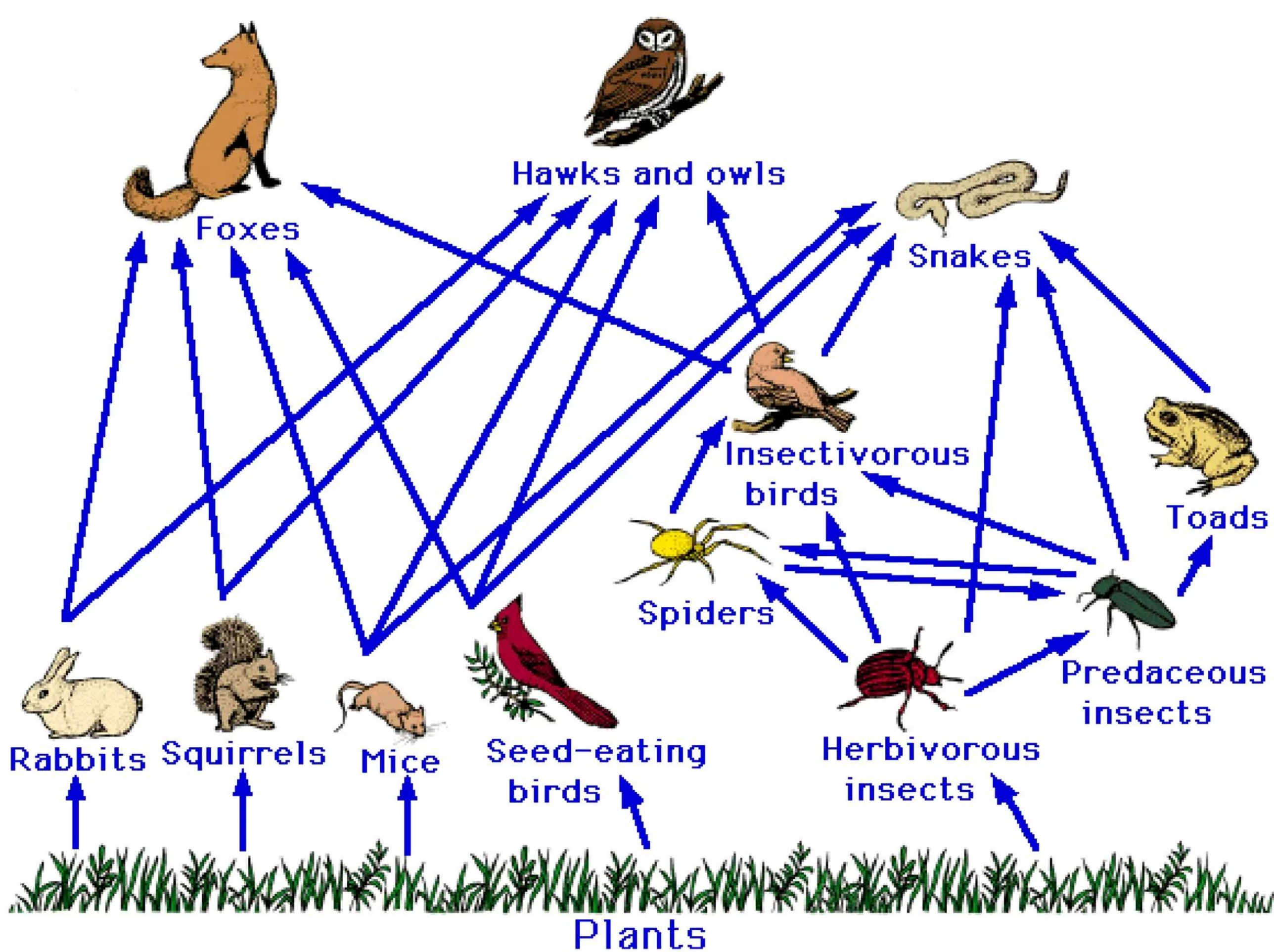
FOOD WEB

In nature simple food chains occur rarely The same organism may operate in the ecosystem at more than one tropic level i.e. it may derive its food from more than one source. Even the same organism may be eaten by several organisms of a higher tropic level or an organism may feed upon several different organisms of a lower tropic level. usually the kind of food changes with the age of the organism and the food availability. Thus in a given ecosystem various food chains are linked together and interested each other to form a complex network called food Web.

The Food Web


Quaternary Consumers
(eat tertiary consumers)
Tertiary Consumers
(eat secondary consumers)
Heterotrophs
Secondary Consumers
(eat primary
consumers)
Primary Consumers
(eat producers)
Autotrophs
Producers
(plants)
©EnchantedLearning.com


Foxes
Hawks and owls
Snakes
Insectivorous birds
Toads
Spiders
Predaceous insects
Rabbits
Squirrels
Mice
Seed-eating birds
Herbivorous insects
Plants

Significance of food chains and food webs

1. Energy flow and nutrient cycling takes place through them.

2. They maintain and regulate the population size of different tropic levels, and thus help in maintaining ecological balance.

3. **Biomagnification**: 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 biomagnification.

ex. DDT – (pesticide) The concentration is increased along the food chain through phytoplankton to zooplanktons and then goes to fish, birds, animals and human beings. DDT damages the shells in the bird's eggs and cells of the human beings

Ecological Pyramids

In the successive steps of grazing food chain-photosynthetic autotroph, herbivorous heterotroph, carnivores heterotroph, decay bacteria-the number and mass of the organisms in each step is limited by the amount of energy available. Since some energy is lost as heat, in each transformation the steps become progressively smaller near the top. This relationship is sometimes called **"ecological pyramid".** The ecological pyramids represent the tropic structure and also tropic function of the ecosystem.

Types of Ecological Pyramids

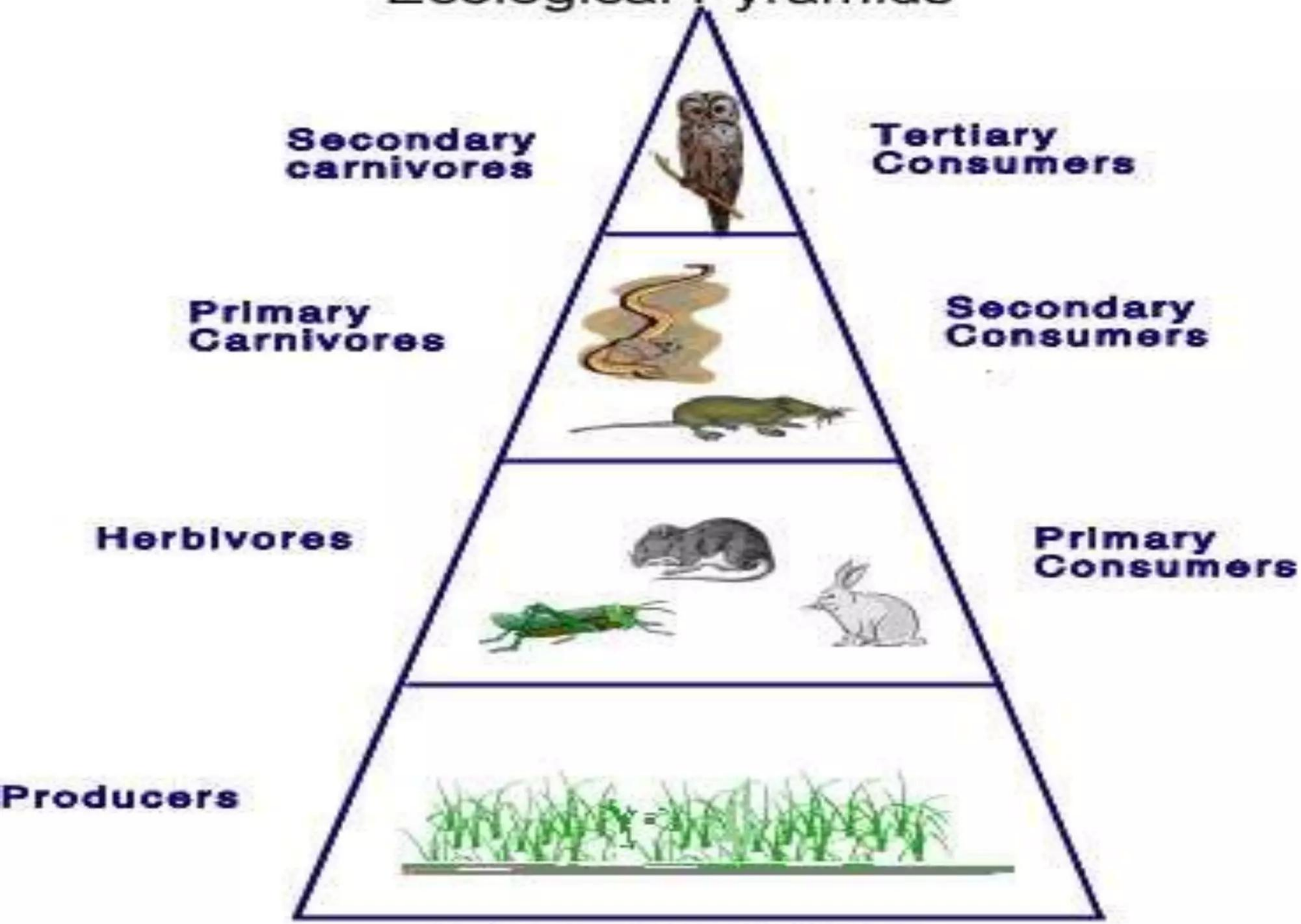
The ecological pyramids may be of following three kinds

