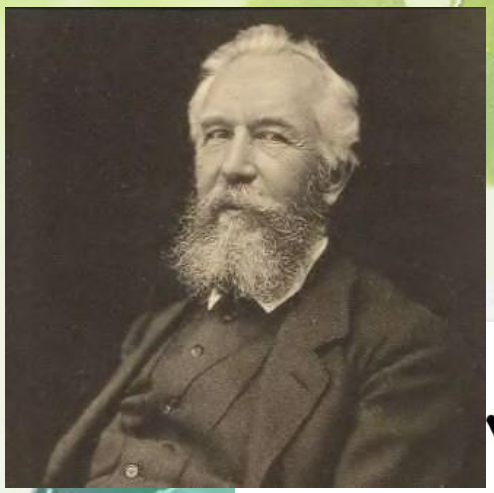
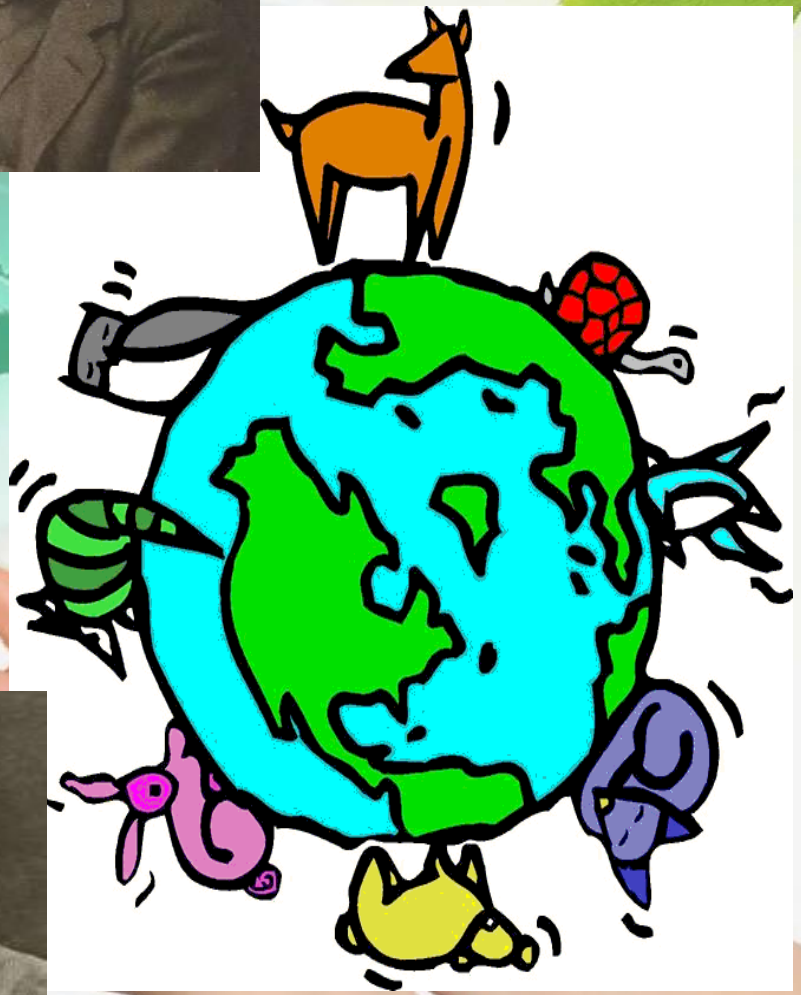
ECOLOGY

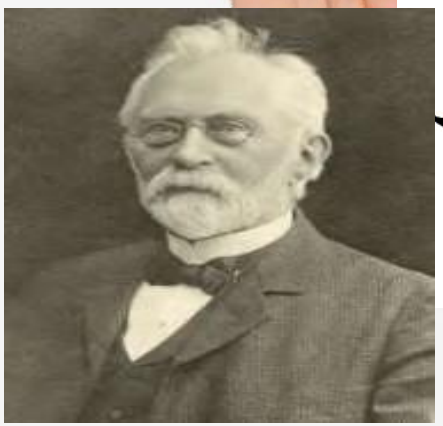
Dr. Anuj Dalal

- The meaning of the word ecology was given by German Biologist Haeckel in 1869.
- The word ecology is derived from Greek words ‘Oikos’ meaning house, habitat or place of living and ‘Logos’ meaning to study.





- After that…. Danish botanist, Eugenius Warming elaborated the idea of Ecology.



Definition

Ecology is the study of interactions among organism or group of organisms with their environment. The environment consists of both biotic components (living organisms) and abiotic components (non – living organisms).

Ecology is study of interactions between

Non-living components in the environment…

Light

Water

Wind

Nutrients in soil
Heat
Solar radiation
Atmosphere, etc.

AND…

Living organisms…

Plants

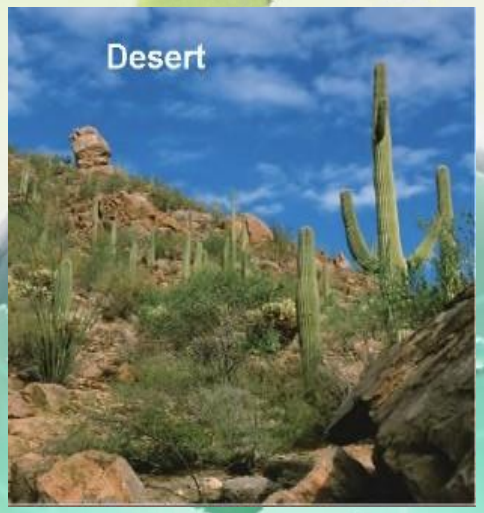
Animals

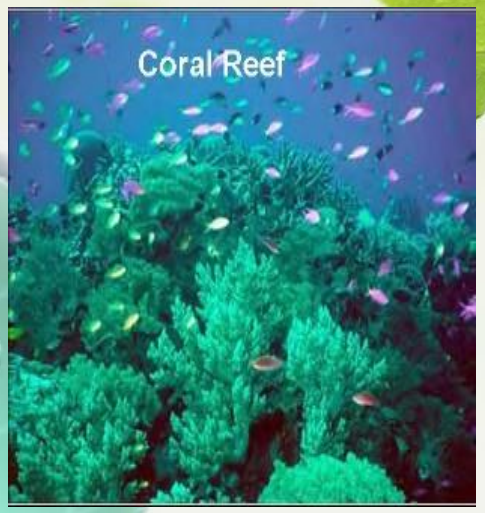
Microorganisms in soil, etc.

