



Ecology , Ecosystems, Biogeochemical Cycle

Important Questions

- *Explain Food Chain and food web.*
- *Describe Ecological Pyramids.*
- *Explain Structure and function of Ecosystem.*
- *Explain Energy flow in an ecosystem.*
- *what is Eltonian Pyramids? Give the names of types of Ecological Pyramids.*
- *Give Classification of Ecology.*
- *Define Ecosystem and discuss classification of ecosystem .*
- *Explain various Components of Ecosystem.*
- *Define Ecosystem and write in brief about biotic and abiotic components .*
- *What is biogeochemical cycles? Give names.*
- *Explain Hydrological Cycle.*
- *Carbon Cycle .*
- *Nitrogen Cycle .*
- *Explain Models of Energy Flow.*
- **Why is ecosystem with large population of one species considered to be not healthy ?**

Ecology

- Definition:- Ecology is derived from two Greek words "Oikos" & "Logos"
- **Ecology= Oikos + Logos**
 - *Oikos means house or dwelling place*
 - *Logos means study of*
- Thus Ecology can be define as "*Study of organisms with respect to their house or dwelling place*".

Ecology is defined as the study of interrelationship of different organisms with each other and with their environment. It is concerned with the general principles that apply to both animals and plants.

Terminology Used in Ecology

- ***Species:*** A Uniform interbreeding population spreading over time & space is known as species.
- ***Community:*** A group of similar or dis-similar species species living to gather under more or less similar environmental condition.
- ***Population:*** It is a group of similar community living together under similar environmental condition.
- ***Biome:*** The complex of several type of community, at different stages of succession living to gather under similar environmental condition.
- ***Vegetation:*** A collective growth of plants in space is known as vegetation.
- ***Habitat:*** The place where an organism live or the place where one would go to find a particular organism is known as habitat.

Terminology Used in Ecology

- ***Factor:*** Any external force, substance, or condition that affects the organism in any way is known as factor.
- ***Standing state:*** The total amount of inorganic substances i.e. minerals Such as phosphorous, sulfur, nitrogen, hydrogen, etc. present at any given time in the environment of an ecosystem is known as standing state.
- ***Biomass:*** Biomass is the total amount of living material present in terms of weight/ unit area.

Classification of Ecology

- Ecology can be classified based upon its sub divisions as:
- ***Based on Taxonomic affinities:***

- **Plant Ecology.**
- **Animal Ecology**

In early days of Ecology, botanist and zoologists engaged themselves in the study of ecology of plants & animals respectively this led to the development of such sub-divisions as **a) Plant Ecology b) Animal Ecology**

- ***Based on Habitat Ecology :*** Some ecologist thought of the study of habitats and their effect upon the organisms. They selected a number of different habitat such as fresh water, grass land, forest etc. this are then studied in detail for their possible relationship with the kind of organisms present there such an approach led to the development of habitat ecology.

- ***Based on level of Organization:-*** In this approach the organisms involved in ecology are either studied individually or in group accordingly they are classified as
- **Autecology & Synecology:**
 - ***Autecology:*** It is also known as ecology of individual organisms.
 - ***Synecology:*** It is also known as ecology of groups of organisms.

Classification of Ecology

- **Based on study area :**

1. Autecology : It deals with the study of an individual species of organisms and it's population. The ecologists study the behavior and adaptations of particular species to the environmental condition at every stage of that individual's life cycle. It is also called the Species ecology.
2. Synecology : It deals with the study of communities, their composition, their behavior and relation with the environment. It is also called as Ecology of communities. It is further divided into 3 types :
 - 1) Population Ecology
 - 2) Community Ecology
 - 3) Ecosystem Ecology

Classification of Ecology

2. Based on Environment or habitat

1) **Aquatic ecology** : The study of interaction of organisms in the water

1) Marine water ecology

- i) Ocean
- ii) Deep Sea
- iii) Estuary

2) Freshwater Ecology

- i) Lentic (Running water)
 - a) River
 - b) Stream
 - c) Spring
- ii) Lentic (Standing Water)
 - a) Pond
 - b) Lake



Fresh water river



Coral reefs

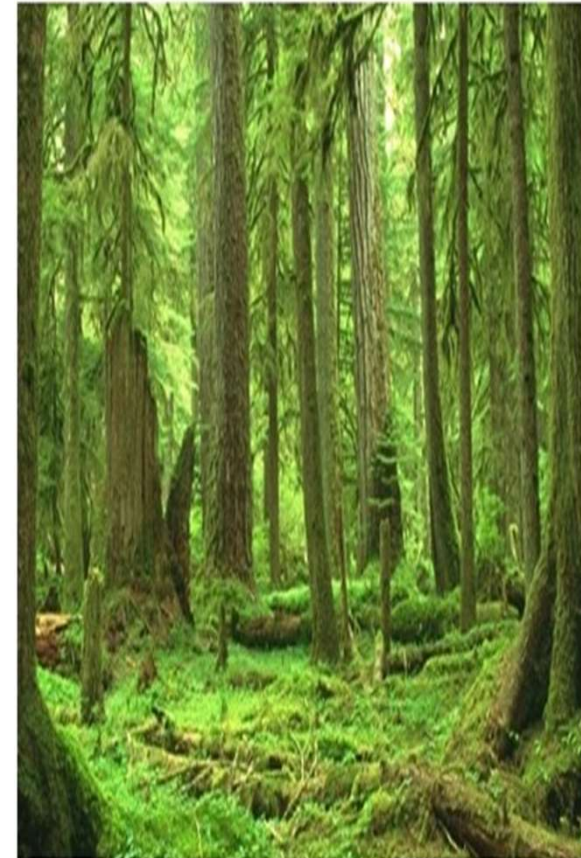
Classification of Ecology

2) **Terrestrial Ecology** : The study of interaction of organisms on land :

- a. Grassland Ecology
- b. Forest Ecology
- c. Desert Ecology

3. **Based on Advancement in the field of ecology**

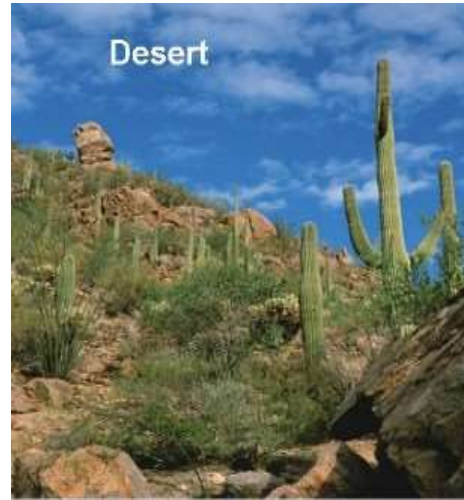
- a. Productive ecology
- b. Population ecology
- c. Community ecology
- d. Ecosystem ecology
- e. Microbial ecology
- f. Radiation ecology
- g. Pollution ecology
- h. Space ecology



Forest Ecology

Ecosystem

- The term Ecosystem was first proposed by A.G. Tansley in 1935. he defined it as “the system resulting from the interaction of all the living and non living factors of the Environment.
- An ecosystem consists of the biological community that occurs in some locale, and the physical and chemical factors that make up its non-living or abiotic environment. There are many examples of ecosystems - a pond, a forest, an estuary, a grassland.



Various types of Ecosystem

Structure of Ecosystem

- A structure of Ecosystem comprise of
- The Composition of biological community including, species number, biomass, life history, and distribution in space.
- The quantity and distribution of non-living material, such as nutrient water, etc.
- The range of condition for existence such as, temperature, light etc.

Function of Ecosystem

- Function of Ecosystem includes
- The rate of biological energy flow i.e. production & respiration rates of the community.
- The rate of material or nutrient cycles
- Biological or ecological regulation including both regulation of organism by environment and regulation of environment by the organisms

Components of an Ecosystem

- Each organisms has two main components
- **Abiotic**
- **Biotic**
- ***Abiotic Component:*** The non living factor or the physical environment prevailing in an ecosystem forms abiotic components.
- ***Abiotic component*** are mainly of two types,
- ***(a) Climatic factors*** It includes, rain, temperature, light, wind, humidity, etc.
- ***(b) Edaphic factors*** (i.e. factors related to soil) : It includes soil, pH, topography, minerals.

Components of an Ecosystem

- ***Biotic Components:*** The living organisms include, plants, animals, and micro-organisms in an ecosystem forms biotic components.
- Biotic Components are further classified into 3 main groups
- **Producers / Autotrophs**
- **Consumers / Heterotrophs**
- **Decomposers or Reducers**
- ***Producer:*** The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compound namely, water and carbon dioxide. This process is known as photosynthesis. The chemical energy stored by the producers is utilized partly by the producers for their own growth and survival and the remaining is stored in the plants for their future use.

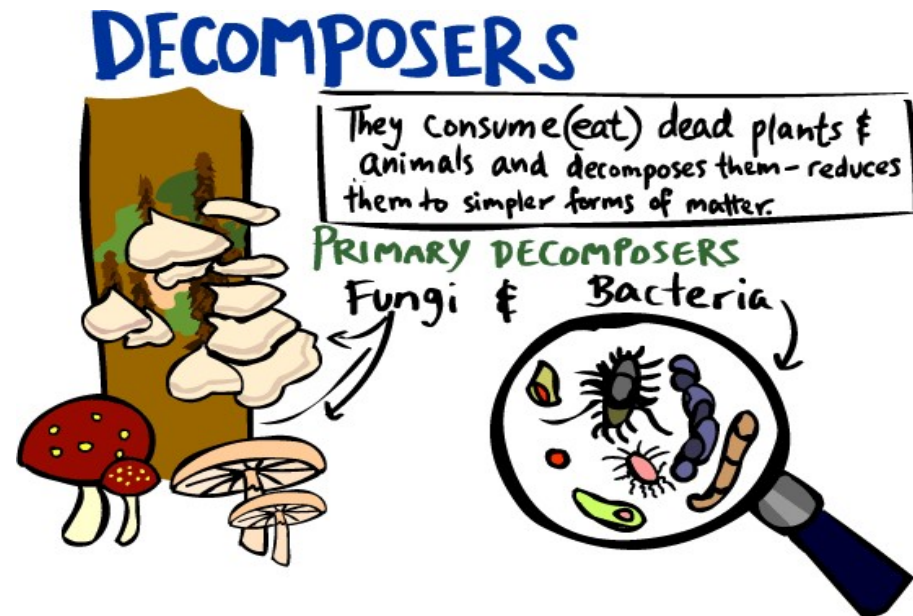
Components of an Ecosystem

- **Consumers:** The animals lack chlorophyll and are unable to synthesize their own food therefore they depend on the producers for their food.
- They are known as heterotrophs (i.e. hetero= others, trophs= feeder)
- The Consumers are of 4 types:
- **(a) Primary Consumer:** (Herbivores) i.e. Animal feeding on plants, e.g. Rabbit, deer, goat etc.
- **(b) Secondary Consumers:** The animal feeding on Herbivores are called as secondary consumers or primary carnivores. e.g. Cats, foxes, snakes.
- **(c) Tertiary Consumers:** These are large carnivores which feed on secondary consumers. e.g. Wolves
- **(d) Quaternary Consumers:** They are also called omnivores these are largest carnivores which feed on tertiary consumers and are not eaten up by any other animals.
e.g. lion and Tiger.

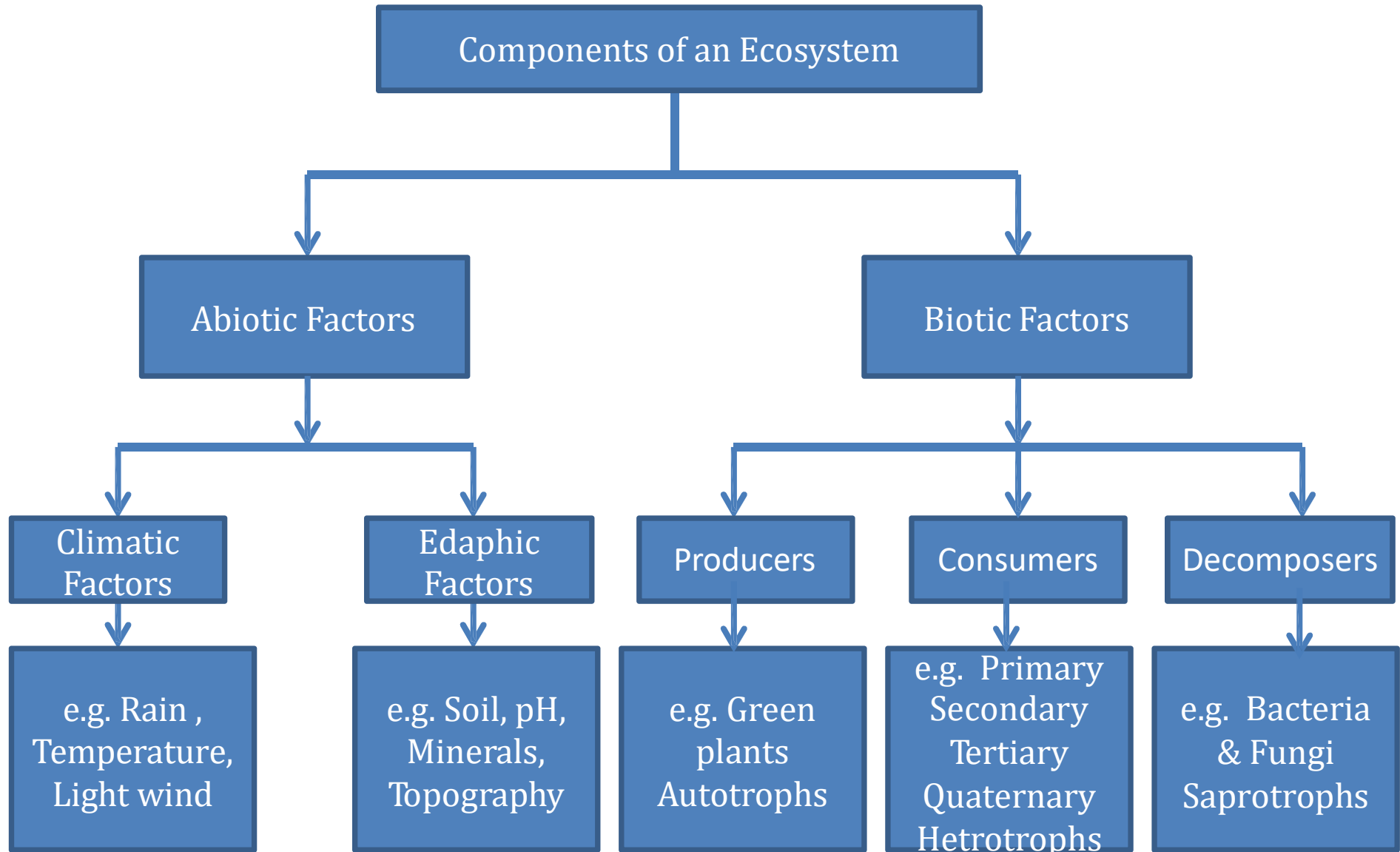
Components of an Ecosystem

- **Decomposers:** Bacteria & fungi belong to this category.