- **Pyramid of number.**
- **Pyramid of biomass.**
- **Pyramid of energy.**

Pyramid of number

It depicts the number of individual organisms at different tropic levels of food chain. The animals at the lower end (base of pyramid) of the chain are the most abundant. Successive links of carnivores decrease rapidly in number until there are very few carnivores at the top. The pyramid of number ignores the biomass of organisms and it also docs not indicate the energy transferred or the use of energy by the groups involved. The lake ecosystem provides a typical example for pyramid of number.

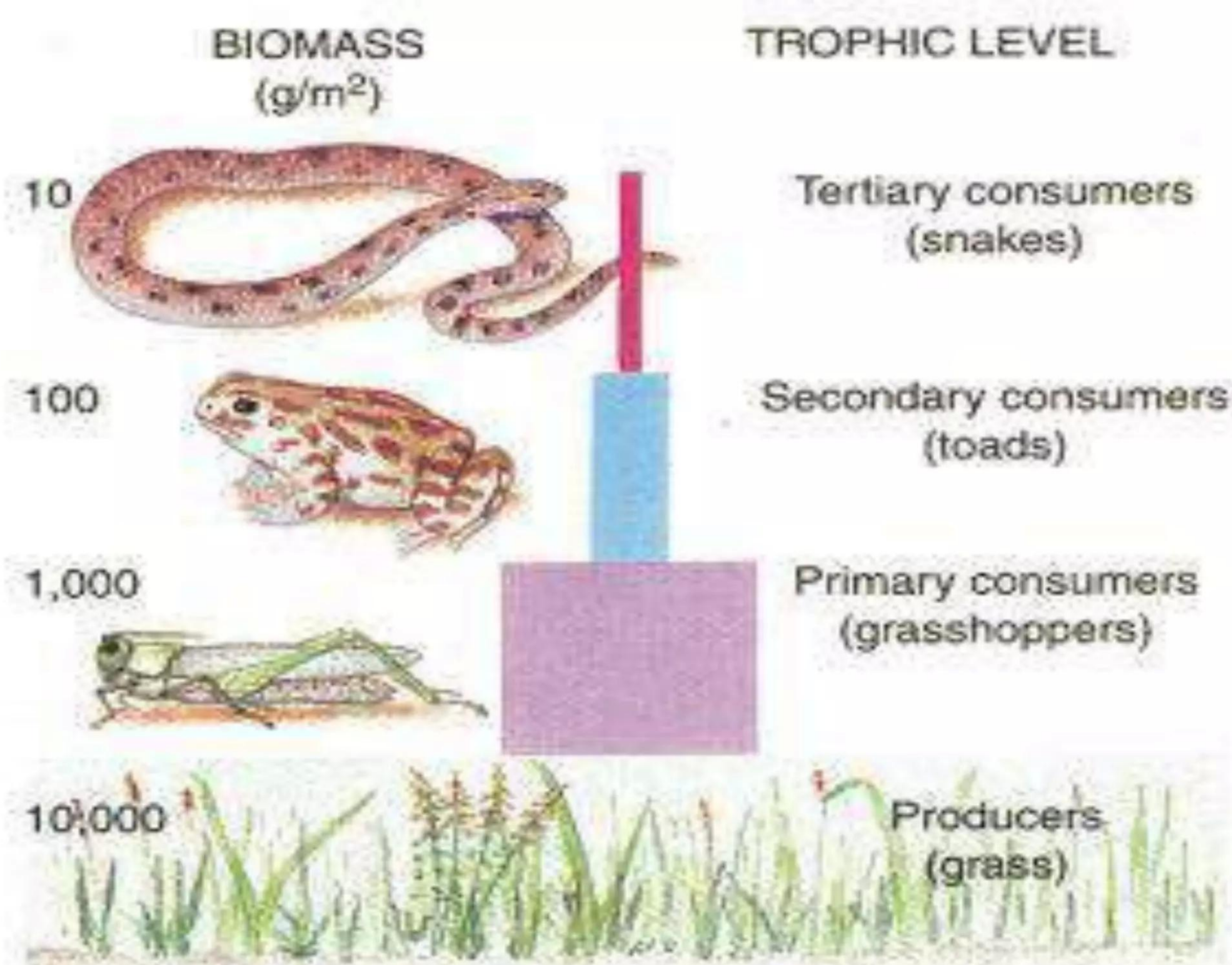
Ecological Pyramids



http://www.eelsinc.org/id64.html

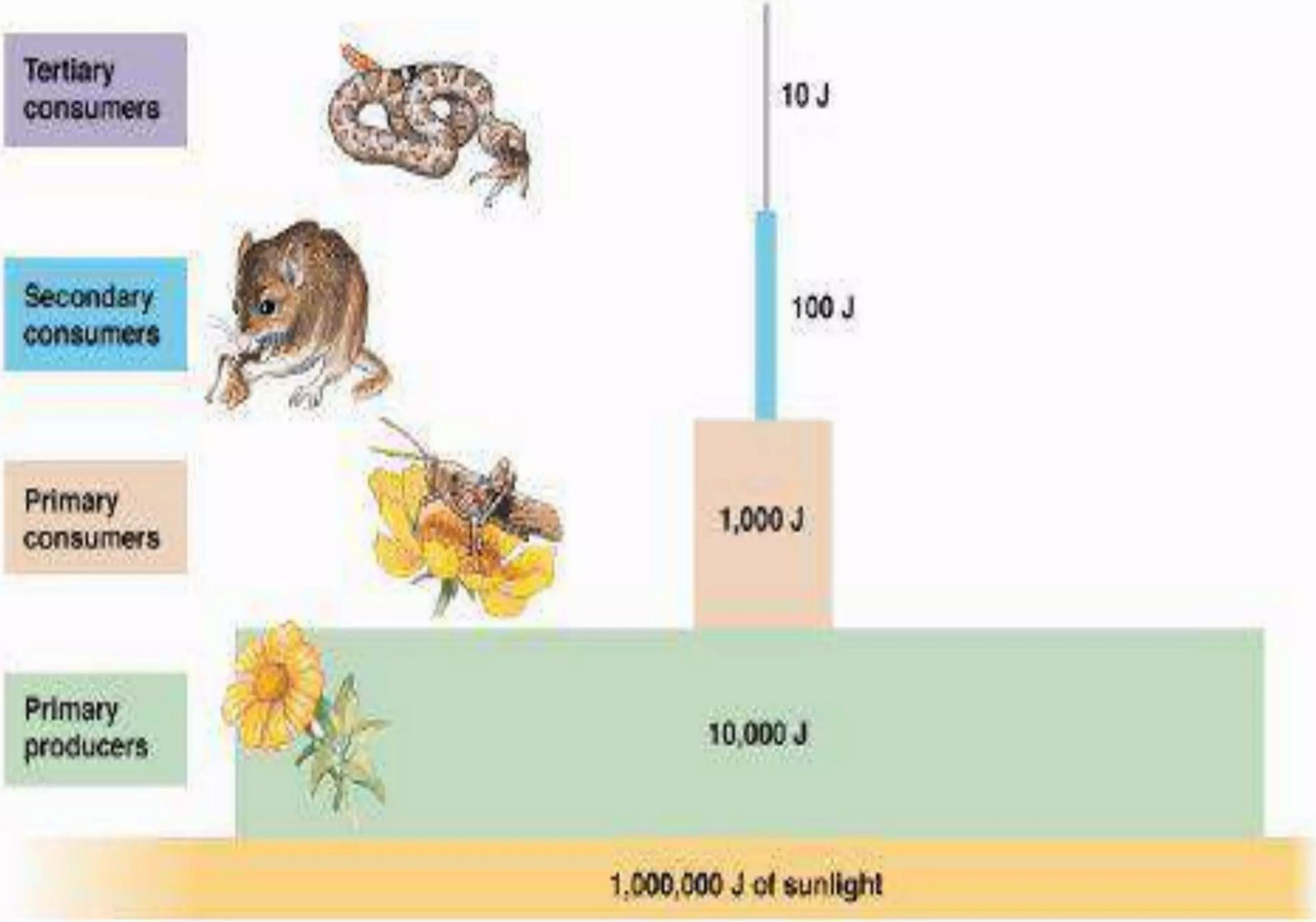
Pyramid of biomass

The biomass of the members of the food chain present at any one time forms the pyramid of the biomass. Pyramid of biomass indicates decrease of biomass in each tropical level from base to apex. For example, the total biomass of the producers ingested by herbivores is more than the total biomass of the herbivores in an ecosystem. Likewise, the total biomass of the primary carnivores (or secondary consumer) will be less man the herbivores and so on.


BIOMASS
(g/m²)
TROPHIC LEVEL
10
Tertiary consumers
(snakes)
100
Secondary consumers
(toads)
1,000
Primary consumers
(grasshoppers)
10,000
Producers
(grass)

Pyramid of energy

When production is considered in terms of energy, the pyramid indicates not only the amount of energy flow at each level the actual role the various organisms play in the transfer of energy. the pyramid of energy is constructed is the quantity of organisms produced per unit time.



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Classification of Ecosystems

- Terrestrial Ecosystems -which encompass the activities that take place on land
- Aquatic ecosystems - the system that exists in water bodies

Terrestrial ecosystem

- ❖Forest ecosystem
- ❖Desert ecosystem
- ❖Grassland ecosystem

Aquatic ecosystem

- ❖Marine ecosystem
- ❖Fresh water ecosystem
- ❖Estuarine ecosystem

FOREST ECOSYSTEM

Undisturbed areas with moderate to high average annual rain precipitation tend to be covered with forest, which contains various species of trees and smaller forms of vegetation.

There are three important types of forests are

- ❖Tropical rain forests.
- ❖Temperate deciduous forests.
- ❖Coniferous forests.

Tropical rain forests

- They are found near the equator.
- These forests have a warm annual mean temperature.
- These forests have high humidity and heavy rainfall almost daily.
- These forests consists of broadleaf ever green plants.
- These trees have larger surface on their leaves that allows them to collect more sunlight and do photosynthesis extensively.
- Tropical rain forests have wide varieties of species.

Temperate Deciduous forests

- Temperate deciduous forests can be found in the eastern part of the United States and Canada, Europe ,China and Japan
- Winter, spring and summer. Winters are cold and summers are warm
- Temperate deciduous forests have a great variety of plant species. Most have three levels of plants .
- Conifers like spruce, fir and pine trees can also be found mixed in with the hardwood trees in this biome.
- There is great diversity of life in this biome. Insects, spiders, slugs, frogs, turtles and salamanders are common.

Coniferous forests

- The **temperate coniferous forest** includes areas South America, New Zealand North America, northwest Europe and Iceland and southern Japan
- Many softwood trees such as fir, pine, spruce, and hemlock.
- Most animals are herbivores, however some carnivores and omnivores are thrown in. Animals in Coniferous Forests include the red fox, moose and owl