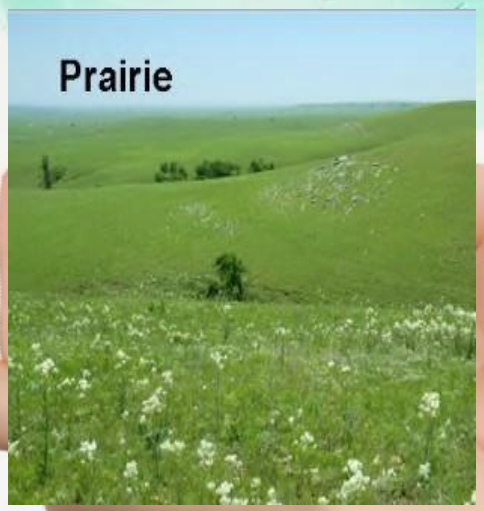
Ecosystem

The term Ecosystem was first proposed by A.G. Tansley in 1935.

An ecosystem consists of the biological community that occurs in some locale, and the physical and chemical factors that make up its non-living environment. There are many examples of ecosystems - a pond, a desert, a forest, an estuary, an ocean.







Ecosystem is the basic functional unit of Ecology.

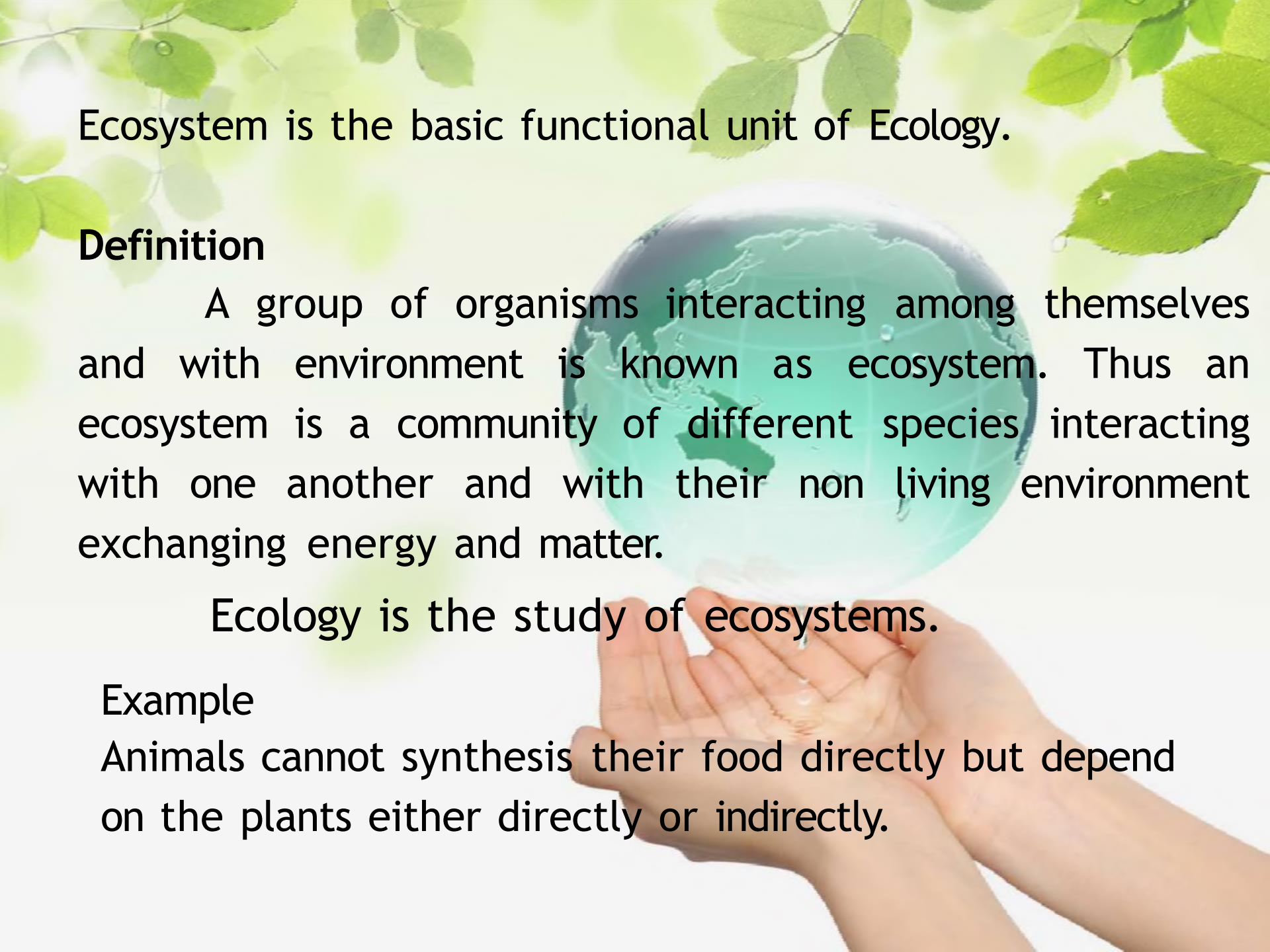
Definition

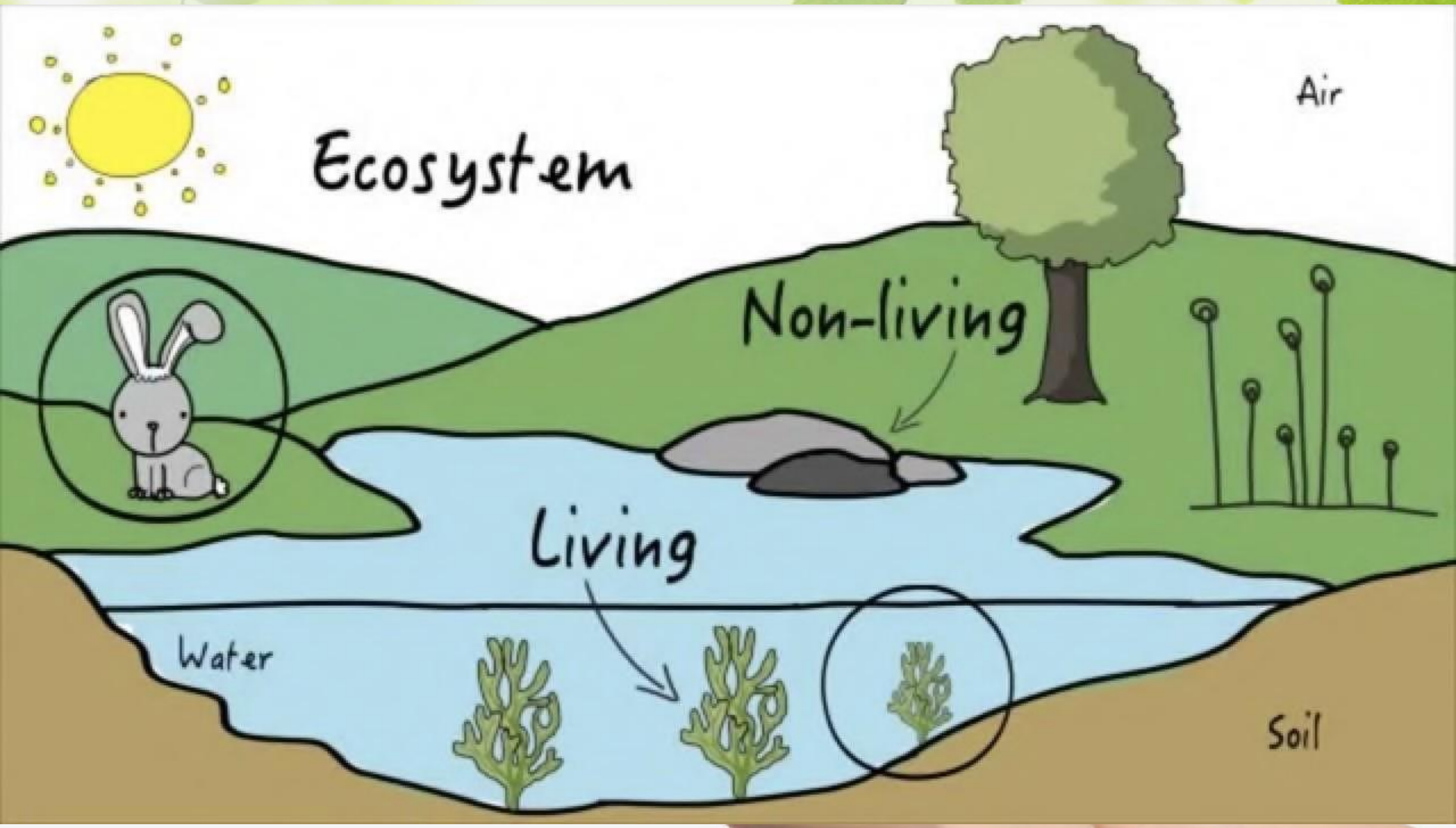
A group of organisms interacting among themselves and with environment is known as ecosystem. Thus an ecosystem is a community of different species interacting with one another and with their non living environment exchanging energy and matter.

Ecology is the study of ecosystems.

Example

Animals cannot synthesis their food directly but depend on the plants either directly or indirectly.




Ecosystem
Air
Non-living
Living
Water
Soil

STRUCTURE OF AN ECOSYSTEM

The term structure refers to the various components of an ecosystem.

An ecosystem has two major components

- Biotic (living) components
- Abiotic (non living) components

- Biotic components

The living organisms (or) living members in an ecosystem collectively called biotic components (or) biotic community.

Ex: Plants, Animals, Microorganisms

Classification biotic components

The members of biotic components of an ecosystem are grouped in to three based on how they get food.

- Producer (Plants)
- Consumer (Animals)
- Decomposers (Micro-organisms)

1.Producers (Autotrophs)