They break down the dead organic matter of producers & consumers for their food and release to the environment the simple inorganic and organic substance. These simple substances are reused by the producers resulting in a cyclic exchange of material between biotic & abiotic environment.



Components of an Ecosystem



Bio-Geo- Chemical Cycles

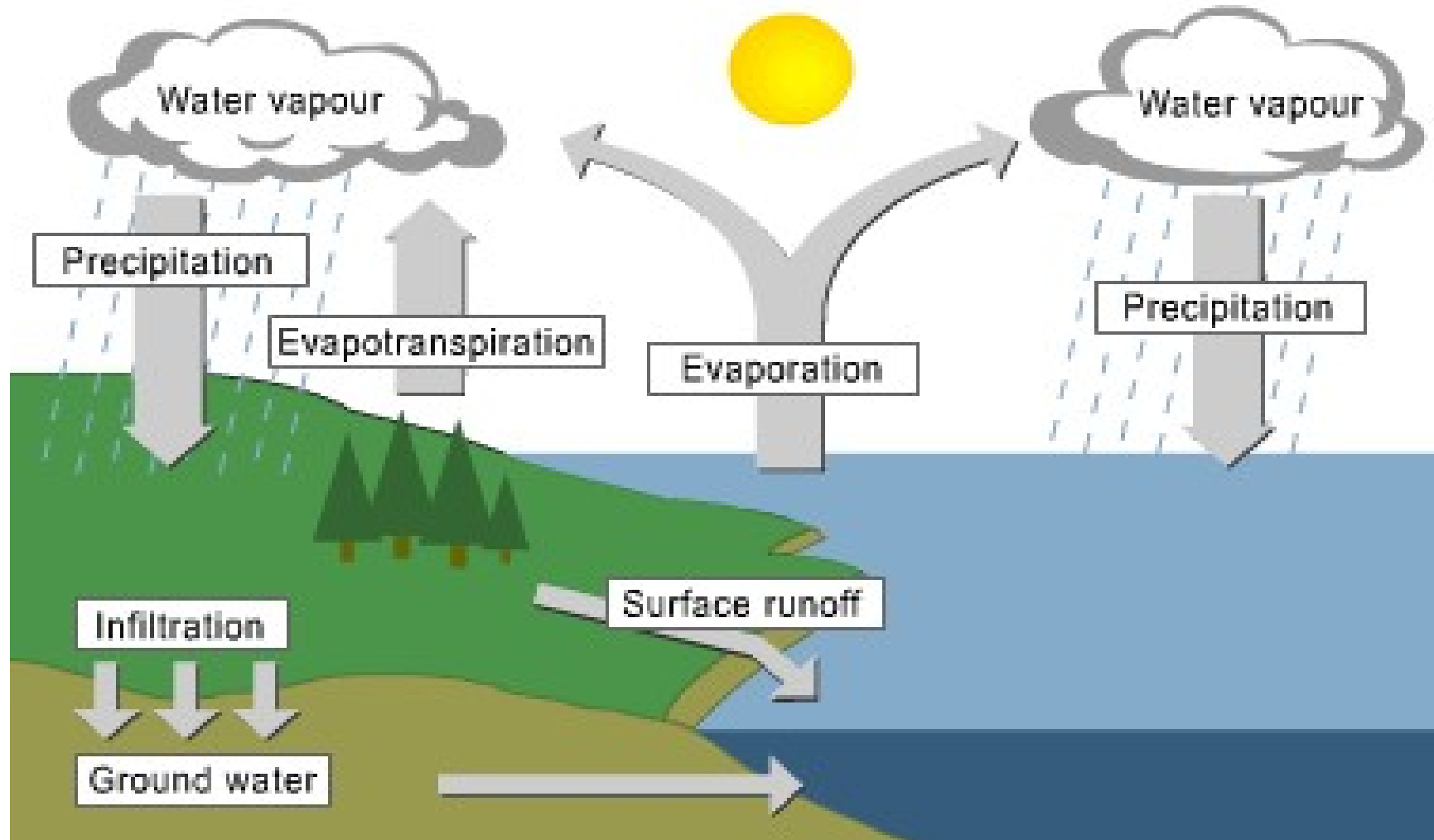
- Nutrients, unlike energy are recycled in the ecosystem. The Producers of an ecosystem take up several basic nutrients from their non-living ecosystem. Materials are in limited quantity in the earth's system and to keep the system going continuously, these materials get transformed into biomass of the producers. Thus they are utilized by the consumer population and are ultimately returned to the environment with the help of reducers or decomposers. The unique method evolved in nature is recycling materials continuously is by linking them in cycle changes. This cyclic exchange of nutrient material between the living organisms & their non-living environment is called Bio-Geochemical cycle. As indicated by the name the nutrients are circulated through life (bio) and through earth(geo) repeatedly (cycle).

Hydrological Cycle

- The natural flow of water through various components of environment resulting in the global circulation is called water cycle.
- ***Steps in Hydrological Cycle:***
- ***Evaporation:*** Surface water is heated by sun and evaporates to become water vapour, water vapour floats in the air.
- ***Condensation:*** As water vapour rises into the air it gradually cools and condenses and become minute droplet of water.
- **Clouds:** Tiny droplets of water together forms clouds.
- ***Precipitation:*** The fall of water on earth surface in any form of water it may be in the form of dew, drizzle, rain is known as precipitation.
- ***Runoff:*** Precipitated rain water accumulates and flows on the surface and sub-surface towards rivers, streams, and underground stores and ultimately reaches to sea.
- ***Percolation & infiltration:*** The process of stored water flowing under earth, merge to the ground water source is called percolation and infiltration
- ***Transpiration:*** The water which directly evaporates from leaves of plants is called Transpiration.
- ***Completion of Cycle:*** All the water bodies continues its journey towards the natural slope and meet the sea where the cycle starts again.

Hydrological Cycle

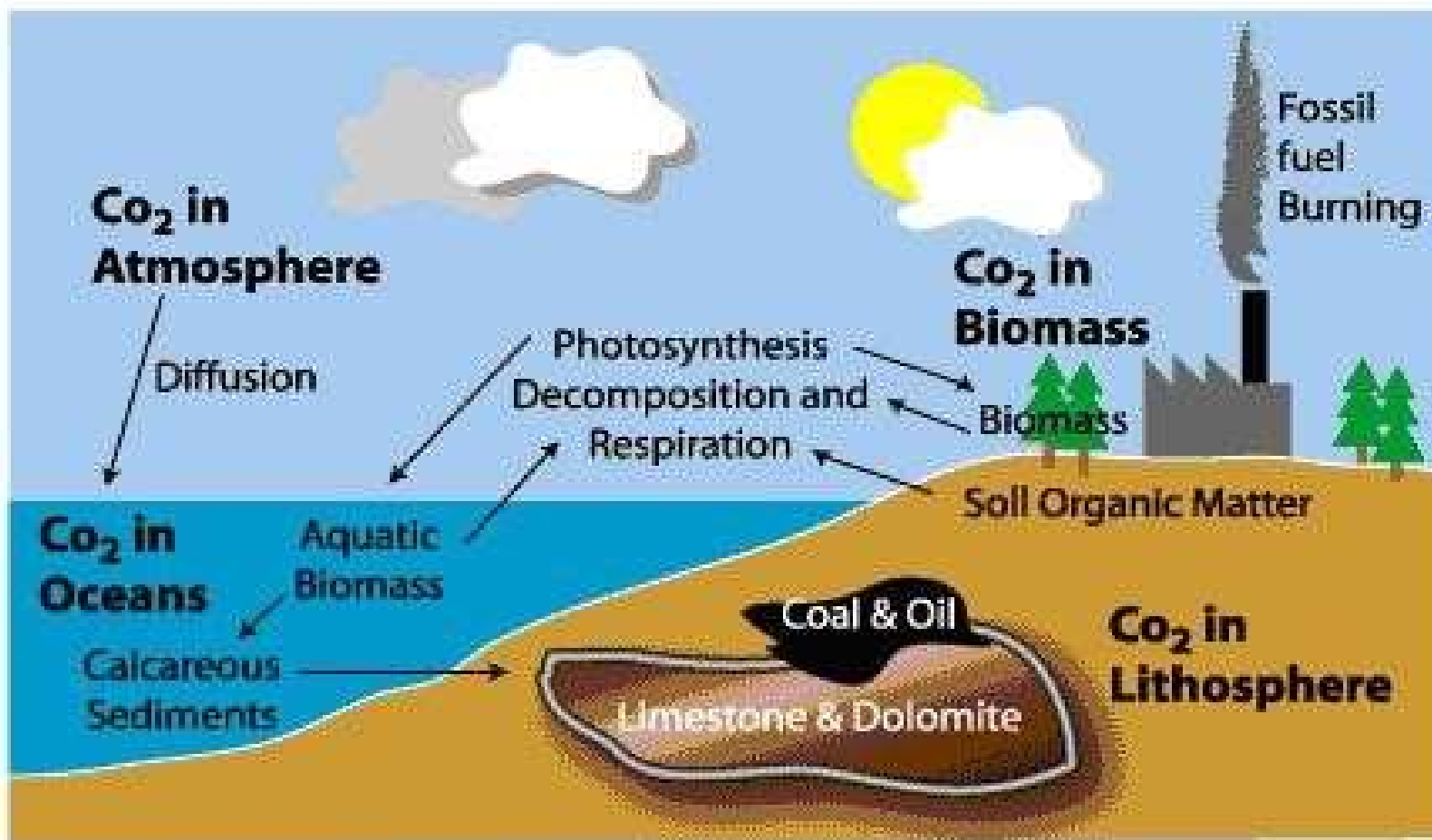
Definition : The water from various moist surface evaporates and falls again on the earth in the form of rains and snow and passes through living organisms and ultimately returns to the ocean or water bodies. This cycle is called as hydrological cycle.



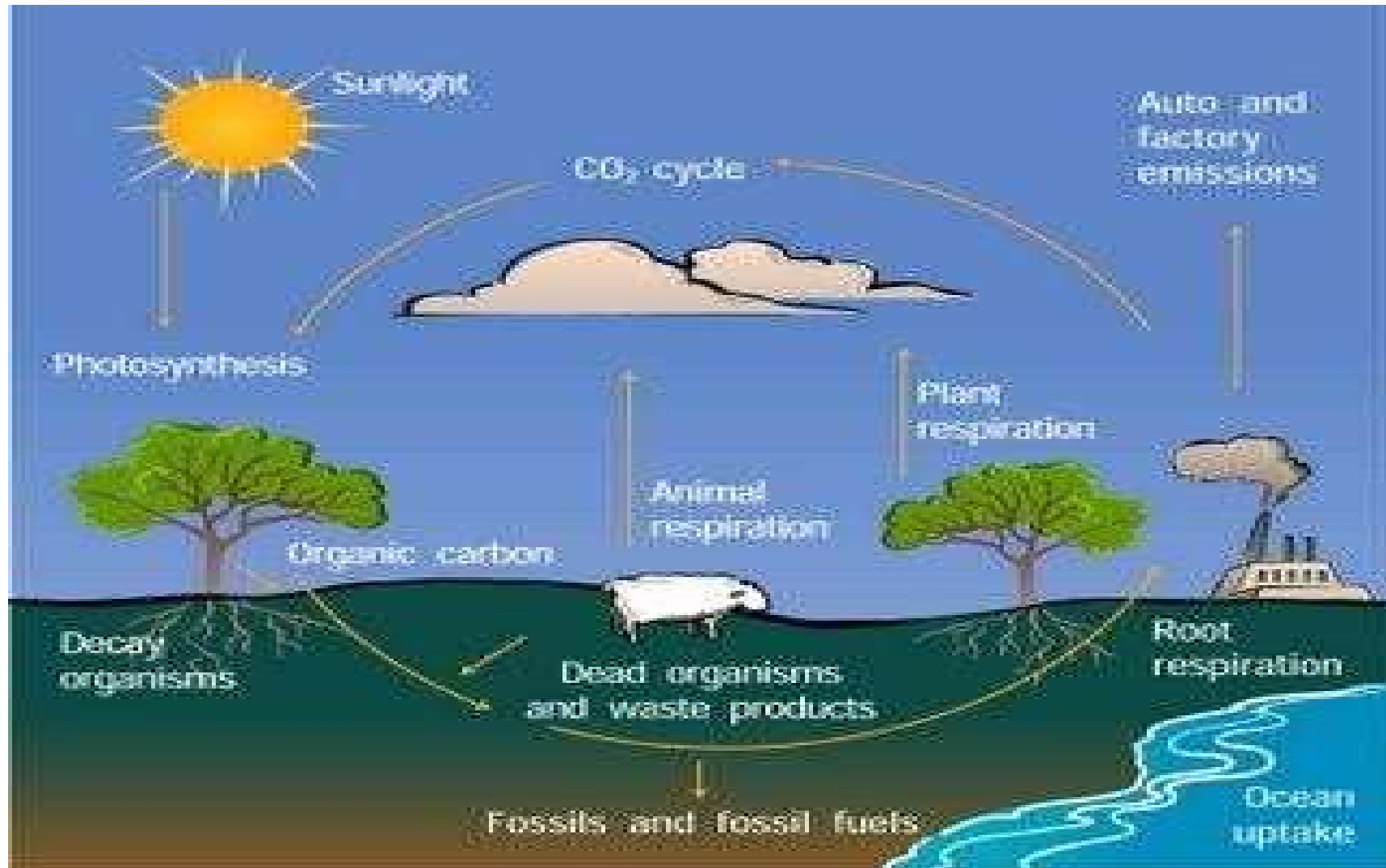
Carbon Cycle

- The **carbon cycle** is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.
- Carbon dioxide gas is emitted from various natural and anthropogenic sources such as , volcanic eruptions, burning forests, decomposition of carbonates, factories & Automobile exhausts, during respiration by humans and plants. The plants consume carbon dioxide during the process of photosynthesis.
- The major reservoir for carbon dioxide are in oceans, carbon dioxide dissolves readily in water.
- On land and in water, plants take up carbon dioxide and convert it into carbohydrates during the process of photosynthesis.
- $6\text{CO}_2 + 6\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- The plants are eaten by animals and when plants & animals die the carbon content in the organic matter again return to the soil with the help of decomposers.