- Coniferous Forests are the largest land Biome of the World.
- A Conifer is a tree that produces its seeds in cones. The Pine tree is the most common example. Conifer leaves conserve water with the thick, waxy layer that covers their leaves, also known as needles

coniferous forest

Structure (components) and function of forest ecosystem

I. **Abiotic components**:

The abiotic components are physical (inorganic and organic substances) components found in soil and atmosphere. (E.g. Temperature, light, rain fall)

II. **Biotic components**:

1. **Producers**: The plants absorb sunlight and produce food through photosynthesis.(e.g. Trees, shrubs and ground vegetation)
2. **Consumers**: a) *Primary consumers*: They directly depend on the plants for their food.(e.g.. Ants, flies, insects, mice, deer)
   b) *Secondary consumers*: They directly depend on the herbivores for their food. (e.g. Snakes, birds, fox)
   c) *Tertiary consumers*: They depend on the primary carnivores for their food.(e.g. .Tiger, lion)
3. **Decomposers**: Rate of decomposition in tropical and subtropical forests is more rapid than in the temperate forests. (e.g. Bacteria and fungi).

GRASSLAND ECOSYSTEM

- Grasslands are regions with enough average annual rain precipitation to allow grass to grow extensively. But drought and fire does not allow trees to grow taller.
- Grasslands are rich biological communities of grasses, seasonal flowering plants and open savannas.
- Great Plains of central North America, Russia, and South American are some of the important grasslands in the world

There are three types of grasslands

- A. Tropical grasslands
- B. Temperate grasslands
- C. Polar grasslands

Tropical grasslands

They have warm temperature year around with two prolonged dry seasons. They are the shelter for animals like zebras, giraffes, black rhino, and African elephant. Savanna grassland in Africa is good example for tropical grassland.

Tropical grassland

Temperate grasslands

Winters are too cold, summers are hot and dry, annual precipitation is less and falls unevenly through the year. Drought, fire and overgrazing inhibits the growth of trees and bushes. The soil in temperate grassland is fertile since grass die and decomposes to for organic manure. *Prairies* in Canada, *Pampas* in South America and *Veldt* in Africa are examples for temperate grasslands

Polar grasslands

It is also known as *arctic tundra*. They occur in arctic polar ice caps. The land is covered with ice and show. Winter is very dark, long and cold

Temperate grassland

Polar grassland

- Seasonal cycles of temperature and precipitation contributes to abundant vegetative growth that enriches and protects the soil of the grasslands.
- There is enough water to support small crops to do photosynthesis
- Grasslands have few trees because inadequate rainfall, large daily and seasonal temperature ranges and frequently grass fires kill woody seedlings.

Major impacts on grasslands are

- ❖Conversion of grasslands into cropland
- ❖Overgrazing of grasslands by livestock
- ❖Exploitation of polar grassland by oil, water and air pollution

Structure and function of the grassland Ecosystems:

I. **Abiotic components**: These abiotic components are supplied by CO_2 (Nutrients C,H,O,N,P,S,etc.)

II. **Biotic components**:

1. **Producers**: They produce food.(Grasses, forbs and shrubs)

2. **Consumers**:

a) **primary consumers:** They depend on grasses for their food.(Cows, buffaloes, deer, sheep, etc.,)

b) **secondary consumers:** They feed on herbivores.(Snakes, lizards, birds, jackals, fox, etc.,)

c) **Tertiary consumers**: They feed on secondary consumers.(Hawks, eagles, etc.,)

3.**Decomposers**: Fungi and bacteria (decompose the dead organic matter.