Producers synthesise their food themselves through photosynthesis

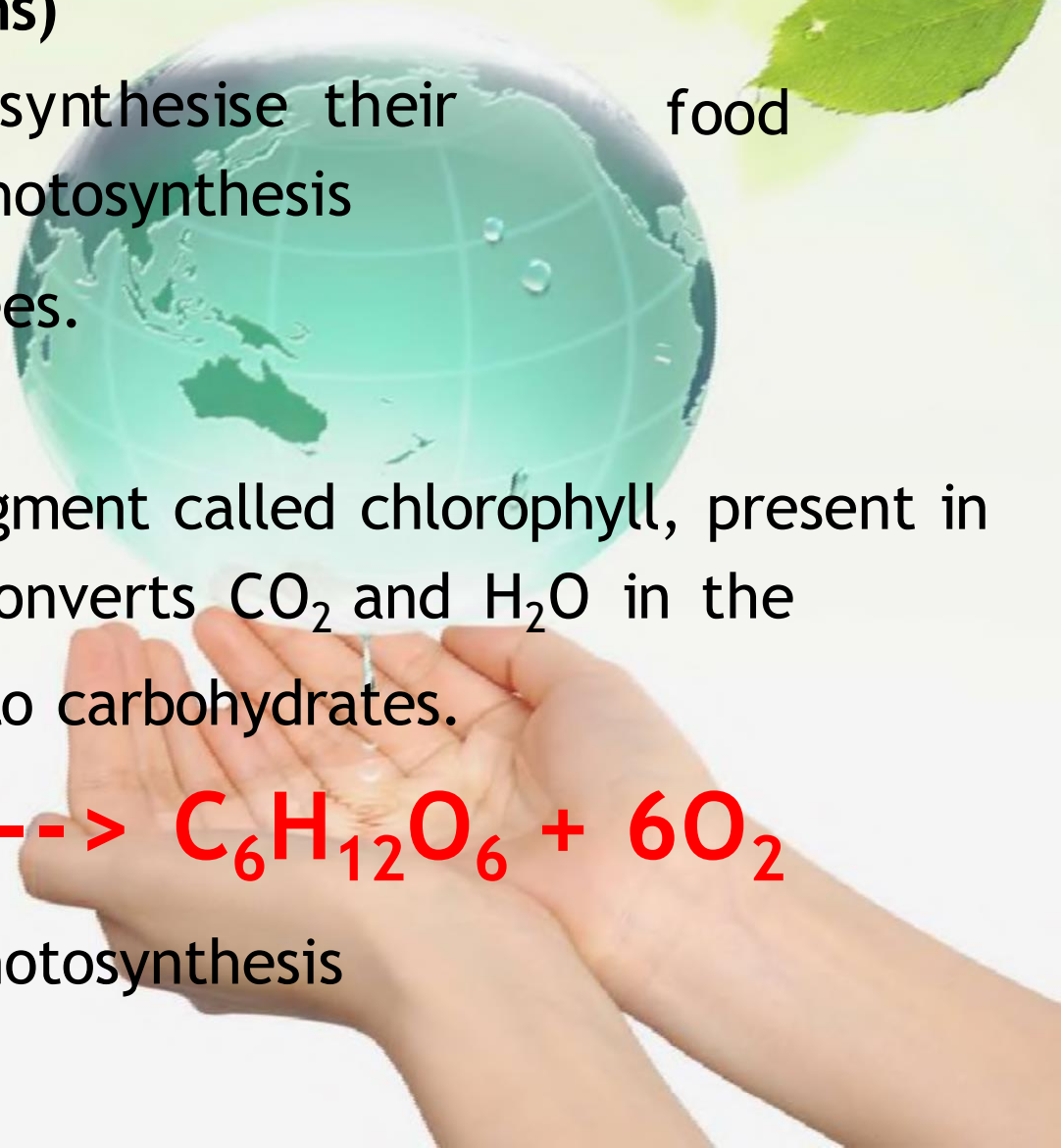
Ex: All green plants, trees.

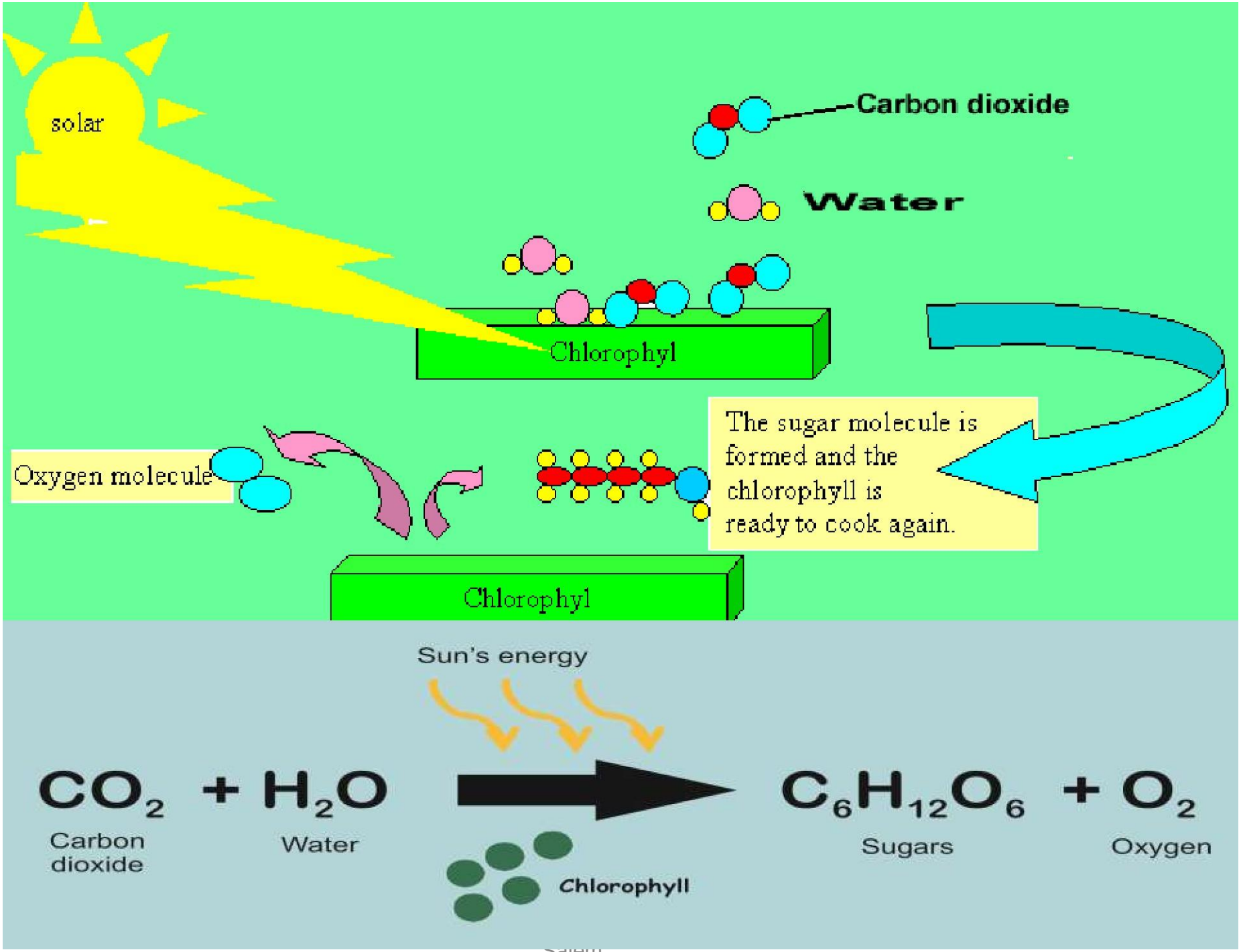
Photosynthesis

The green pigment called chlorophyll, present in the leaves of plants, converts CO_2 and H_2O in the presence of sunlight into carbohydrates.