Carbon Cycle



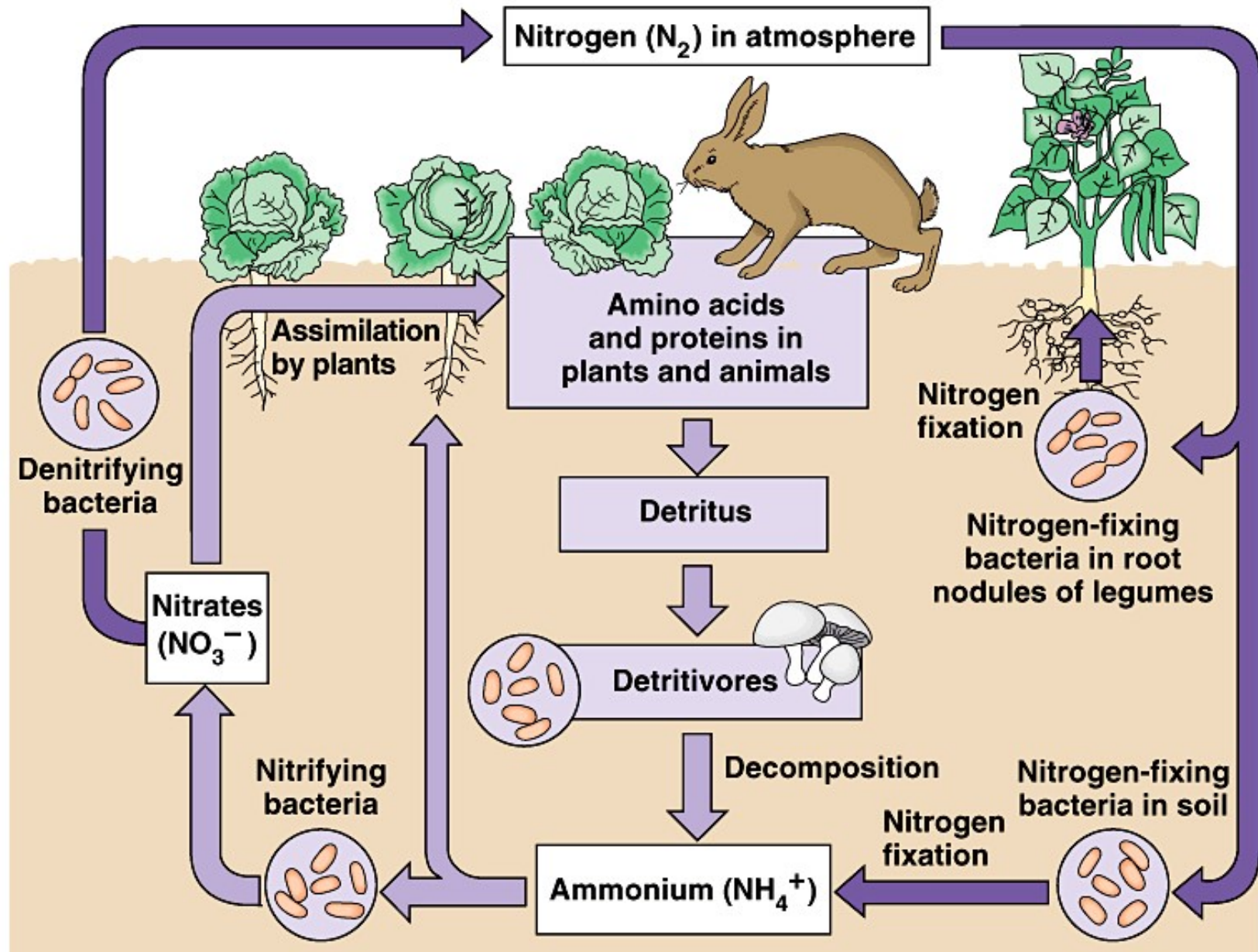
Carbon Cycle



Nitrogen Cycle

- Nitrogen is present in atmosphere as N_2 in large amount (78 %) and it is fixed either by physical process of lightening or biologically by some bacteria like rhizobium, aezotobacter and cyanobacteria these microorganisms converts elemental nitrogen into nitrates. Nitrogen in the for of Nitrates is taken up by plants and used in metabolism for biosynthesis of amino acids, proteins, vitamins etc. and passes through the food chain. After death of the plant and animals, the organic nitrogen in dead tissues is decomposed by several groups of nitrifying bacteria which convert them in to ammonia, nitrite & nitrates, which are again used by plants. Some bacteria (denitrifying bacteria) converts nitrates in to molecular Nitrogen or N_2 under anaerobic condition, which is release back into atmosphere and the cycle goes on.

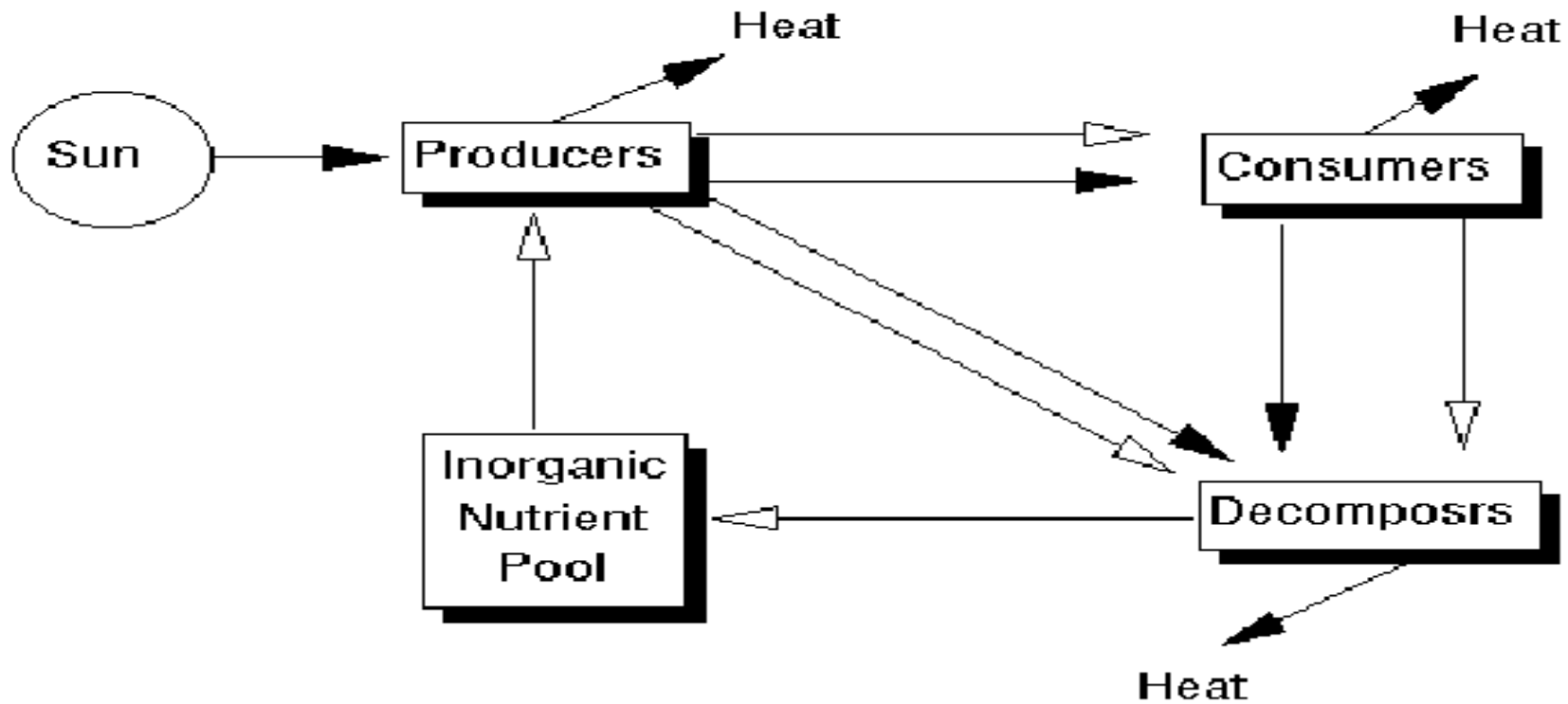
Nitrogen Cycle



Energy flow in an Ecosystem

- Biological activities requires energy which ultimately comes from the sun. Solar energy is transformed into chemical energy by a process of photosynthesis this energy is stored in plant tissue and then transformed into heat energy during metabolic activities.
- Thus in biological world the energy flows from the sun to plants and then to all heterotrophic organisms The flow of energy is unidirectional and non-cyclic. This one way flow of energy is governed by laws of thermodynamics which states that:
 - (a) Energy can neither be created nor be destroyed but may be transformed from one form to another.
 - (b) During the energy transfer there is degradation of energy from a concentrated form (mechanical, chemical, or electrical etc.) to a dispersed form (heat).
- No energy transformation is 100 % efficient, it is always accompanied by some dispersion or loss of energy in the form heat. Therefore, biological systems including ecosystems, must be supplied with energy on a continuous Basis.

Energy flow in an Ecosystem



Food Chain & Food Web

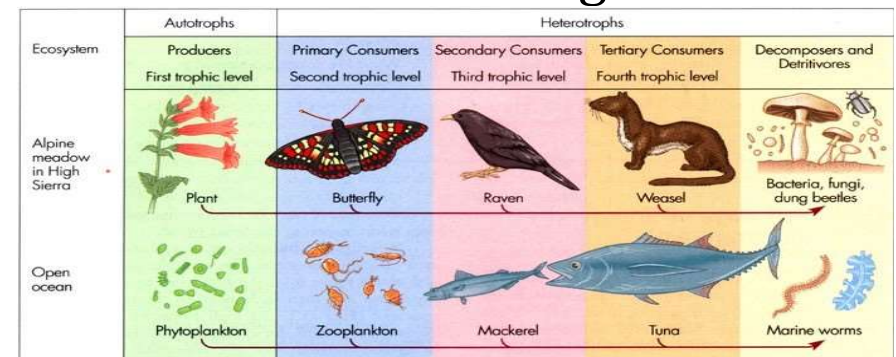
- ***Food Chain:*** In food chain each organism eats the smaller organisms and is eaten by the larger one. All those organisms which are interlinked with each other through food to gather constitute the ecosystem.
- The different levels in a food chain are called trophic levels, Each food chain has three main trophic levels:- Producer level, Consumer level, and decomposer level.
- If any of the intermediate stage of the food chain is removed, the succeeding links of the food chain will be affected.
- The arrangement in a food chain can be depicted as :

Types of Food Chains

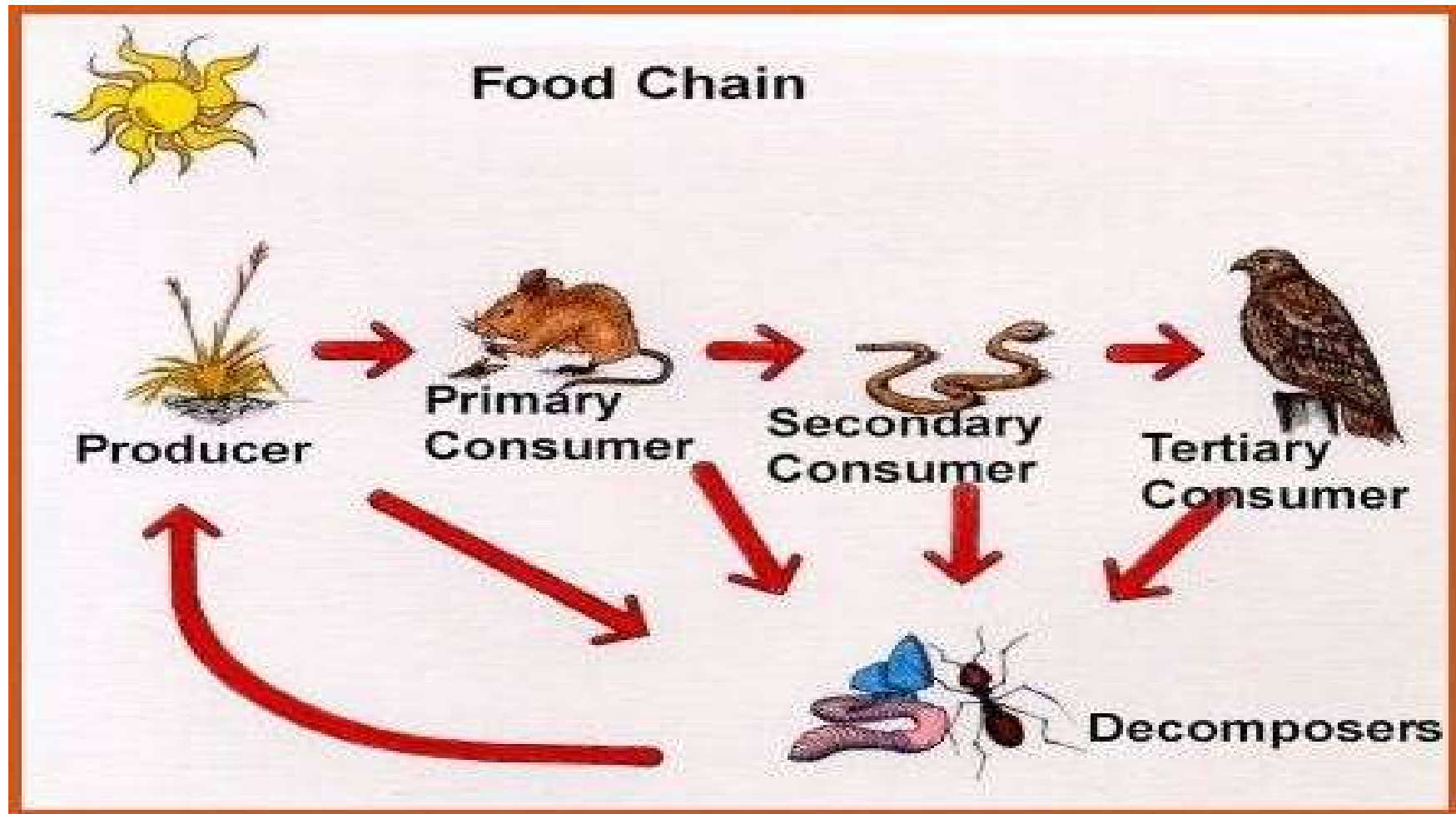
Grazing Food Chain: This type of food chain starts from living green plants goes to grazing herbivores and onto carnivores. Ecosystem with such type of food chain directly depends upon the solar energy for their food requirements. Most of the ecosystem in nature follow this type of food chain.

Detritus food Chain: This type of food chain goes from dead organic matter onto microorganisms and then to the organisms feeding on detritus and their predators. Such ecosystem are less dependent on direct solar energy.