DESERT ECOSYSTEM

- Deserts are dry places with unpredictable and infrequent precipitation. A desert is an area where evaporation exceeds precipitation.
- Daily and seasonal temperature of the desert will vary since desert has very little moisture to absorb and store sun radiation.
- Deserts with less than 2.5 cm of precipitation supports almost zero vegetation.
- Deserts with 2.5 to 5.0 cm precipitation have thin (scanty) vegetation(less than 10% of the ground is covered).
- Seasonal leaf production, water-storage tissues and thick epidermal layer help to reduce water loss.
- A combination of low rainfall and different average temperatures creates tropical, temperate and cold deserts.

(c)Walter Feller DigitalDesert.NET

TROPICAL DESERTS	TEMPERATE DESERTS	COLD DESERTS
Temperature is high around year	Day time temperature is high in summer & low in winter	Winters are too cold, summers are too hot
There is very little rainfall during 1 or 2 months of a year.	There is more precipitation than tropical deserts	Precipitation is too low
These driest places on the earth have few plants along with wind blown sands and rocks	It consists of drought resistant shrubs, cacti and other succulents* and few animals	Small shrubs
Ex: *Sahara* in Africa	*Mojave* in south California	*Gobi* desert in China

Structure and functions of the desert ecosystems:

I. **Abiotic components**: Temperature water, sunlight, rainfall, etc. The temperature is very high and low rain fall & low nutrient cycling.

II Biotic components:

1. **Producers**: Shrubs, bushes

In deserts mostly Succulent (e.g., cacti) plants are found available. They have water inside them to stay alive.

2. **Consumers**: Squirrels, mice, rabbits, reptiles.

These animals dig holes in the ground to live in. Most of the animals can extract water from the seeds they eat.

3. **Decomposers**: Fungi and bacteria

Desert has poor vegetation with a very low amount of dead organic matter.

AQUATIC (Water) ECOSYSTEMS

Freshwater Ecosystems

Wetlands:

Once considered useless, disease ridden places (e.g., malaria and yellow fever)

Provide many benefits to society:

- Fish and wildlife habitats
- Natural water quality improvement
- Flood storage

They also are a source of substantial biodiversity in supporting major groups of organisms numerous species from all of the from microbes to mammals

Aquatic Ecosystems

Lakes

- **Littoral zone**

  light penetrates to the bottom, allowing aquatic plants to grow.

- **Limnetic zone**

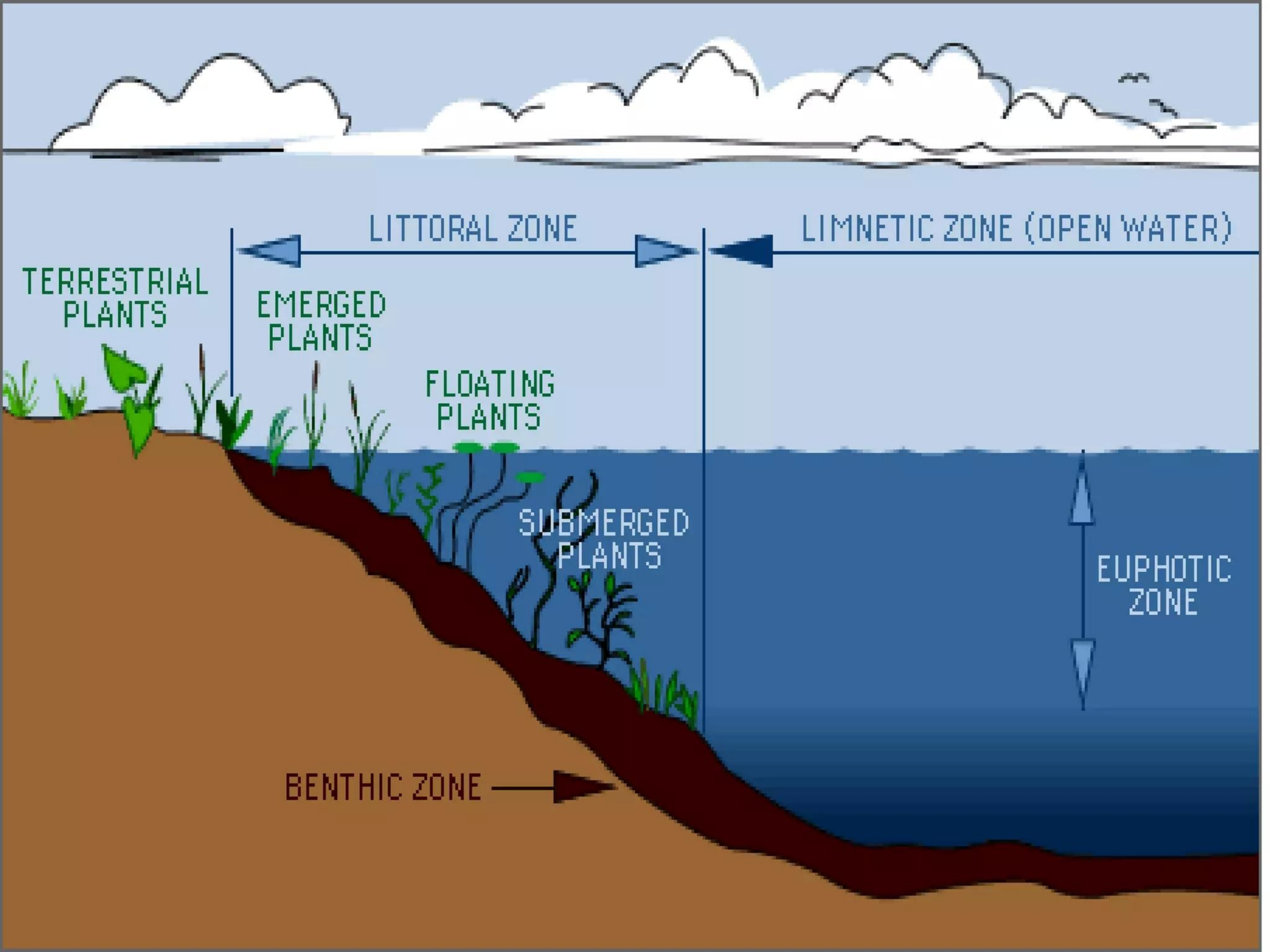
  the open water area where light does not generally penetrate all the way to the bottom.

- **Euphotic zone**

  the layer from the surface down to the depth where light levels become too low for photosynthesis.