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

This process is called photosynthesis




solar
Carbon dioxide
Water
Chlorophyl
The sugar molecule is formed and the chlorophyll is ready to cook again.
Oxygen molecule
Chlorophyl
Sun's energy
CO_2 + H_2O → $C_6H_{12}O_6$ + O_2
Carbon dioxide
Water
Chlorophyll
Sugars
Oxygen


Algae
Grass
Trees

2. Consumers also called as Heterotrophs:

Classification of consumers

Consumers are further classified as

(i) Primary consumers or Herbivores or Plant eaters:

Primary consumers are also called herbivores, they directly depend on the plants for their food. So they are called plant eaters.

Examples : Insects, rat, goat, deer, cow etc.

(ii) Secondary consumers (primary carnivores) (Meat eaters):

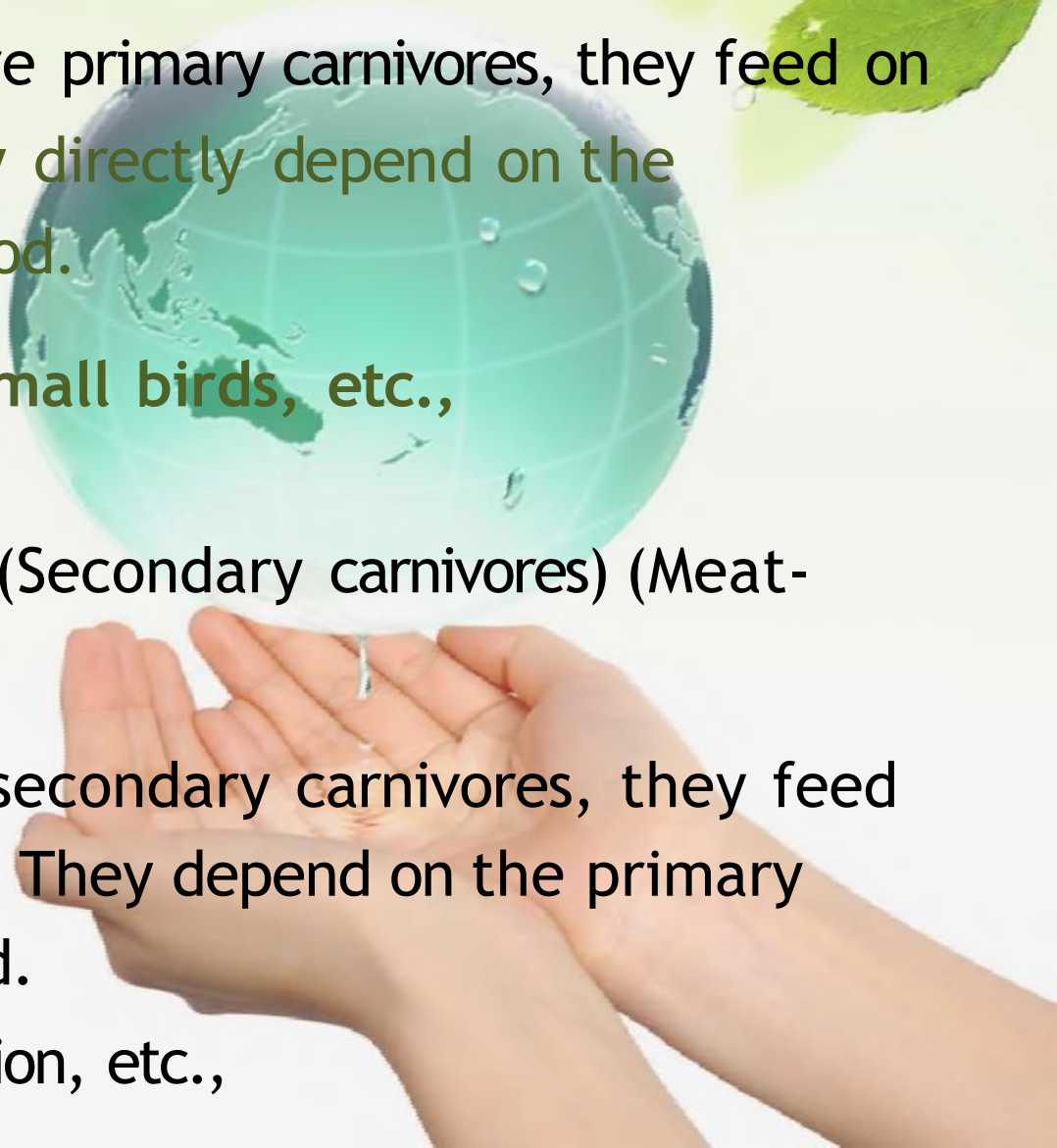
Secondary consumers are primary carnivores, they feed on primary consumers. They directly depend on the herbivores for their food.