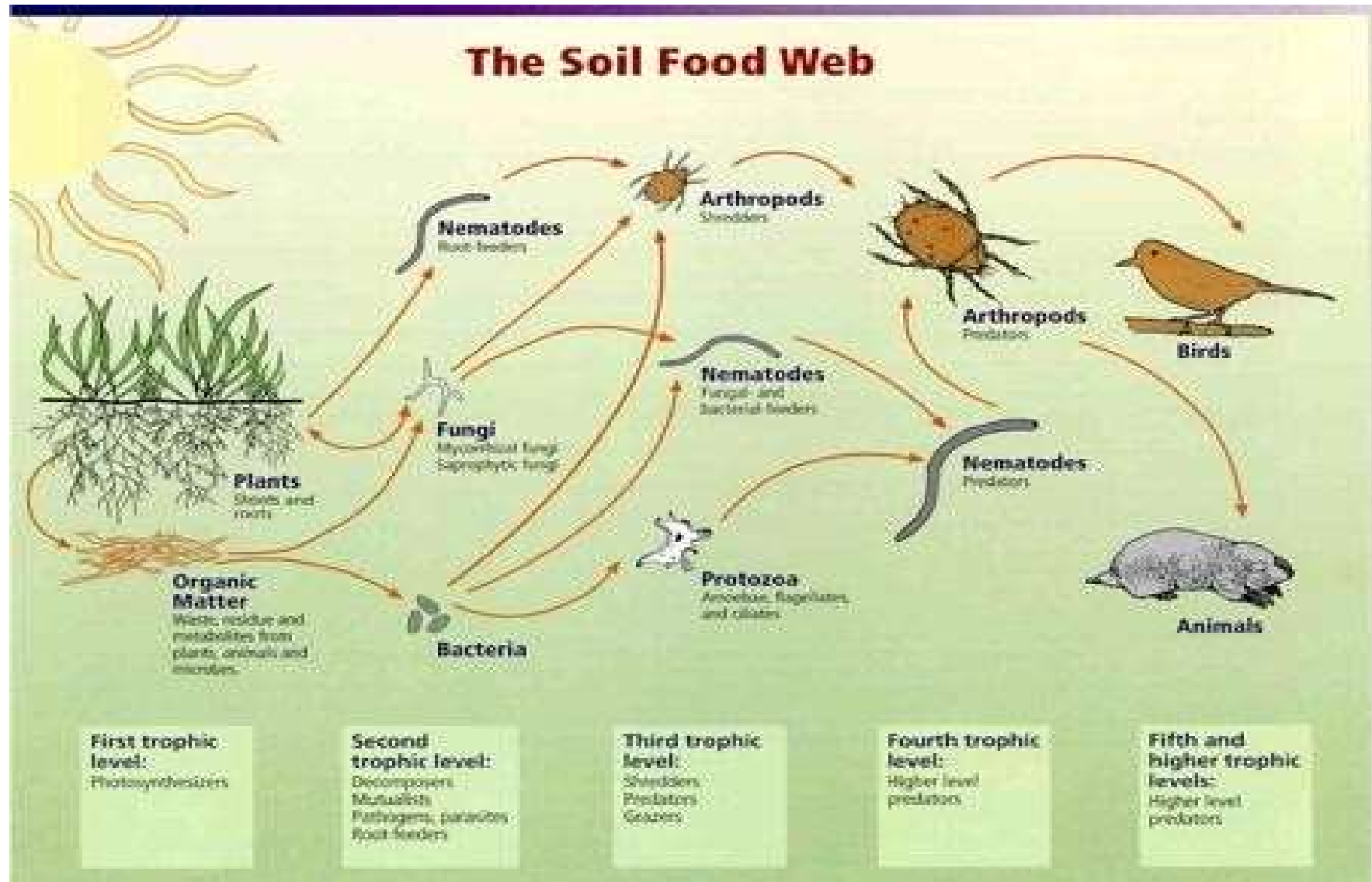
Parasitic Food Chain: This type of food chain starts from big hosts and ends with parasitic organisms.



Grazing Food Chain



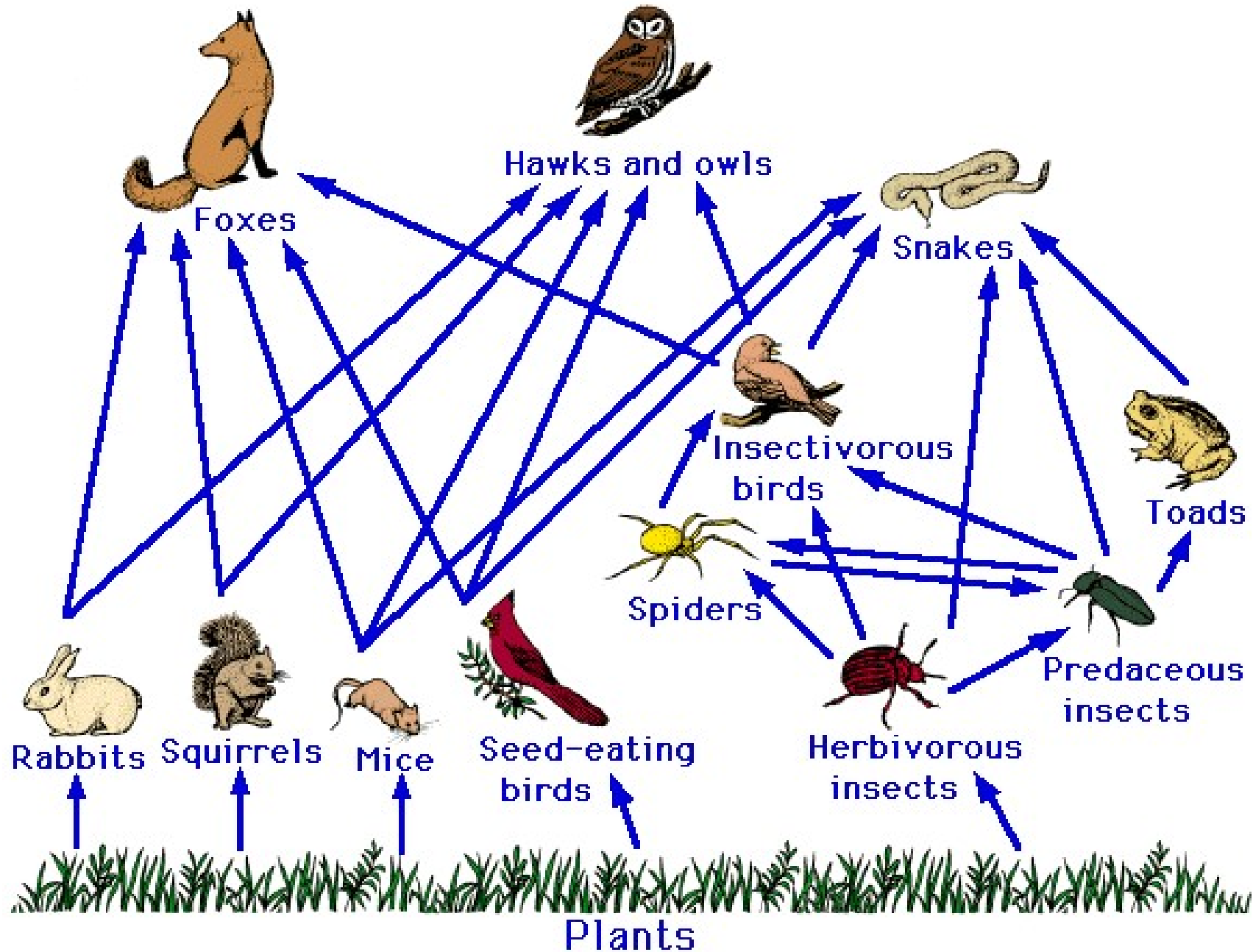
Detritus Food Chain



Food Web

- ***Food Web:*** The interconnected, interlocking pattern of food chain is known as food web.
- Under natural condition of the linear arrangement of food chain hardly occurs and they remain interconnected with each other through different types of organisms at different levels Such a interconnected and interlocking pattern of food chain is known as food web..

Food Web



Ecological Pyramids

- The different species in a food chain are called trophic levels. Each food chain has 3 main trophic level, producer, consumer, and decomposers.
- Thus Graphical representation of these trophic levels is called as Ecological Pyramids. It was devised by an ecologist “ Charles Elton” therefore this pyramid are also called Ecological pyramid or Eltonian pyramids.

Types of Ecological Pyramids

- Ecological pyramids are of three types:
- Pyramid of Number
- Pyramid of biomass
- Pyramid of Energy

Pyramid of Number

- They show the relationship between producers, herbivores, and carnivores at successive trophic levels in terms of their number.
- In case of grassland ecosystem the producers are mainly grasses and are always maximum in number this number then shows a decrease towards apex as primary consumers like mice, rabbit are lesser in number than grasses, the secondary consumers like lizard, snake, are even lesser in number than the grasses, finally the top tertiary consumers like hawks are least in number. Thus the shape of pyramid is upright. But in case of forest ecosystem the pyramid is always inverted because the producers are mainly large trees, are lesser in numbers, the herbivores fruit eating birds are more in number than the producers, then there is gradual decrease in number of secondary consumers thus making pyramid upright again. Thus the pyramid of number does not give a true picture of the food chain and are not very functional.

Pyramid of Number

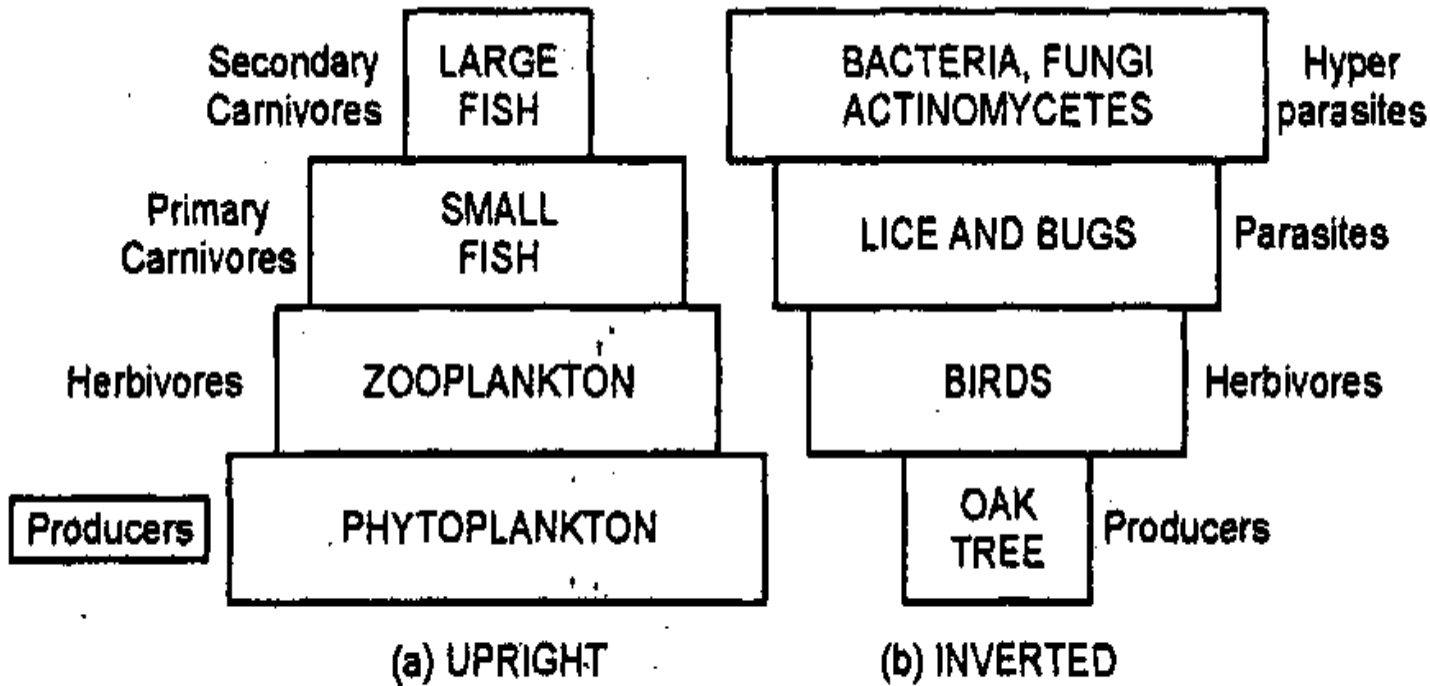
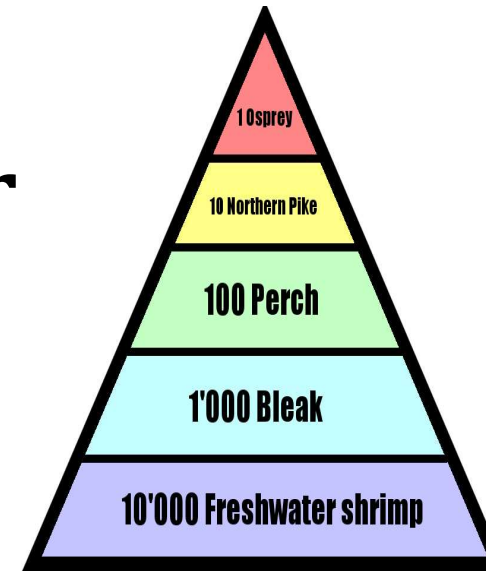


FIGURE 14.9. Pyramids of numbers (A) in pond ecosystem (B) in parasitic food chain.

Pyramid of Biomass

- The pyramid of biomass represents the relationship between different trophic levels in terms of biomass.
- There is generally gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramid of biomass is upright for grassland ecosystem.
- However in case of a pond as the producers are algae, are least in number and this value gradually shows an increase towards the apex of pyramid thus making the pyramid inverted in shape.