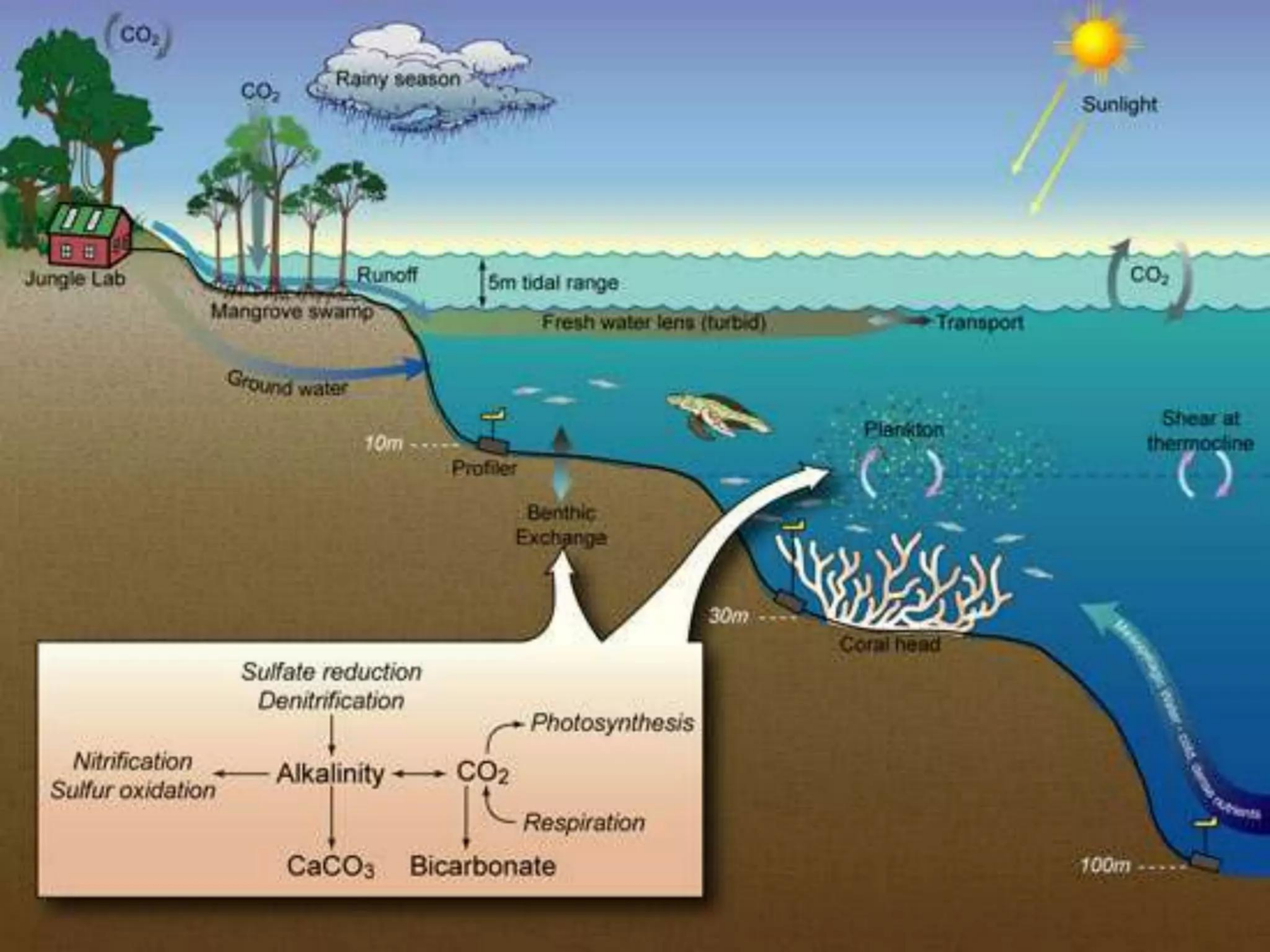
- **Benthic zone**

  the bottom sediment


LITTORAL ZONE
LIMNETIC ZONE (OPEN WATER)
TERRESTRIAL PLANTS
EMERGED PLANTS
FLOATING PLANTS
SUBMERGED PLANTS
EUPHOTIC ZONE
BENTHIC ZONE

Major threats to lakes:

- An overabundance of nutrients
- An overabundance of sediment
- Metals and other organic chemicals such as polychlorinated biphenyls (PCBs)


CO_2
CO_2
Rainy season
Sunlight
Jungle Lab
Runoff
5m tidal range
CO_2
Mangrove swamp
Fresh water lens (turbid)
Transport
Ground water
10m
Profiler
Plankton
Shear at thermocline
Benthic Exchange
30m
Coral head
100m
Sulfate reduction
Denitrification
Photosynthesis
Nitrification
Sulfur oxidation
Alkalinity
CO_2
Respiration
$CaCO_3$
Bicarbonate

Structure and function of aquatic ecosystem

I. Abiotic components: Temperature, light proteins, O_2

II. Biotic components:

1. **Producers**: They are green plants, may be submerged, free floating and amphibious plants. phytoplanktons, algae and flagellates
2. **Consumers**: a) **Primary Consumers** (Zooplanktons) Cilictes, protozoans, etc., - They feed on phytoplankton.

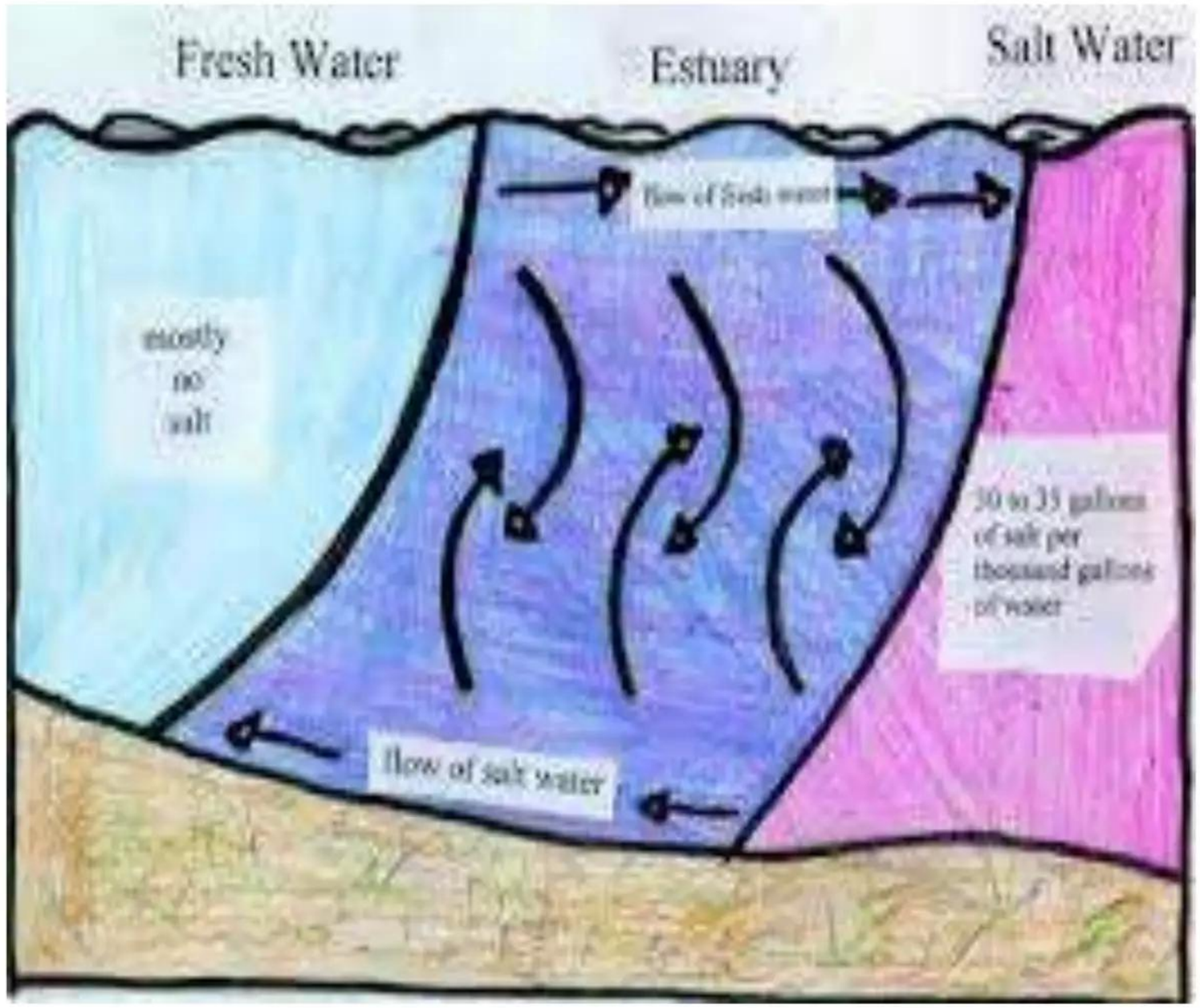
   b) **Secondary consumers** (carnivores)Insects and small fishes. – They feed on zooplankton.

   c) **Tertiary consumers**: Large fishes like game fish - They feed on smaller fish.

3. **Decomposers**: Bacteria, fungi and actinomycetes.- They decompose the dead plants and animals.

ESTUARIES

- They are bays or partially enclosed bodies of brackish water that form where river enter into ocean.
- Estuaries contain rich sediments carried down river, forming mudflats that act as home for many aquatic lives.
- The combination of certain physical factors makes them very protective and of high species diversity.
- Delta, broad, shallow deposits of river borne sand and mud, can be part estuary zone.
- a steady flow of nutrients makes delta biologically rich.


Fresh Water
Estuary
Salt Water
mostly
no
salt
30 to 35 gallons
of salt per
thousand gallons
of water
flow of salt water

Structure and function of Estuarine Ecosystem:

I.Abiotic components:

Temperature, pH, sodium and potassium salts and various nutrients.