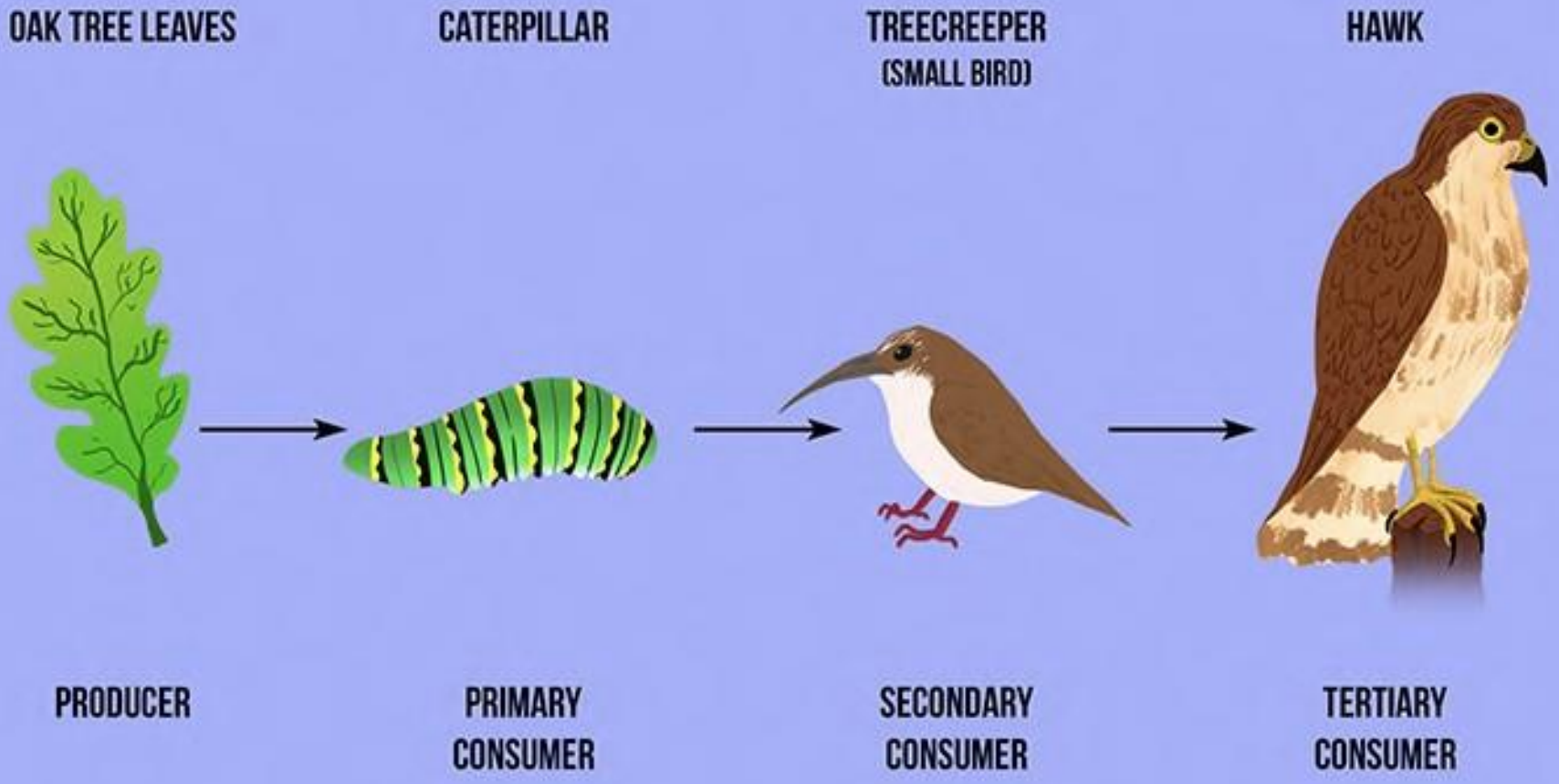
Ex: Frog, cat, snakes, small birds, etc.,

(iii) Tertiary consumers (Secondary carnivores) (Meat-eaters)

Tertiary consumers are secondary carnivores, they feed on secondary consumers. They depend on the primary carnivores for their food.

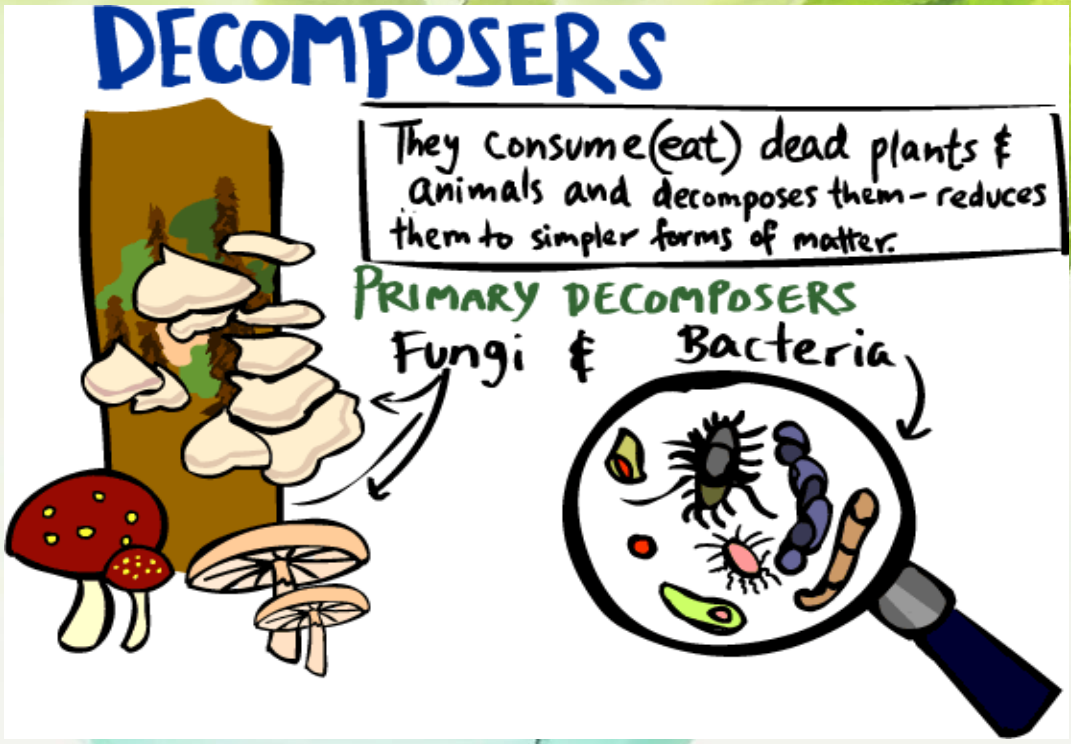
Ex: Hawk, Eagle, Tiger, Lion, etc.,




OAK TREE LEAVES
CATERPILLAR
TREECREEPER
(SMALL BIRD)
HAWK
PRODUCER
PRIMARY CONSUMER
SECONDARY CONSUMER
TERTIARY CONSUMER

Omnivore: Organisms that feed both on plants and animals. Ex: Human, rat, birds.

Detritivore: They feed on dead organisms, wastes of living beings and partially decomposed matter. Ex: Termites, earthworm, ants etc.