Pyramid of Biomass

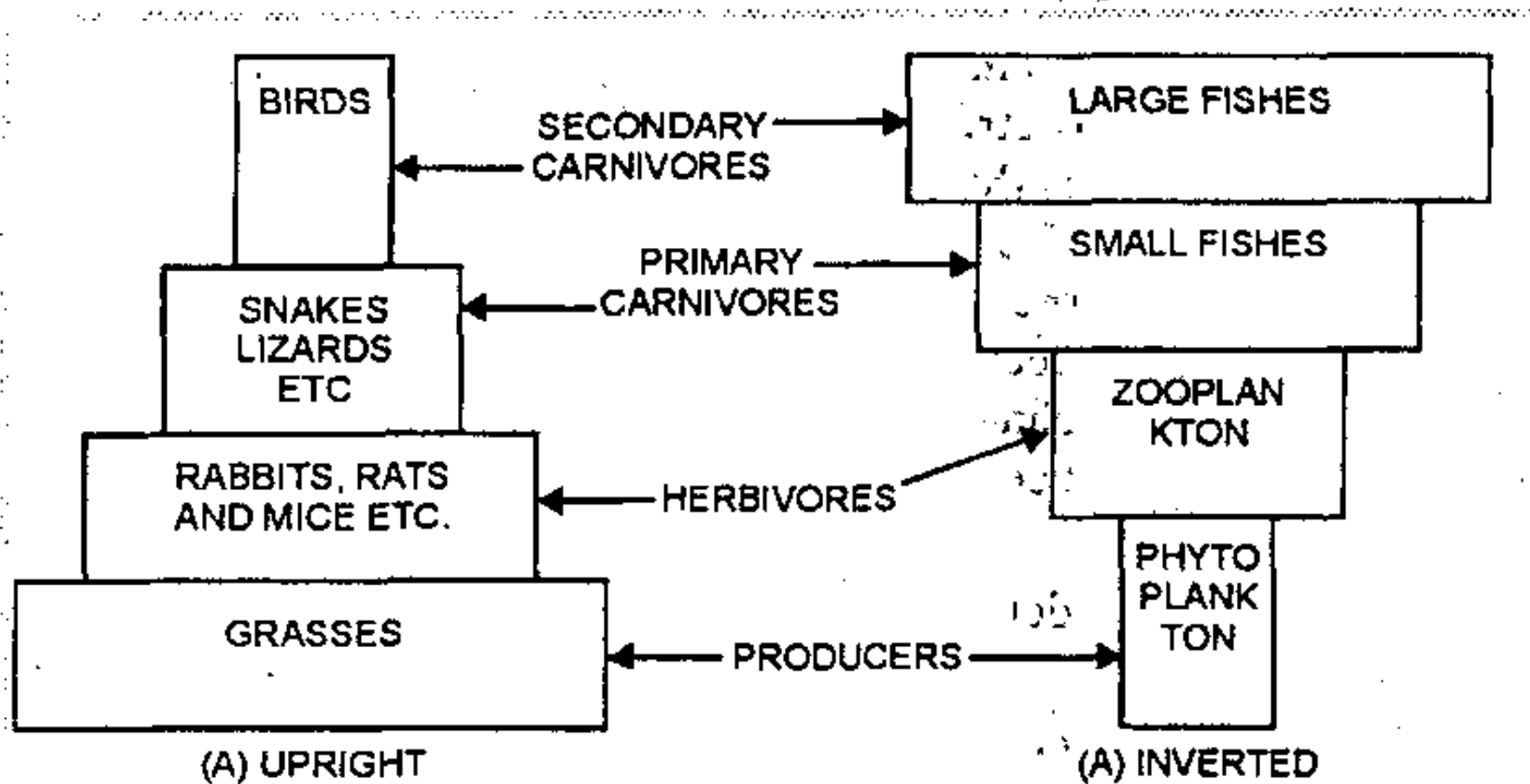
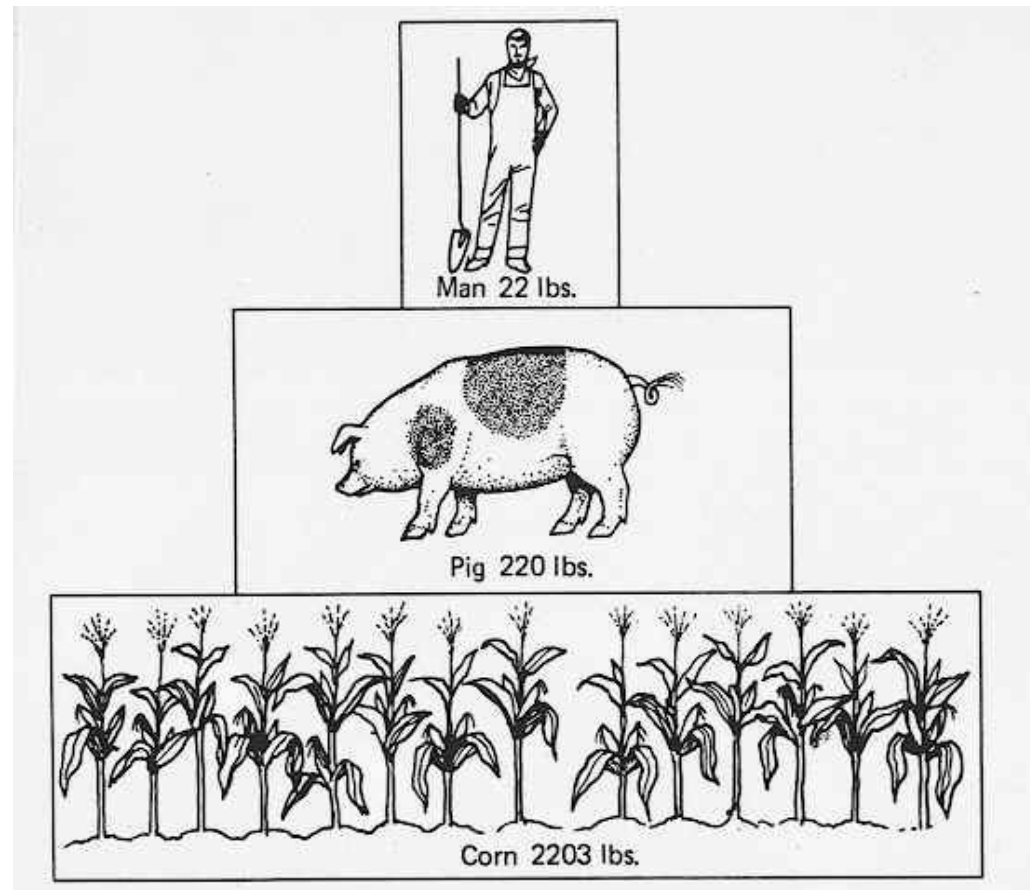


FIGURE 14.10. Pyramids of biomass
(A) in a grassland ecosystem (B) in a pond ecosystem.

Pyramid of Biomass:

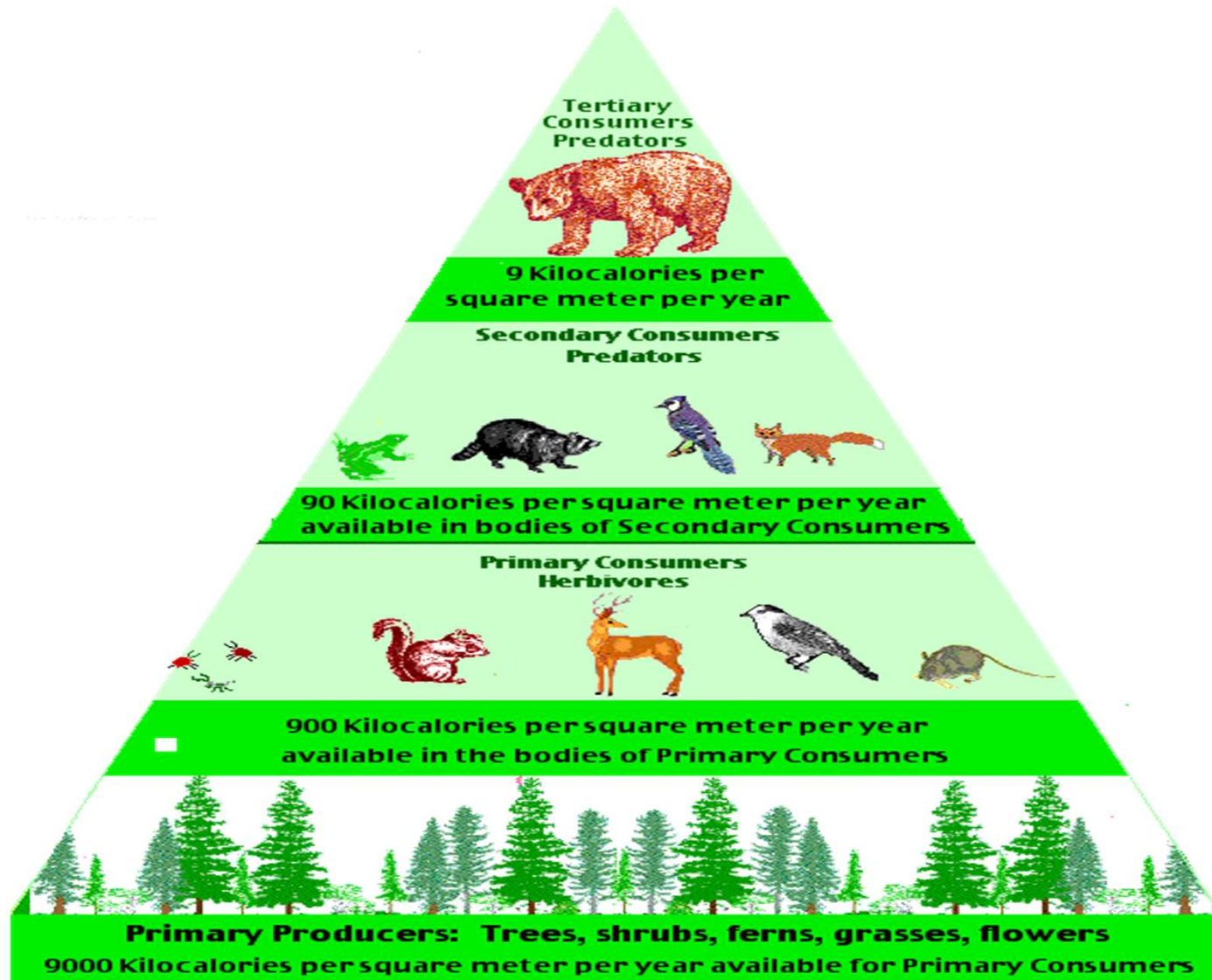
- Illustrates the amount of biomass in each trophic level
 - - Biomass weight is determined after dehydration
- Shows the amount of matter lost
- between trophic levels.
- Measured in Kg, grams or pounds



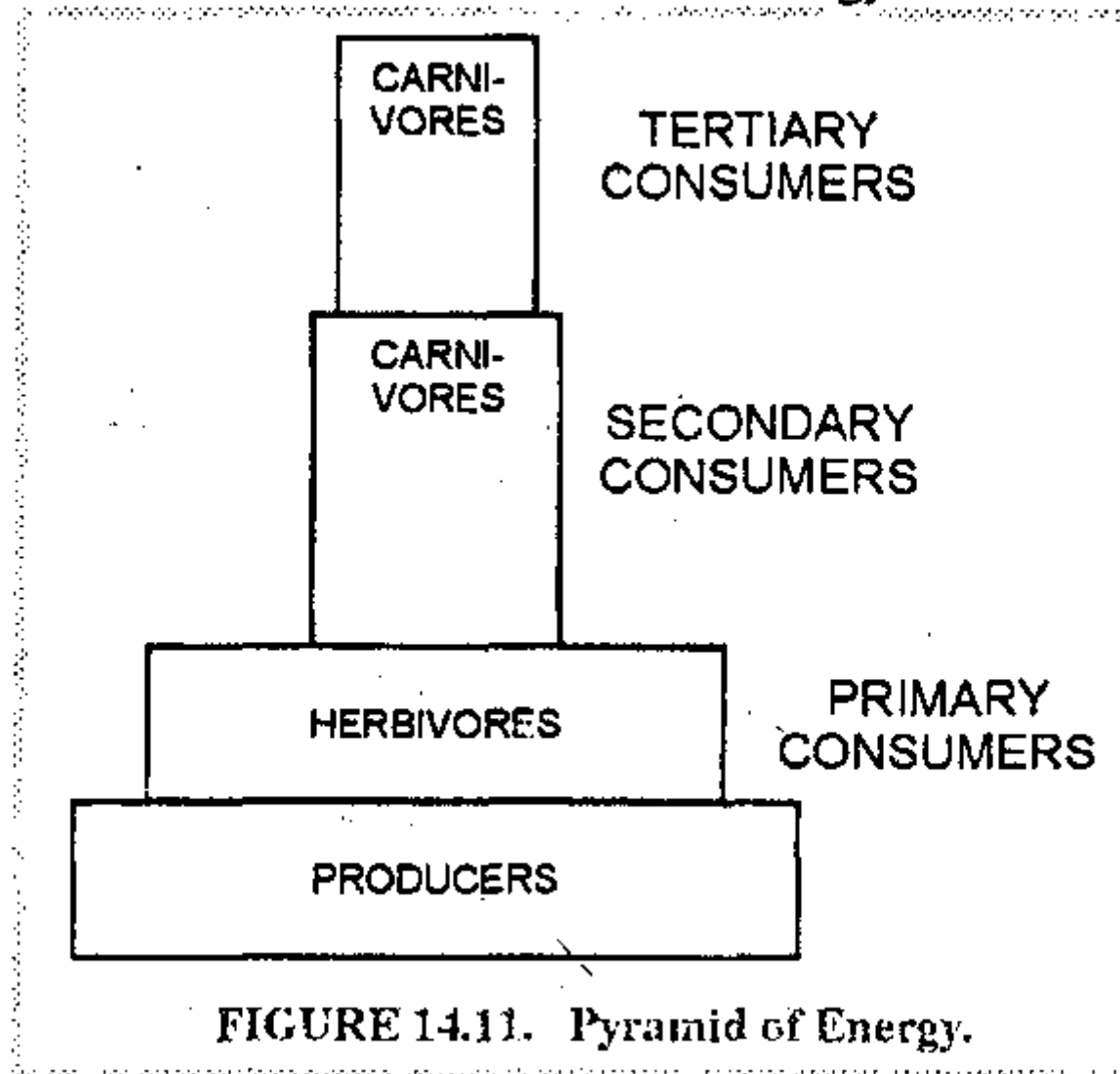
Pyramid of Energy

- Of the 3 types of ecological pyramid the energy pyramid gives the best picture of overall nature of the ecosystem. In this type of pyramid the trophic level is decided depending upon the rate at which food is being produced.
- In shape it is always upright as in most of the cases there is always gradual decrease in the energy content at successive trophic level from producers to various consumers.