II.Biotic Components:

a) Producers: marsh grasses, seaweeds, seagrasses and phytoplankton

b) Consumers: Oysters, crabs, seanirds, small fishes.

C) Decomposers: Bacterias, fungi and actenomycetous.

Biodiversity and its conservation

- **Biodiversity is the variety of life on earth It includes all life forms-from the unicellular fungi, protozoa and bacteria to complex multi-cellular organisms such as plants, birds, fishes and animals.**
- Biodiversity is the variety of flora and fauna on this planet earth.
- The concept reflects the inter-relatedness of genes, species and ecosystems. Because genes are the components of species, and species are the components of ecosystems
- Diversity may be defined as the number of species present in a community, a measure termed as species richness

GENETIC DIVERSITY

- It refers to the total genetic information contained in the genes of individuals of plants, animals and microorganisms.
- The genes found in organisms can form enormous number of combinations each of which gives rise to some variability. Genes are the basic units of hereditary information transmitted from one generation to other.
- When the genes within the same species show different versions due to new combinations, it is called genetic variability.

SPECIES DIVERSITY

- A species generally consists of all the individual organisms of a natural population which are able to interbreed, generally sharing similar appearance, characteristics and genetics. A species is one of the basic units of biodiversity.
- Species richness is the simplest measure of biodiversity and is simply a count of the number of different species in a given area.

- Species evenness is a diversity index, a measure of biodiversity which quantifies how equal the populations are numerically
- This is the variability found within the population of a species or between different species of community.
- It represents broadly the species richness and their abundance in a community.

ECOSYSTEM DIVERSITY

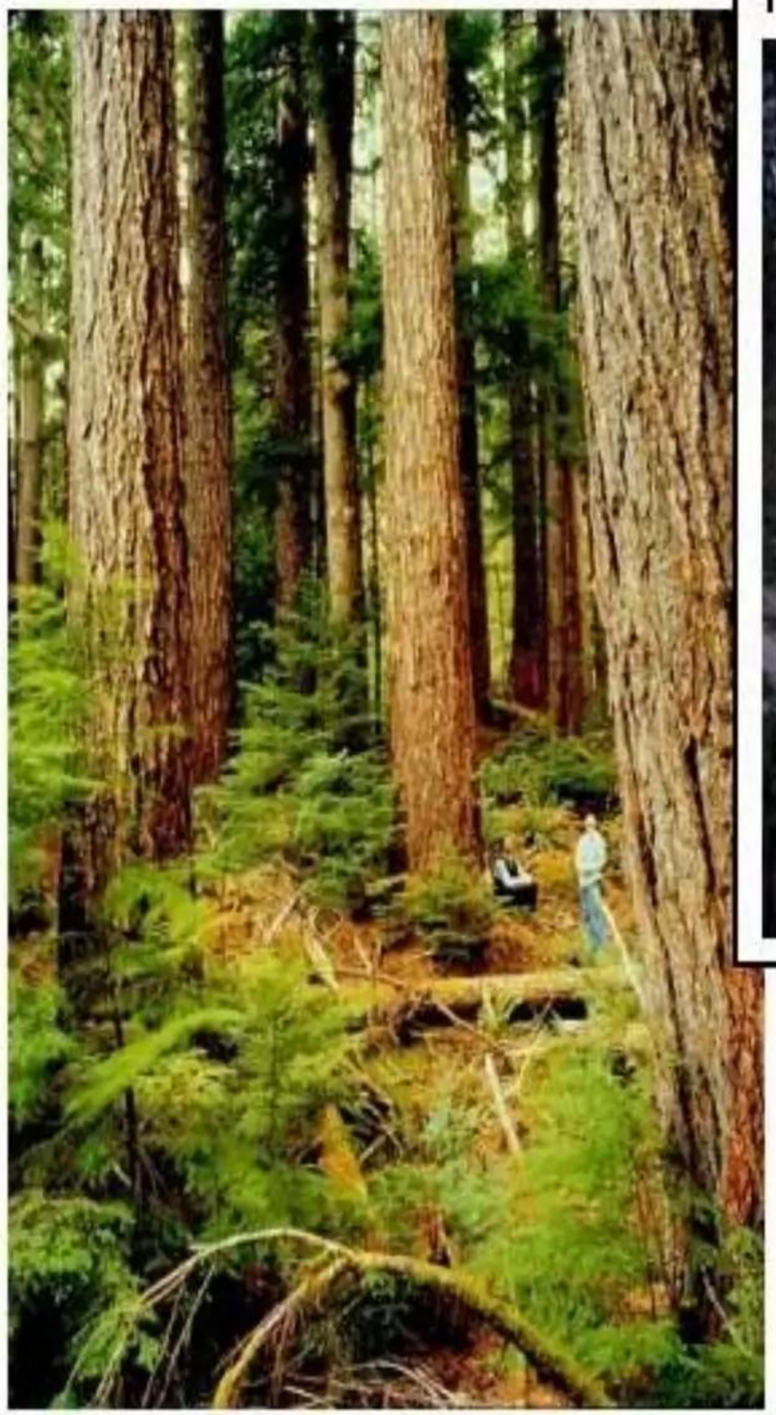
This is the diversity of ecological variations in

- tropic structure,
- food-webs,
- nutrient cycling etc.

The ecosystems also show variations with respect to physical parameters like

- moisture
- temperature
- altitude
- precipitation etc.,

- The ecosystem diversity is of great value that must be kept intact. This diversity has developed over millions of years of evolution. If we destroy this diversity, it would disrupt the ecological balance.
- We cannot even replace the diversity of one ecosystem by that of another. Coniferous trees of boreal forests cannot take up the function of the trees' of tropical deciduous forest lands and vice versa



Coastal forest

Palliser River Valley

Dry open forest

Bio-Geographical Classification of India

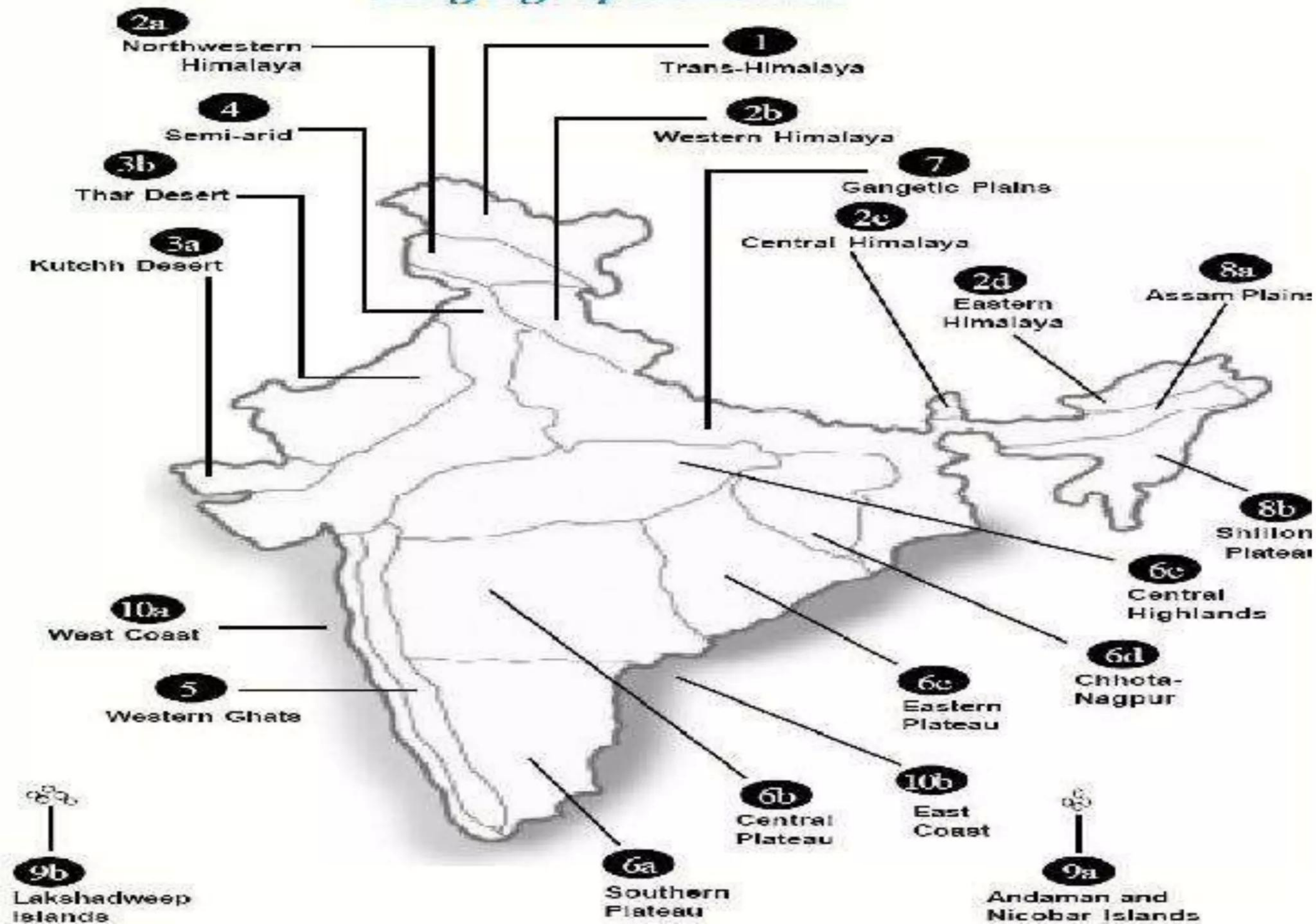
- Biogeography: It is the science which deals with patterns of species distribution and the processes that result in such patterns.
- Evolution (change in genetic composition of a population).
- Extinction (disappearance of a species).
- Dispersal (movement of populations away from their point of origin, related to migration).
- Range and distribution.
- Endemic areas.