3. Decomposers

Decomposers attack the dead bodies of producers and consumers, and decompose them into simpler compounds. During the decomposition inorganic nutrients are released.

The inorganic nutrients together with other organic substances are then utilised by the producers for the synthesis of their own food.

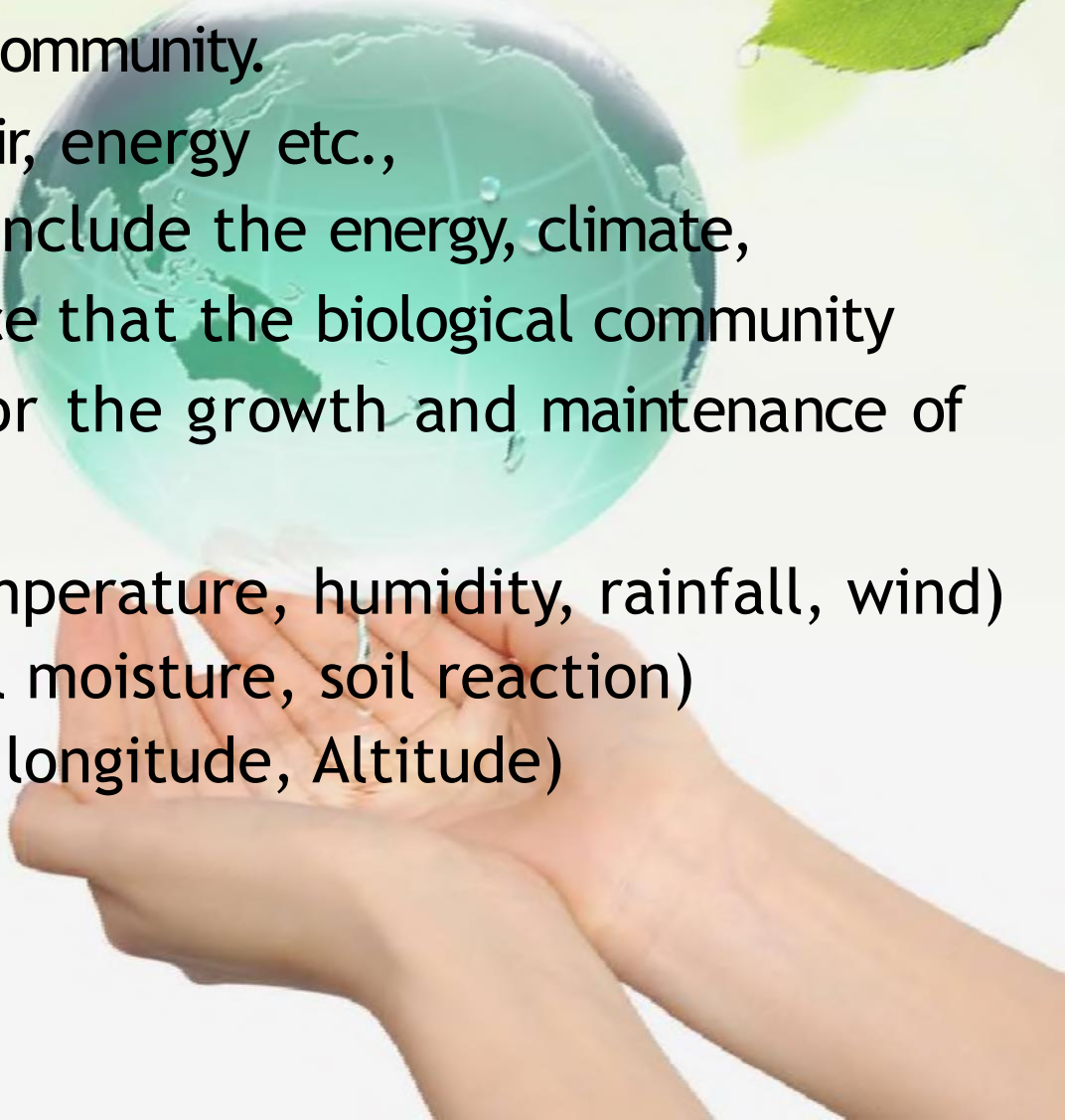
Abiotic (non-living) components

The non-living components (physical and chemical) of ecosystem collectively form a community called abiotic components (or) abiotic community.

Ex: Climate, soil, water, air, energy etc.,

1.Physical components: Include the energy, climate, nutrients and living space that the biological community needs. They are useful for the growth and maintenance of its member.

- Climatic (Sunlight, temperature, humidity, rainfall, wind)
- Edaphic (soil type, soil moisture, soil reaction)
- Geographic (Latitude, longitude, Altitude)



2.Chemical Components: They are the sources of essential nutrients.

- Organic substances : Protein, lipids, carbohydrates, etc.,
- Inorganic substances: All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, K) and few other elements.

TYPES OF ECOSYSTEM

Natural ecosystem: These operate themselves under natural conditions. Based on habitat types, it can be further classified into three types.

Terrestrial ecosystem: This ecosystem is related to land.