Pyramid of Energy

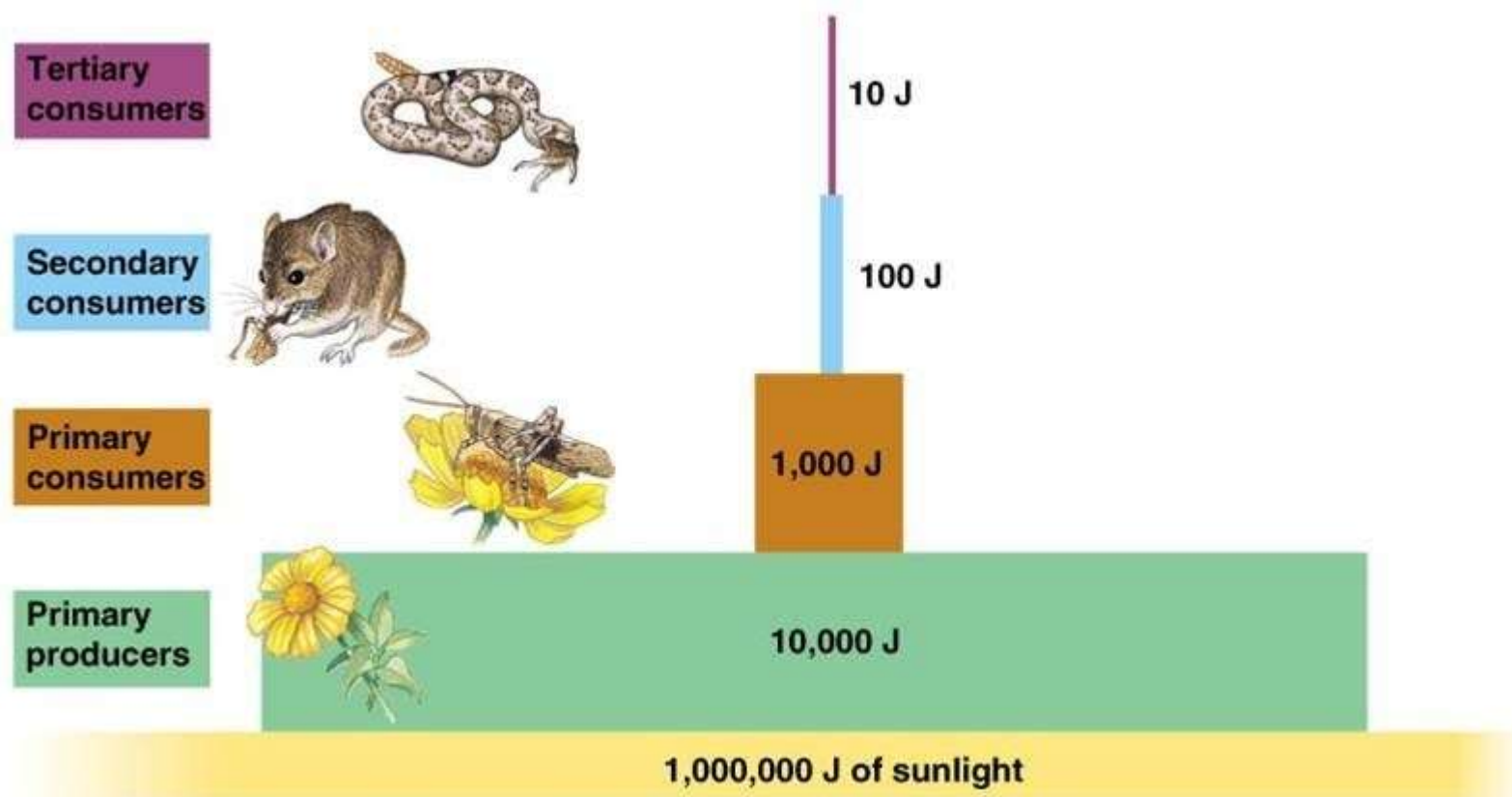


Pyramid of Energy



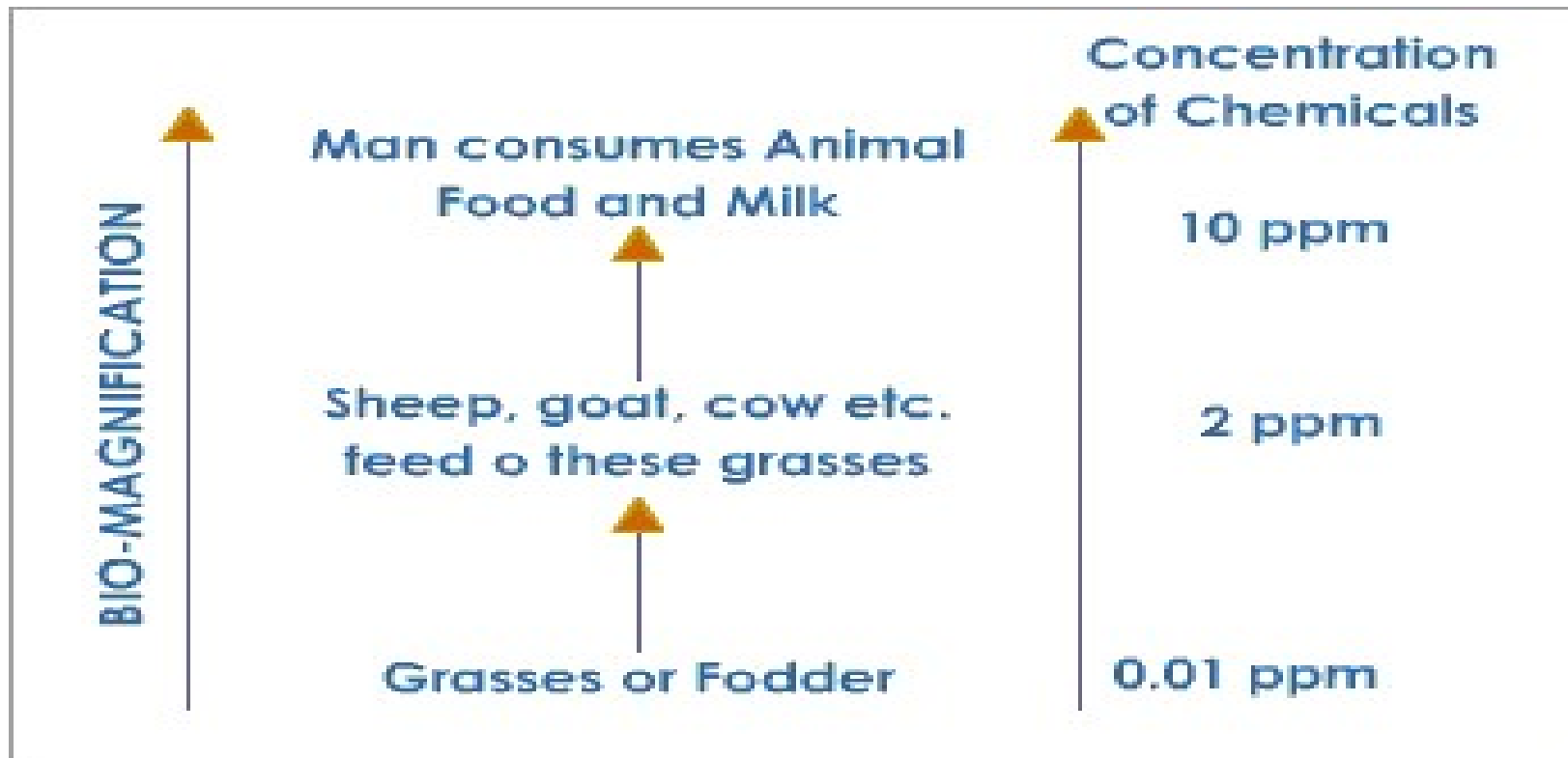
Pyramid of Energy:

- Shows the energy available at each trophic level.
 - The size of the blocks represents the proportion of productivity
 - Measured in Joules or Calories



Bio-Magnification

- Biological magnification is the tendency of pollutants to get concentrated in successive trophic levels. Large concentration of pollutants Could be detrimental if they are toxic.



Types of Ecosystem

1. **Natural Ecosystems** : These operate under natural conditions without any major interference by man.
 - i. **Terrestrial Ecosystem** : Forest, grassland, desert, etc.
 - ii. **Aquatic Ecosystem** :
 - a. **Fresh water** : Lotic (running water like spring, stream, or rivers) or Lentic (standing water as lake, pond, pools, etc.)
 - b. **Marine water** : Such as deep bodies as ocean or shallow ones as Sea or an estuary.



Lentic (standing water) lake ecosystem



Lotic (flowing water) river ecosystem

Types of Ecosystem

2. **Artificial (Man Engineered) Ecosystems** : These are maintained artificially by man where by addition of energy and planned manipulation, natural balance is disturbed regularly e.g., crop land ecosystem.

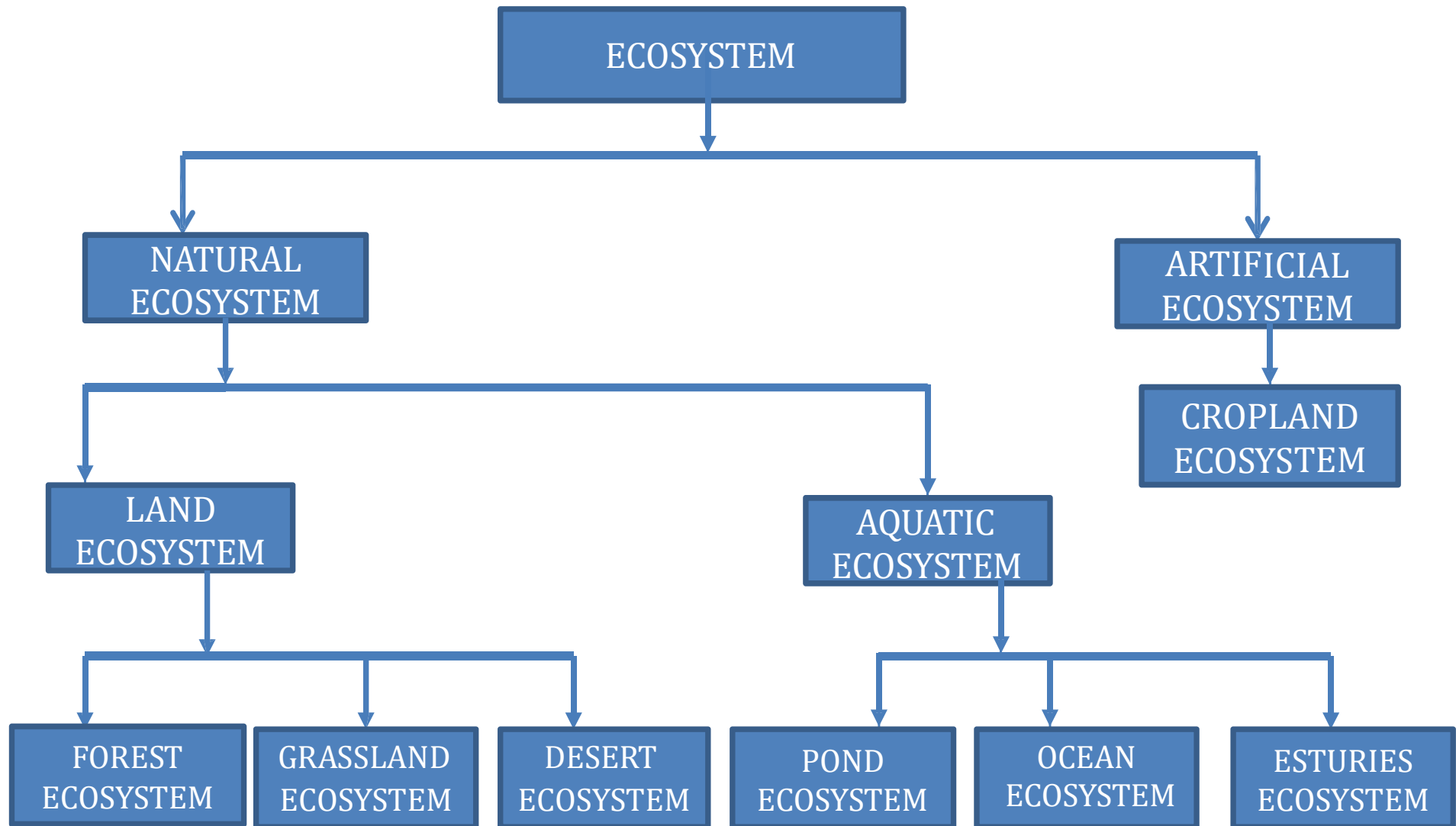


Crop land ecosystem

Major Ecosystems

- Earth is a vast ecosystem it is however difficult to handle and thus for convenience we generally study it by making artificial subdivisions into units of smaller ecosystem. (eg. *Terrestrial ecosystem* as, forest ecosystem, desert ecosystem, grassland ecosystem, *manmade ecosystem* as cropland ecosystem, and *aquatic ecosystem* as freshwater, marine, etc.)
- An ecosystem thus be separated from each other but it must be remembered that these units of ecosystem are linked with each other forming an integrated system.

Classification of Ecosystem



Classification of Ecosystem

- Different types of ecosystem of biosphere artificially categorized as follows:
- **Natural Ecosystems**
- **Artificial ecosystems**
- **Natural Ecosystems**
- These ecosystems operate by themselves under natural conditions without any major interference by man. Based upon the particular kind of habitat, these are further divided as:
 - Terrestrial as forest, grassland, desert etc.
 - Aquatic which may be further distinguished as
 - Freshwater which may be lotic (running water as springs, stream, river) or lentic (standing water as lake, pond, pools, ditch, swamps, etc.)
 - Marine Ecosystems: as an ocean or shallow ones like sea or estuary etc.

- ***Artificial Ecosystems:*** These are maintained by man where, by addition of energy & planned manipulations natural balance is disturbed regularly, for ex , croplands like maize, wheat, rice-fields etc, where man tries to control the biotic community as well as physico-chemical environment are artificial ecosystems.

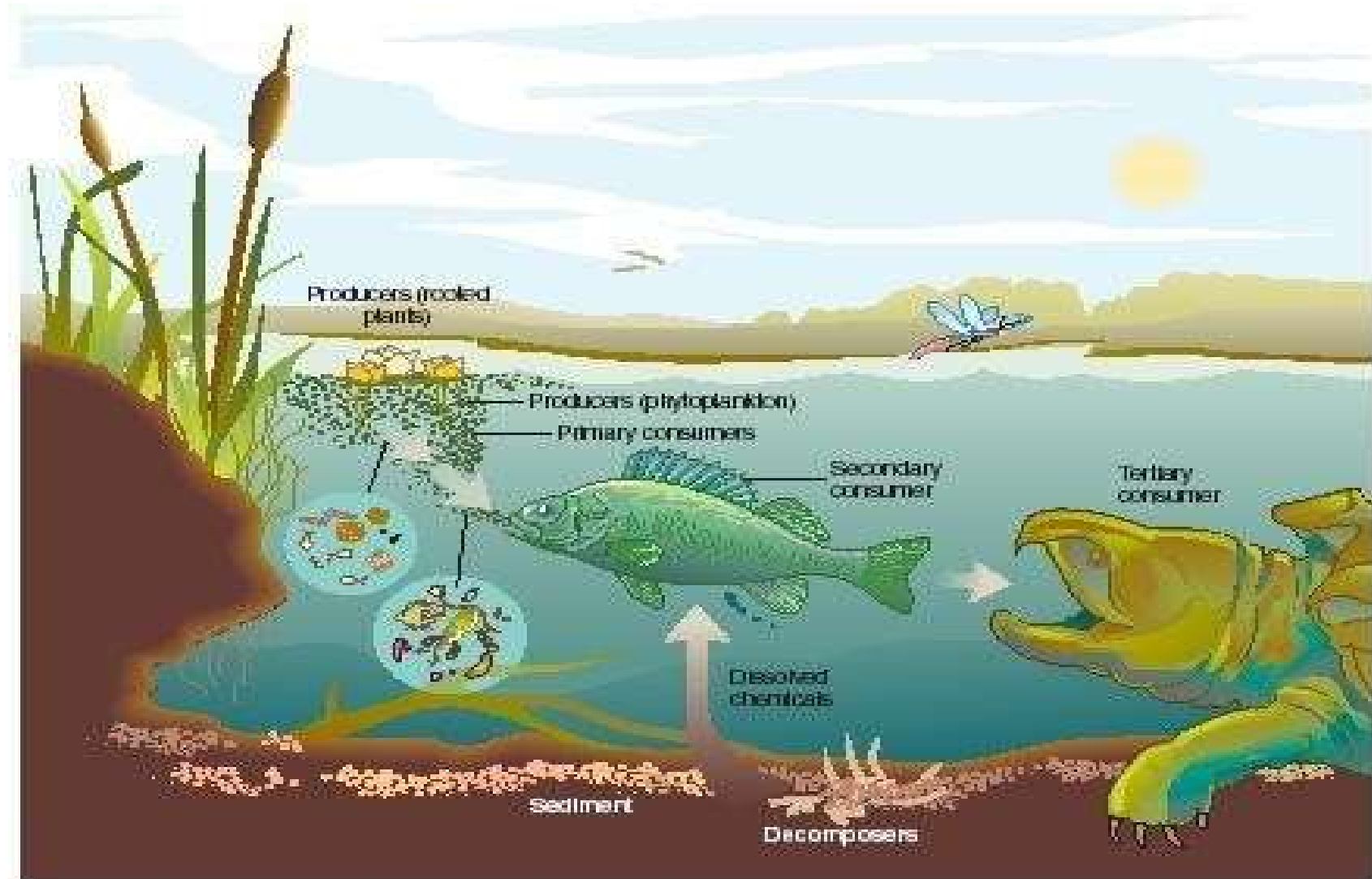
Pond Ecosystem

- ***Pond Ecosystem:*** A Pond as a whole serves a good example of freshwater ecosystem
- ***Abiotic Components:*** The chief components are heat, light, pH of water, CO₂, oxygen, calcium, nitrogen, phosphates, etc.
- ***Biotic Components:*** The various organization that constitute the biotic component are as follows,
- ***Producers:*** These are green plants, and some photosynthetic bacteria. The producer fix radiant energy and convert it into organic substances as carbohydrates, protein etc.