- India has different types of climate and topography in different parts of the country and these variations have induced enormous variability in flora and fauna. India has a rich heritage of biological diversity
- Bio-geographic zones: Major zones representing distinctive units of similar ecology, biome representation, community and species. e.g. Himalaya, Gangetic plain.
- Biotic provinces: Next level of detail within the zones. e.g. Northwestern Himalaya, Western Himalaya.
- Biomes: Major ecosystem groupings found within each province and region. e.g. Alpine, sub alpine.

The zones are

- Trans-Himalaya with 2 provinces
- The Himalaya with 4 provinces
- The Indian Desert with 2 provinces
- The Semi-Arid Zone with 2 provinces
- The Western Ghats with 2 provinces
- The Deccan Peninsula with 5 provinces
- The Gangetic Plain with 2 provinces
- The Coasts with 3 provinces
- North East India with 2 provinces
- The Islands with 2 provinces

Biogeographic Zones



Bio-geographic Zones

1. Trans-Himalaya:

- Biotic Province: Ladakh (J&K) and Lahaul - Spiti (Himachal)[1]
- Biome: Tundra valley, lakes and marshes.
- Wildlife: Chiru, Black-necked Crane, Himalayan pit viper.

2. Himalaya:

- Biotic Province: Northwestern Himalaya (2a), Western Himalaya (2b), Central Himalaya (2c),Eastern Himalaya (2d).
- Biome: All alpine, temperate conifer, temperate broadleaf, subtropical
- Wildlife: Ibex, red panda, Monal Pheasant.

3. Indian Desert:

- Biotic Province: Kutchh (3a), Thar (3b).
- Biome: Saltflats, scrublands, desert grasslands.
- Wildlife: Wild ass, blackbuck, flamingo, desert monitor.

4. Semi-arid:

- Biotic Province: Punjab and Gujarat-Rajwara[4]
- Biome: Scrublands, Bhabar forests, wetlands, dry deciduous, hill and thorn forests.
- Wildlife: Tiger, Asiatic lion, Great Indian Bustard, gharial.

5. Western Ghats:

- Biotic Province: Western Ghats[5]
- Biome: Evergreen, moist deciduous, wetlands, Montane forests, grasslands.
- Wildlife: Lion-tailed macaque, Malabar civet, hornbill, draco.

6. Deccan Peninsula:

- Biotic Province: Southern Plateau (6a), Central Plateau (6b), Eastern Plateau (6c), Chota-Nagpur (6d), Central Highlands (6e).
- Biome: Dry deciduous, thorn forests, wetlands, subtropical, moist deciduous.
- Wildlife: Swamp deer, Jerdon.s Courser, mugger.

7. Gangetic Plains:

- Biotic Province: Lower and upper Gangetic plains (7).
- Biome: Alluvial plain, wetlands, rivers.
- Wildlife: Rhino, otter, Gangetic dolphin, terrapin.

8. Northeast India:

- Biotic Province: Assam Plains (8a), Shillong Plateau (8b).
- Biome: All plain grasslands, woodlands, Bhabar terai, evergreen moist deciduous, wetlands andrivers, subtropical temperate.
- Wildlife: Pygmy hog ,serow, Yellow-backed Sunbird.

9. Islands:

- Biotic Province: Andaman and Nicobar (9a), Lakshadweep (9b).
- Biome: Evergreen, moist deciduous, subtropical temperate wetlands, coastal habitat.
- Wildlife: Dolphin, Narcondam Hornbill, olive ridley turtle.

10. Coasts:

- Biotic Province: West Coast (10a), East Coast (10b).
- Biome: Mangrove, brackish lakes and lagoons, mudflats, sandy or rocky littoral.
- Wildlife: dugong, Brahminy Kite, sand skink

Value of Bio-Diversity

Consumptive value:

These are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fibre etc.

Drugs and medicines:

- About 75% of the world's population Depends upon plants or plant extracts for medicines. The wonder drug Penicillin used as an antibiotic is derived from a fungus called "Penicillium.
- we get Tetracyclin from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree,
- Digitalin is obtained from foxglove (Digitalis) which is an effective cure for heart disease.
- Vinblastin and vincristine, two anticancer drugs, have been obtained from Periwinkle (Catharanthus) plant, which possesses anticancer alkaloids.

Fuel:

Our forests have been used since ages for fuel wood. The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity.

PRODUCTIVE VALUES:

These are the commercially usable values where the product is marketed and sold. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, fir of many animals etc, all of which are traded in the market. A wild variety of rice from UP. Saved millions of hectares of paddy crop from Grossy-Stuntvirus

SOCIAL VALUES/ETHICAL VALUES:

- These are the values associated with the social life, customs, religion and aspects of the people.
- Many of the plants are considered holy and sacred in our country like Tulsi (holy basil),Peepal, Mango, Lotus, Neem etc.
- The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped. The tribal people are very closely linked with the wild life in the forests.

AESTHETIC VALUE:

- Great aesthetic value is attached to biodiversity. We will not like to visit vast barren lands with no signs of visible life.
- People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as **ecotourism**.

ECOLOGICAL VALUE:

It refers to the services provided by ecosystems such as

- prevention of soil erosion,
- prevention of floods,
- maintenance of soil fertility,
- nutrients cycles,
- fixation of nitrogen,
- hydrological cycle,
- acts as carbon sinks,
- pollutant absorption
- Reduction of the threat of global warming

Levels of Bio-Diversity

BIODIVERSITY AT GLOBAL LEVEL

- Cellular life has existed on Earth for probably more than 3,500 million years, but for more than half this time consisted only of prokaryotes (i.e. unicellular organisms such as bacteria and blue-green algae).Multi-cellular animals (metazoans) first appeared some 600 million years ago.
- The present geological era is perhaps the richest in biological diversity. About 2.1 million species have been identified till date.
- About 70% of all known species are invertebrates (animals without backbones such as insects, sponges, worms, etc.); while, about 15% are plants

- Tropical deforestation alone is reducing the biodiversity by half a percent every year. Many of these species are more vulnerable to extinction when their natural home is destroyed.
- About 50 to 80% of global biodiversity lies in these rainforests.
- More than one-fourth of the world's prescription drugs are extracted from plants growing in tropical forests.
- Temperate forests have much less biodiversity.
- Globally, we have roughly
  - 1, 70,000 = flowering plants
  - 30,000 = vertebrates
  - 2, 50,000 = other groups of species

DIVERSITY AT NATIONAL LEVEL :

Indian Biodiversity:

- Every country is characterized by its own biodiversity depending mainly on its climate.
- India has a rich biological diversity of flora and fauna.
- Overall six percent of the global species are found in India.
- It is estimated that India ranks 10th among the plant rich countries of the world.
- India ranks 11th in terms of number of endemic species of higher vertebrates.
- India ranks 6th place among the centers of diversity and origin of agricultural crops.
- The total number of living species identified in our country is 1,50,000.
- Indian is also one of the 12 mega-biodiversity countries in the world.
- Out of a total of 25 biodiversity hot-spots in the world, India possesses 2, one in the northeast region and second one in the western ghats.