Pond Ecosystem

- **Producers** are of following type
- **Macrophytes:** these are large rooted plants, which include partly or completely submerged hydrophytes, eg Hydrilla, Trapa, Typha.
- **Phytoplankton:** These are minute floating or submerged lower plants eg algae.
- **Consumers:** They are heterotrophs which depends for their nutrition on the organic food manufactured by producers.
- **Primary Consumers:**
 - **Benthos:** These are animals associated with living plants ,detritivores and some other microorganisms
 - **Zooplanktons:** These are chiefly rotifers, protozoans, they feed on phytoplankton
- **Secondary Consumers:** They are the Carnivores which feed on herbivores, these are chiefly insect and fish, most insects & water beetles, they feed on zooplanktons.
- **Tertiary Consumers:** These are some large fish as game fish, turtles, which feed on small fish and thus become tertiary consumers.
- **Decomposers:** They are also known as micro-consumers. They decompose dead organic matter of both producers and animal to simple form. Thus they play an important role in the return of minerals again to the pond ecosystem, they are chiefly bacteria, & fungi.

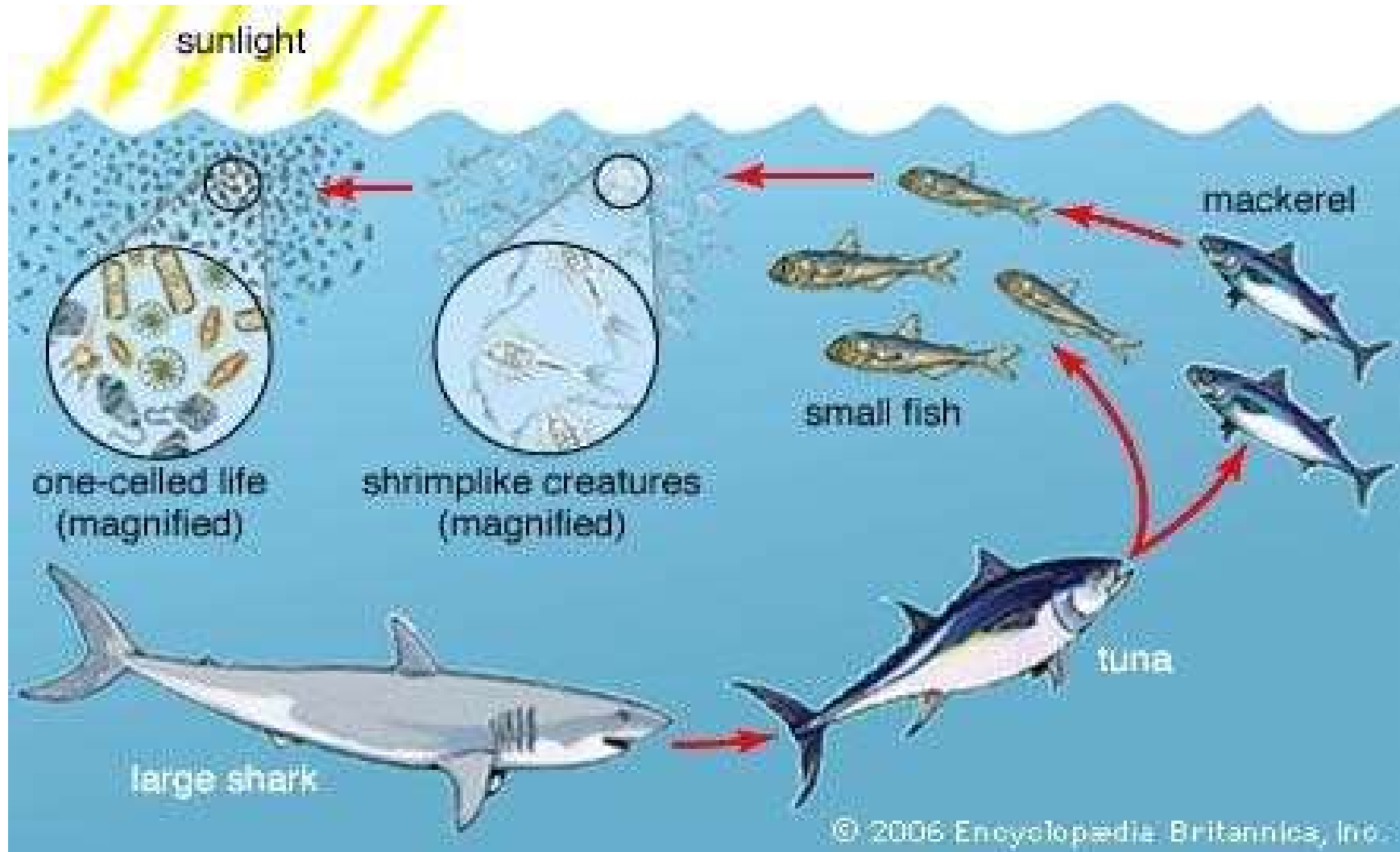
Pond Ecosystem



Ocean Ecosystem

- Ocean Ecosystem are more stable than pond ecosystem, they occupy 70 % of the earth surface.
- **Abiotic Components:** Dissolved oxygen, light, temperature, minerals.
- Biotic Components:
- **Producers:** These are autotrophs and are also known Primary producers. They are mainly, some microscopic algae (phytoplanktons) besides them there are mainly, seaweeds, as brown and red algae also contribute to primary production.
- **Consumers:** They are all heterotrophic macro consumers
- **Primary Consumer:** The herbivores, that feed on producers are shrimps, Molluscs, fish, etc.
- **Secondary Consumers:** These are carnivores fish as Herring, Shad, Mackerel, feeding on herbivores.
- **Tertiary Consumers:** These includes, other carnivores fishes like, COD, Halibut, Sea Turtle, Sharks etc.
- **Decomposers:** The microbes active in the decay of dead organic matter of producers, and animals are chiefly, bacteria and some fungi.

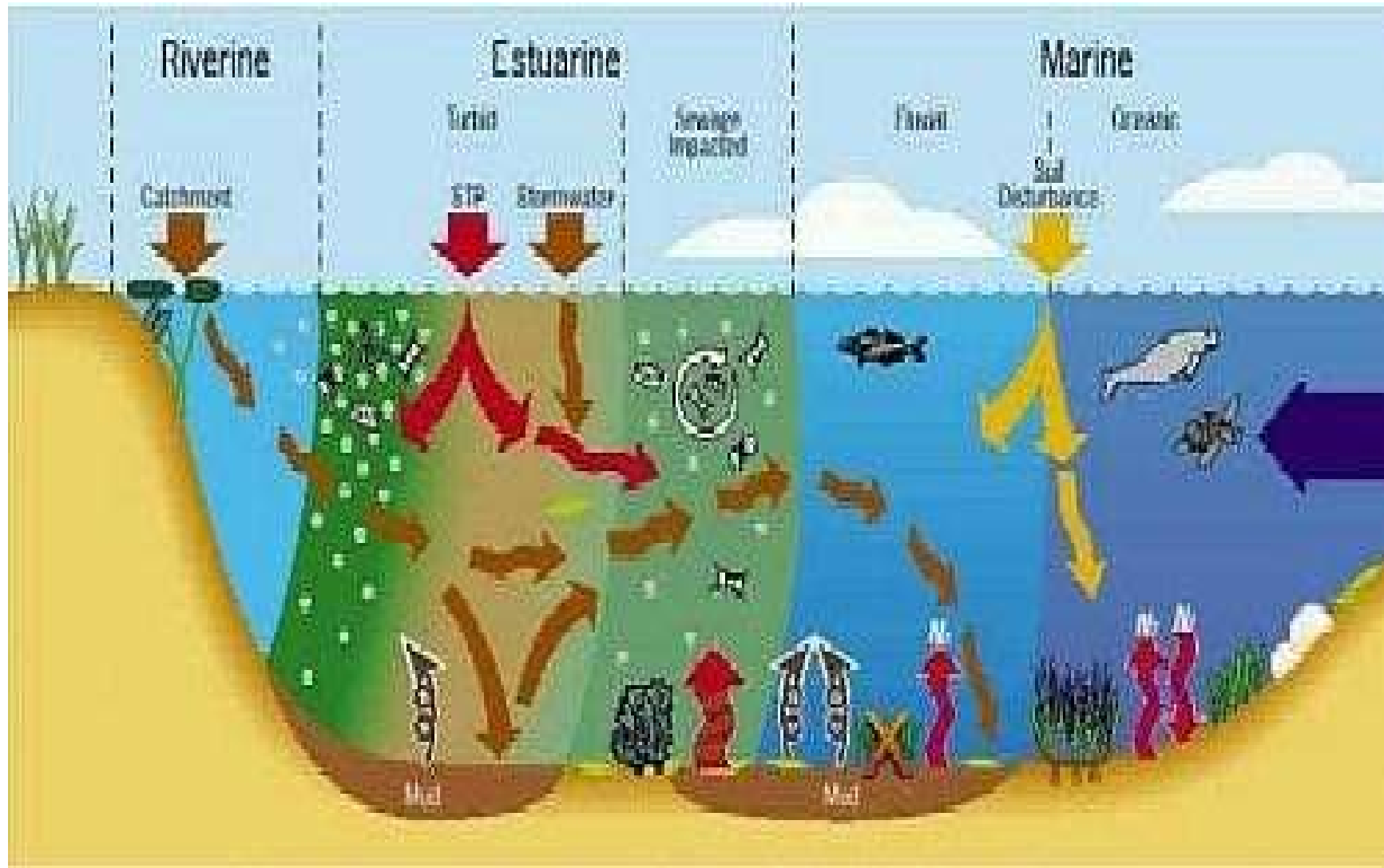
Ocean Ecosystem



Estuarine Ecosystem

- An estuary is a partially enclosed body of water along the coast where fresh water from river and streams meet and mix with salt water from oceans. This Ecosystems are considered as most fertile ecosystem.
- **Abiotic Components:** Nutrients such as phosphorus and nitrogen, temperature, light, salinity, pH.
- This ecosystem experience wide daily and seasonal fluctuations in temperature and Salinity level because of variation in freshwater in flow.
- **Biotic Components:**
- **Producers: Phyplanktons**- these micro-organisms manufacture food by photosynthesis and absorb nutrients such as phosphorous and nitrogen, besides them, mangroves, sea grass, weeds, and salt marshes.
- **Consumers: Primary consumers**, Zooplanktons that feed on Phytoplankton, besides them some small microorganisms that feed on producers.
- **Secondary Consumer:** Include worms, shellfish, small fish, feeding on Zooplanktons
- **Tertiary Consumer** :Fishes, turtles, crabs, starfishes feeding on secondary consumers.
- **Decomposers:** Fungi & Bacteria are the chief microbes active in decay of dead organic matter.

Estuarine Ecosystem



Estuaries

- An area in which fresh water from a river mixes with salt water from the ocean; a transition area from the land to the ocean. Other names: bay, sound, lagoon, harbor, or bayou

The Ocean

Area where
fresh and salt
water mix

River bringing
freshwater to
the sea



Riverine Ecosystem

- As Compared with lentic freshwater (Ponds & lakes), lotic waters such as streams, and river have been less studied. However, the various components of an riverine and stream ecosystem can be arranged as follows.
- **Producers:** The chief producers that remain permanently attached to a firm substrata are green algae as Cladophora, and aquatic mosses.
- **Consumers:** The consumers show certain features as permanent attachment to firm substrata, presence of hooks & suckers, sticky undersurface, streamline bodies, flattened bodies.. Thus a variety of animal are found, which are fresh spongy and caddis-fly larvae, snails, flat worms etc.
- **Decomposers:** Various bacteria and fungi like actinomycetes are present which acts as decomposers.

Species in Riverine Ecosystem



Land Ecosystem

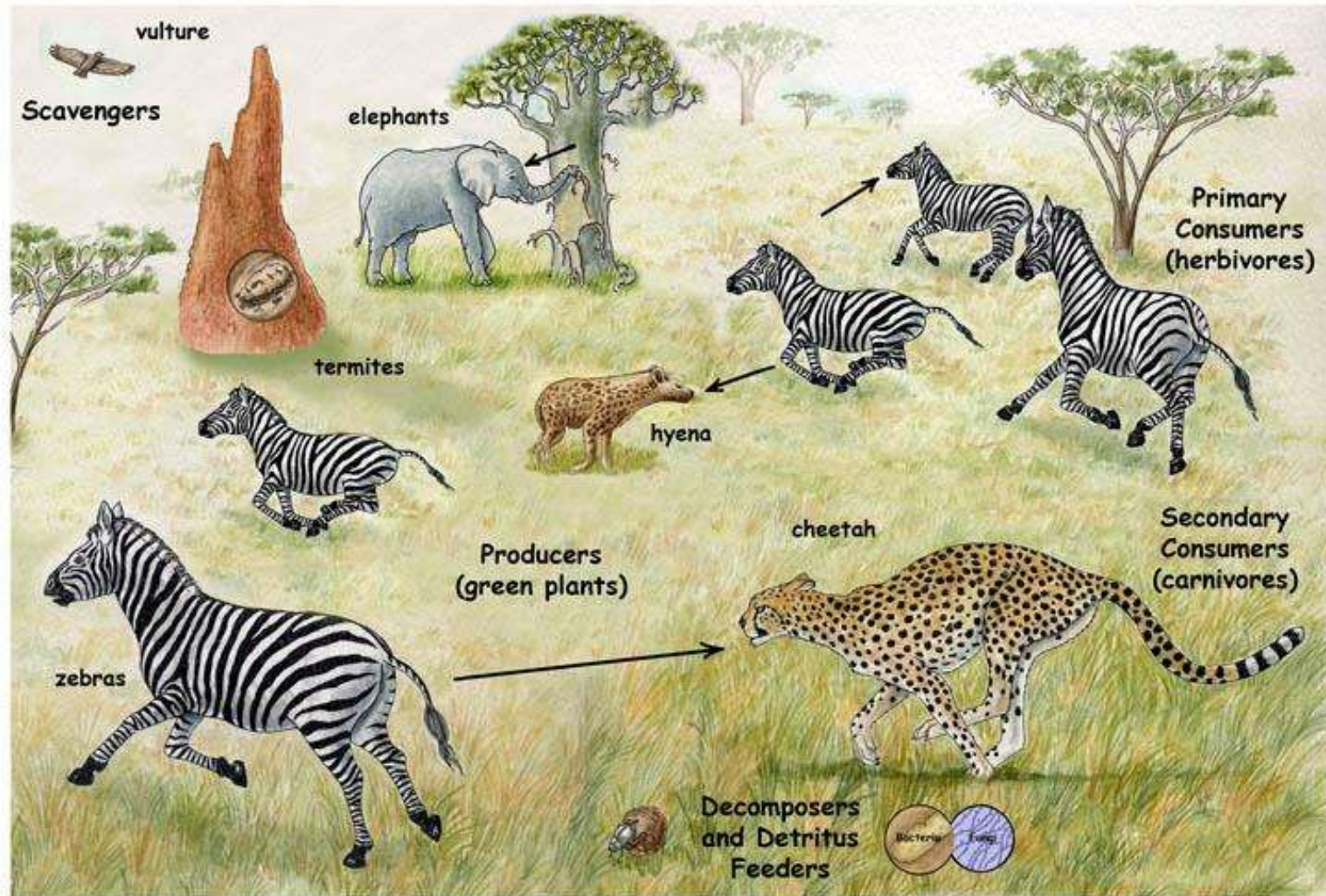
- A grassland ecosystem is an ecological unit that has physical factors like water, soil and air, which help to establish that animals live there. The plants, animals, microbes along with the water, soil and air they live in help to create the ecosystem.
 - About $1.2 \times 10^8 \text{mi}^2$ ($4.6 \times 10^7 \text{km}^2$) of the Earth's surface is covered with grasslands, which make up about 32% of the plant cover of the world.
 - Grasslands occur in regions that are too dry for forests but that have sufficient soil water to support a closed herbaceous plant canopy that is lacking in deserts.
 - Different kinds of grasslands develop within continents, and their classification is based on similarity of dominant vegetation, presence or absence of specific dominant species, or prevailing climate conditions.
1. Temperate grasslands
 2. Tropical grasslands
 3. Polar grasslands
- Grassland Soils are highly fertile & contain large amount of exchangeable bases & organic matter.

Land Ecosystem

- **Grassland Ecosystem:** Grassland occupy comparatively fewer area roughly 19 % of the earth's surface.
- **Abiotic Components:** These are nutrients present in soil, and aerial environment, thus the elements like, phosphates, sulphates, water, carbon dioxide, present in soil and in air. Moreover some trace elements are also present.
- **Biotic Components:**
 - **Producers:** They are mainly grasses as species of Cynadon, Desmodium, besides them a few shrubs also contribute some primary production.
 - **Consumers:**
 - **Primary Consumers:** The herbivores feeding on grasses are grazing animals, as cows, goats, rabbit, etc. besides them there are some insects as termites, millipedes that feed on grasses.
 - **Secondary Consumers:** These are carnivores feeding on herbivores these include, animals like, fox, jackals, snakes, frogs, birds.
 - **Tertiary Consumers:** Some times hawks, vultures, feeding on secondary consumer, thus occupy tertiary consumers.
 - **Decomposers:** The microbes active in the decay of dead organic matter of different form are fungi and some bacteria

Grassland Ecosystem

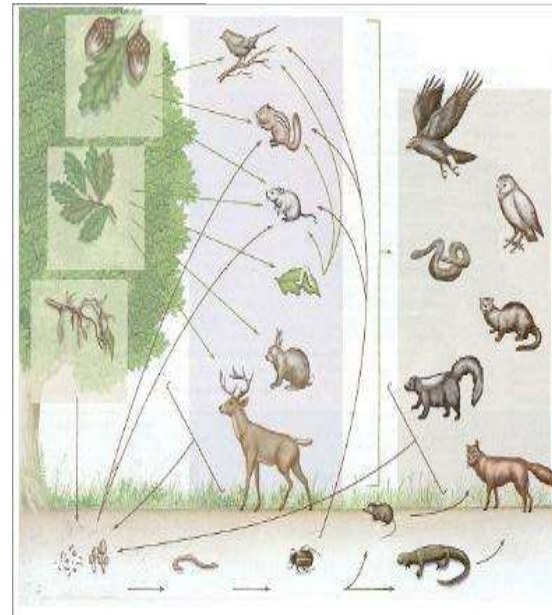
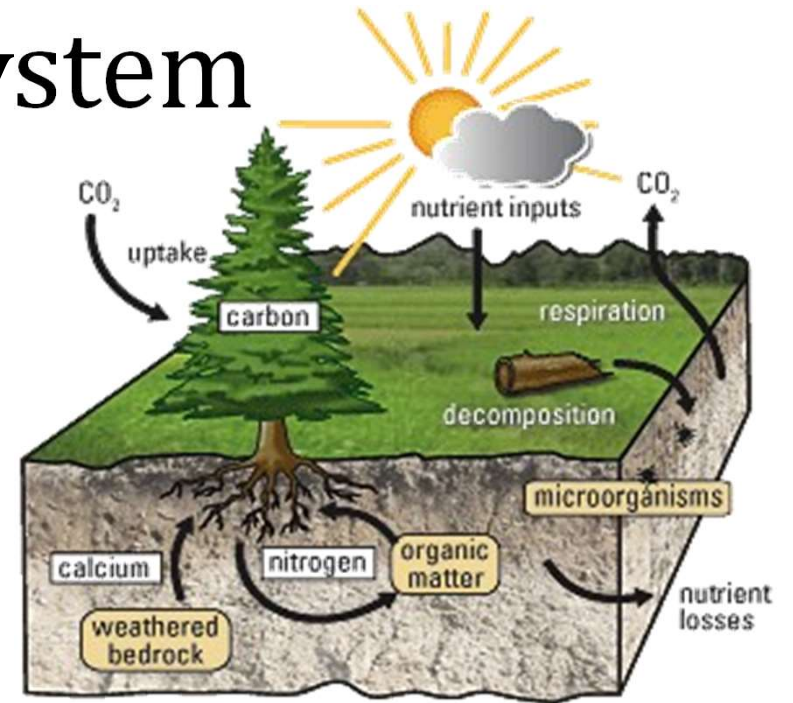
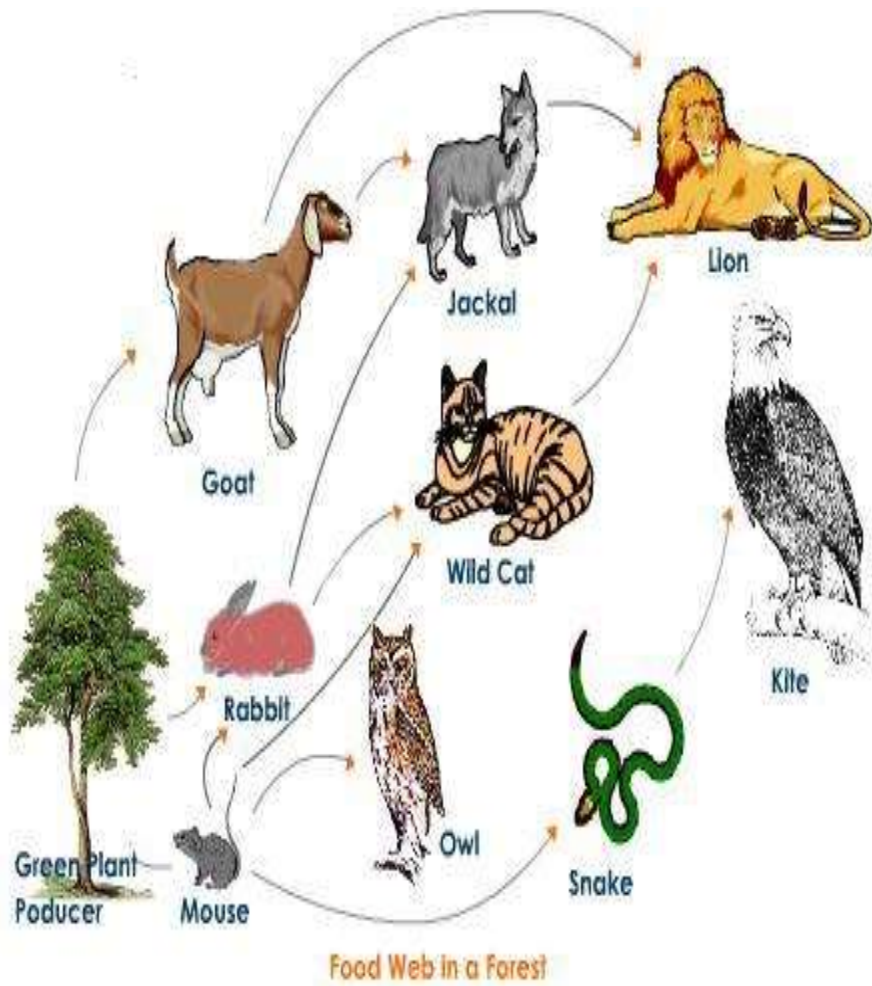
Grassland Food Web



Forest Ecosystem

- Forest Occupy roughly 40 % of the land. The different components of forest ecosystem are as follows:
- **Abiotic Components:** These are organic & inorganic substances present in the soil and atmosphere. In addition to minerals present in forest we find the dead organic debris, moreover light conditions are different due to complex stratification in the plants.
- **Biotic Components:**
- **Producers** These are mainly trees that show much species and greater degree of stratification. Besides trees there are also present shrubs, and ground vegetation.
- **Consumers:** Primary Consumers: These are herbivores that include animals feeding on tree leaves, ants, beetles, grass hoppers, etc., and large elephants, dears, squirrels, etc.
- **Secondary Consumers:** These are carnivores, like snakes, birds, lizards, fox, etc. feeding on herbivores.
- **Tertiary consumers:** These are top carnivores like lion tiger, etc. that eat carnivores of secondary level.
- **Decomposers:** These are wide variety of micro organisms including, fungi, bacteria.

Forest Ecosystem



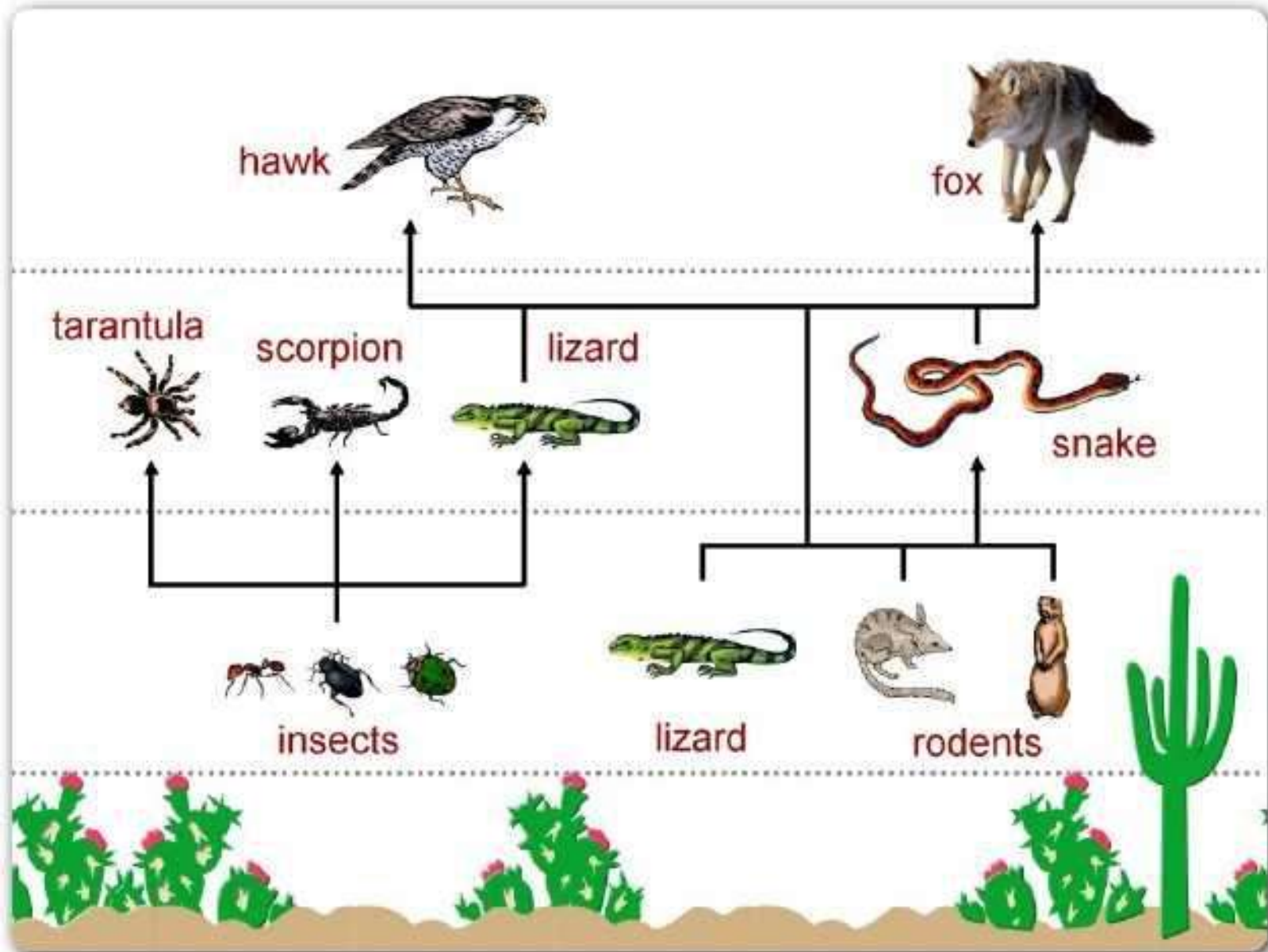
Desert – an ecosystem found where there is very little rainfall.

- They occur in regions where evaporation exceeds precipitation (rainfall, snow, etc.)
- Mainly two kinds of deserts:
 - Hot deserts
 - Cold deserts
- Hot deserts
 - Temperatures are very warm all year round
 - The summers are very hot
- Cold deserts
 - Short, warm summers
 - Long, cold winters
 - Found in places near the north and south poles

Desert Ecosystem

- Desert occupy 17 % of land.
- ***Abiotic components*** include, light, temperature, minerals.
- ***Biotic Components:***
- ***Producers*** : These are shrubs, especially bushes, some grasses, and few trees.
- E.g. Cacti, Xerophytes, mosses
- ***Consumers:*** The most common animals are reptiles, and insects, there are some rodents, and birds, and above all ship of desert camels, feed on tender plants.
- ***Decomposers:*** These are very few as due to poor vegetation the amount of dead organic matter is less. They are some fungi and bacteria.

Desert Ecosystem





Case Study: Sacred Groves of India

- ***Sacred groves of India:*** The Sacred groves of India are a unique traditional institution devoted to the conservation of forests and biodiversity. They were protected by local communities through social tradition and taboos that incorporated spiritual and ecological values. They were the most common type of community-protected areas.
- A Sacred groves are also referred to in the ancient texts, and thousands of them have existed. Preserved over the course of many generation, sacred groves represent native vegetation in a natural or near-natural state. They are thus rich in biodiversity. They often contain species that have disappeared in other places. Rare medicinal plants are also found in these groves.
- Many groves have water sources that help the local communities. They groves adsorb water during the monsoon and release it slowly during the dry period.





Sacred Groves of India



Activity

-  Observe various ecosystems in your surrounding Environment & mention the Species involved in each and every Ecosystem.
-  What can you do to save the planet ?
For e.g. Did you cut trees or plant some? did you collect any rain water? Did you clear the backyard of all grasses & plants ?

Assignment

-  Define Ecology and Explain the purpose of Ecological Study.
-  Enlist & Explain various Types of Ecosystems.
-  Explain Biogeochemical cycles with the help of neat sketch
(All Six Cycles).
-  Describe the Flow of Energy in an Ecosystem,
Also discuss the Energy Flow Models