India as a mega-diversity nation

- The country has a rich heritage of biodiversity, a wide spectrum of habitats from tropical rainforests to alpine vegetation, and from temperate forests to coastal wetlands.
- India occupies 2.4% of the total land area of the world, but India contributes 8.22% of the known global biodiversity.
- India is one of the 12 mega-diversity nations of the world.
- India is in the 10th position in the world and 4th in the Asia in terms of plant diversity.
- India ranks 10th in the world in terms of number of mammalian species.
- India ranks 11th in the world in terms of endemic species of higher vertebrates
- In terms of number of species contributed to agriculture and animal husbandry, it ranks 7th in the world.

- India has three biomes, namely the tropical humid forests, the tropical dry deciduous forests and the warm desert/semi-deserts.
- India can be divided into ten biogeographic zones and 26 biotic provinces which represent the major ecosystems of the world.
- Out of 25 hotspots in the world, India has two ’hotspots'. the Western Ghats and the Eastern Himalayas.
- Endemism: Species which are restricted only to a particular area are known as endemic.
- About 62% of amphibians and 50% of lizards are endemic to India. Western ghats are the site of maximum endemism. India has 26 recognized endemic centers.
- Biosphere reserves : which protect larger areas of natural habitat ,it includes National Parks, preserves, along buffer zones that are open to some economic uses. The World has 482 biosphere reserves in 102 countries.

Hot spots of Bio-Diversity

- Hotspots are the main areas of focus for biodiversity conservation. These are the areas that are extremely rich in biodiversity, have high level of endemism, and are under constant threat of species extinctions and habitat destruction.
- There are 25 hot spots at global level. Out of 25, two are present in India, namely the Eastern Himalayas and Western Ghats.
- Nearly 70% of the bird species in this hotspot are endemic. These are the areas of high diversity, endemism and are also threatened by human activities.

- About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots.
- It has been estimated that 50,000 endemic plants, which comprise 20% of global plant life, probably occur in only 18 hotspots in the world.
- Countries which have a relatively large proportion of these biodiversity hotspots are referred to as mega-diversity nations.

Hotspots in India

The Eastern Himalayas

- The area comprises Nepal, Bhutan, and neighbouring states of northern India, along with Southwest china.
- All Himalayan forests lie north of the Tropic of Cancer, and some of them are at attitudes of 1780 -3500 m, they can be considered tropical forests.
- The Eastern Himalayas display an varied topography, a factor that fosters species diversity and endemism. Many deep and semi-isolated valleys are exceptionally rich in endemic plant species.
- In Sikkim, in an area of 7298 km2 , of the 4250 plant species , 2550 (60%) are endemic. there are about 5800 plant species, of which roughly 2000(36%) are endemic.

- In Nepal, there are around 7000 plant species, many of which overlap with those of Indian and Bhutan, at least 500(8%) are believed to be endemic to Nepal.
- Bhutan possesses an estimated 5000 species, of which as many as 750 (15%) are considered to be endemic to the Eastern Himalayas

Western Ghats:

- Out of India's 49219 plant species , 1600 endemics(40% of the total number of endemics) are found in an 17000 km2 along the sea side of the Western Ghats in Maharasthtra, Karnataka, Tamil Nadu,
- Kerala Forest track up to 500km2 in elevation, comprising one fifth of the entire forest expanse, are mostly evergreen, while those in 500-1500 m range are semi- evergreen. There are two main centers of diversity, the Agasthyamalai Hills and the Silent Valley. The forest cover in western ghats has reduced to 34 %.

Threats to Bio-Diversity

Extinction, the elimination of a species is a normal process in nature. Species however, human impacts on populations and ecosystems have accelerated that rate of extinction, causing hundreds of species, sub-species and varieties to become extinct every year.

The causes of extinction are:

Population Risk: uneven change in population rates (i.e. birth rates and death rates) can cause a species in low abundance to become extinct. e.g. blue whales.

Environmental Risk: Environmental risk means variation in the physical or biological environment, including variations in predator, prey, symbiotic or competitor species. In case of species that are sufficiently rare and isolated, such normal environmental variations can lead to their extinction.

Natural calamities: A natural catastrophe is a sudden change in the environment .It includes fires, storms, floods, earthquakes, volcanic eruptions etc. Such a natural phenomenon may cause the extinction of most forms of life there.

Genetic Risk: Change in genetic characteristics in a small population of a species, due to reduced genetic variation, genetic drift or mutation, genetic assimilation [cross-breeding] makes the species more vulnerable to extinction.

Human Actions: human activities like hunting , development of agriculture, rise of civilization, rapid deforestation and introduction of industrial chemicals and emissions, pesticides and pollution are also leads to extinction of species.

Habitat Loss and Degradation: Habitat loss and degradation are the major proximate causes of species extinction, affecting 89% of all threatened birds, 83% of mammals and 91% of all threatened plants assessed globally. The main causes of habitat loss are agricultural activities, harvesting or extraction (including mining, fishing, logging, etc.) and development of human settlements, industry and associated infrastructure.

Diseases: Pathogens, or disease organisms, may cause extinction. Animals [in sanctuaries and reserves] are more prone to infection when they are under stress.

Poaching: Poaching is another threat to

Endangered Species of India

- An **endangered species** is a population of organisms which is at risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predation parameters.
- In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare. Existence of about threatened while an unknown number of species of insects relevance here to give a complete list of endangered flora and fauna of our country. However, a few species of endangered reptiles, birds, mammals and plants are given below:

Reptiles:

- ❖green sea turtle,
- ❖tortoise,
- ❖python

Birds:

- ❖Great Indian bustard,
- ❖Peacock, Pelican,
- ❖Siberian White Crane

Carnivorous:

- ❖Indian wolf,
- ❖Mammals tiger,
- ❖leopard,
- ❖striped hyena,
- ❖Indian lion

Endemic Species of India

- Endemics are species that are found in a single locality/area and nowhere else in the world. They have a value in their uniqueness. Areas of endemism containing several endemic species, genera or even families have generally been isolated for a long time.

- Out of about 47,000 species of plants in our country 7000 are endemic.
- Thus, Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, Khasi Hills and Western Ghats.
- A large number out of a total of 81,000 species of animals in our country is endemic.
- The Western Ghats are particularly rich in amphibians (frogs, toads etc.) and reptiles (lizards, crocodiles etc.). About 62% amphibians and 50% lizards are endemic to Western Ghats.

Conservation of Bio-Diversity

- The act or process of conserving. The protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soil, and water.

Conservation of our natural resources has the following three specific objectives:

- (i) to maintain essential ecological processes and life-supporting systems .
- (ii) to preserve the diversity of species or the range of genetic material found in the organisms on the planet .
- (iii) to ensure sustainable utilization of species and ecosystems which support millions of rural communities as well as the major industries all over the world.

There are two approaches of biodiversity conservation:

- (a) In situ conservation (within habitat): This is achieved by protection of wild flora and fauna in nature itself, e.g. Biosphere Reserves, National Parks, Sanctuaries, Reserve Forests etc.
- (b) Ex situ conservation (outside habitats) This is done by establishment of gene banks, seed banks, zoo, botanical gardens, culture collections etc.

THANK YOU