Ex: Grassland ecosystem, forest ecosystem, desert ecosystem, etc.,

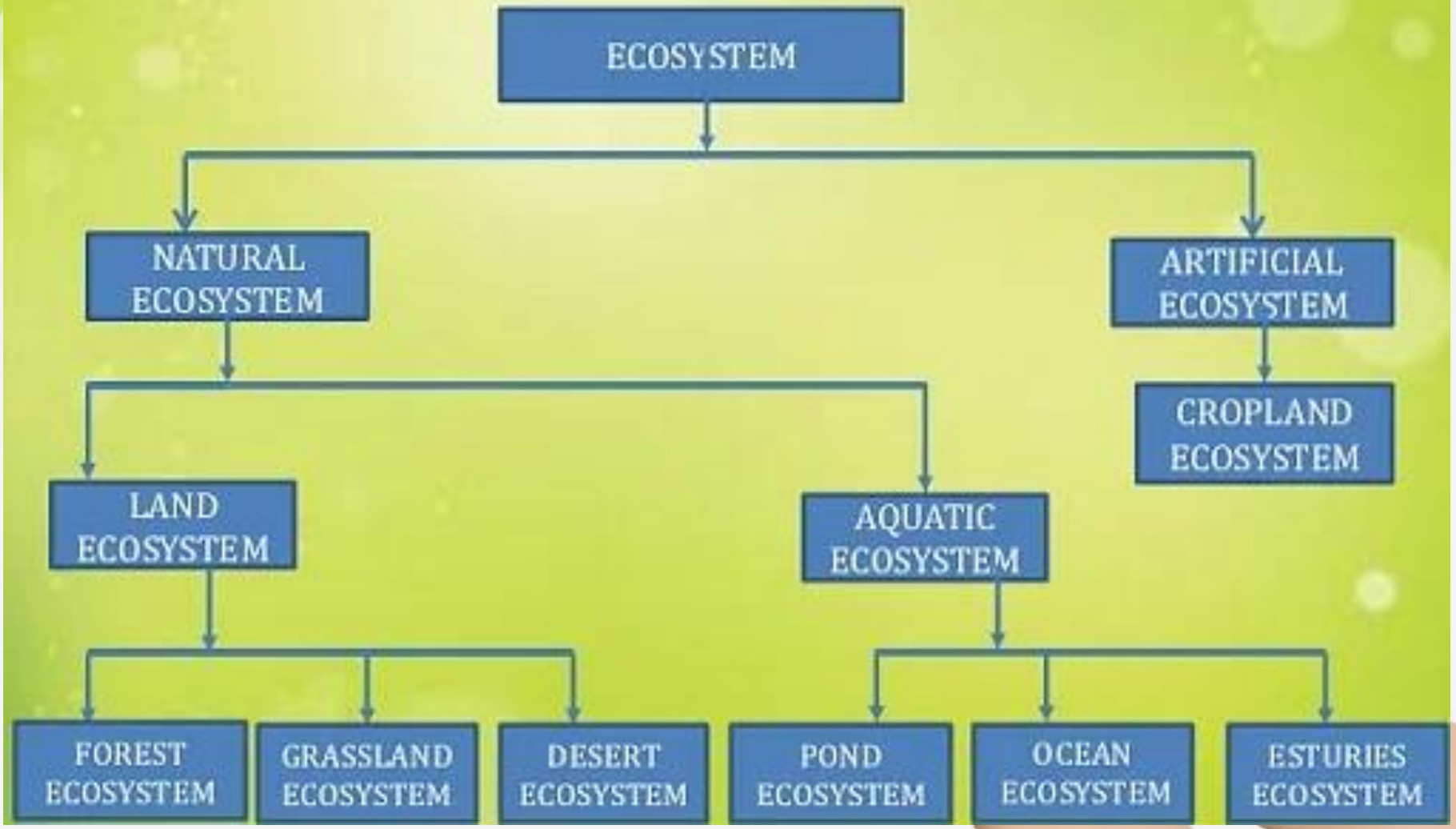
Aquatic ecosystem: This ecosystem is related to water. It is further sub classified into two types based on salt content.

- Fresh water ecosystem
  - (a) Running water ecosystems. Ex: Rivers, Streams…
  - (b) Standing water ecosystems Ex: Pond, lake…
- Marine ecosystem Ex: Seas and sea shores…

3. **Man - made (or) Artificial ecosystems:** Artificial ecosystem is operated (or) maintained by man himself.

Ex: Croplands, gardens…

Classification of Ecosystem



Limiting Factors

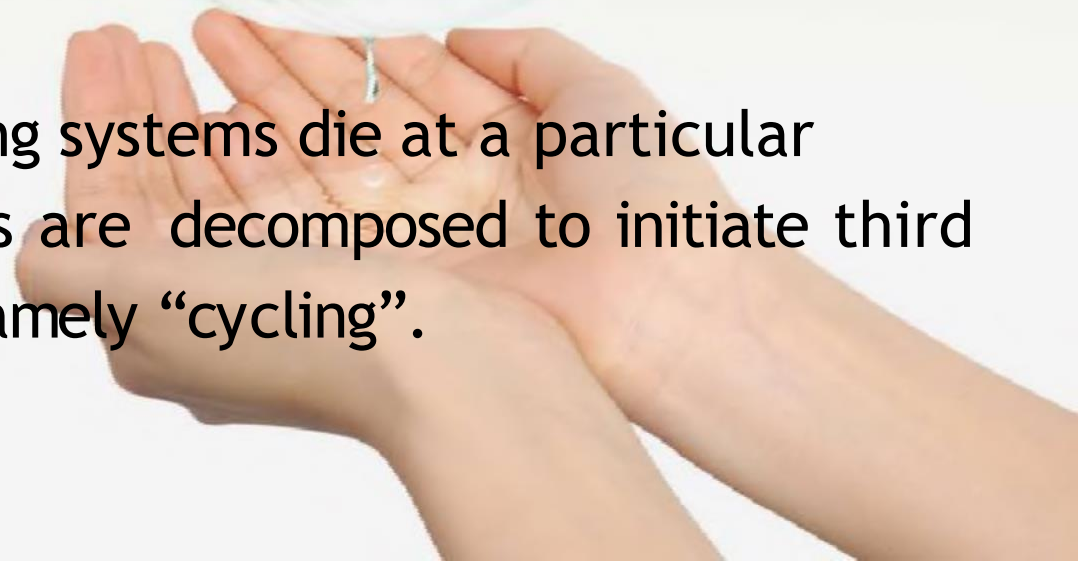
- Factors which restrict the further growth of population
  - Availability of food
  - Water
  - Shelter
  - Space

FUNCTION OF AN ECOSYSTEM

The function of an ecosystem is to allow flow of energy and cycling of nutrients.

Functions of an ecosystem are of three types.

- **Primary function:** The primary function of all ecosystem is manufacture of starch (photosynthesis).
- **Secondary function:** The secondary function of all ecosystem is distribution energy in the form of food to all consumers.
- **Tertiary Function:** All living systems die at a particular stage. These dead systems are decomposed to initiate third function of ecosystems namely “cycling”.

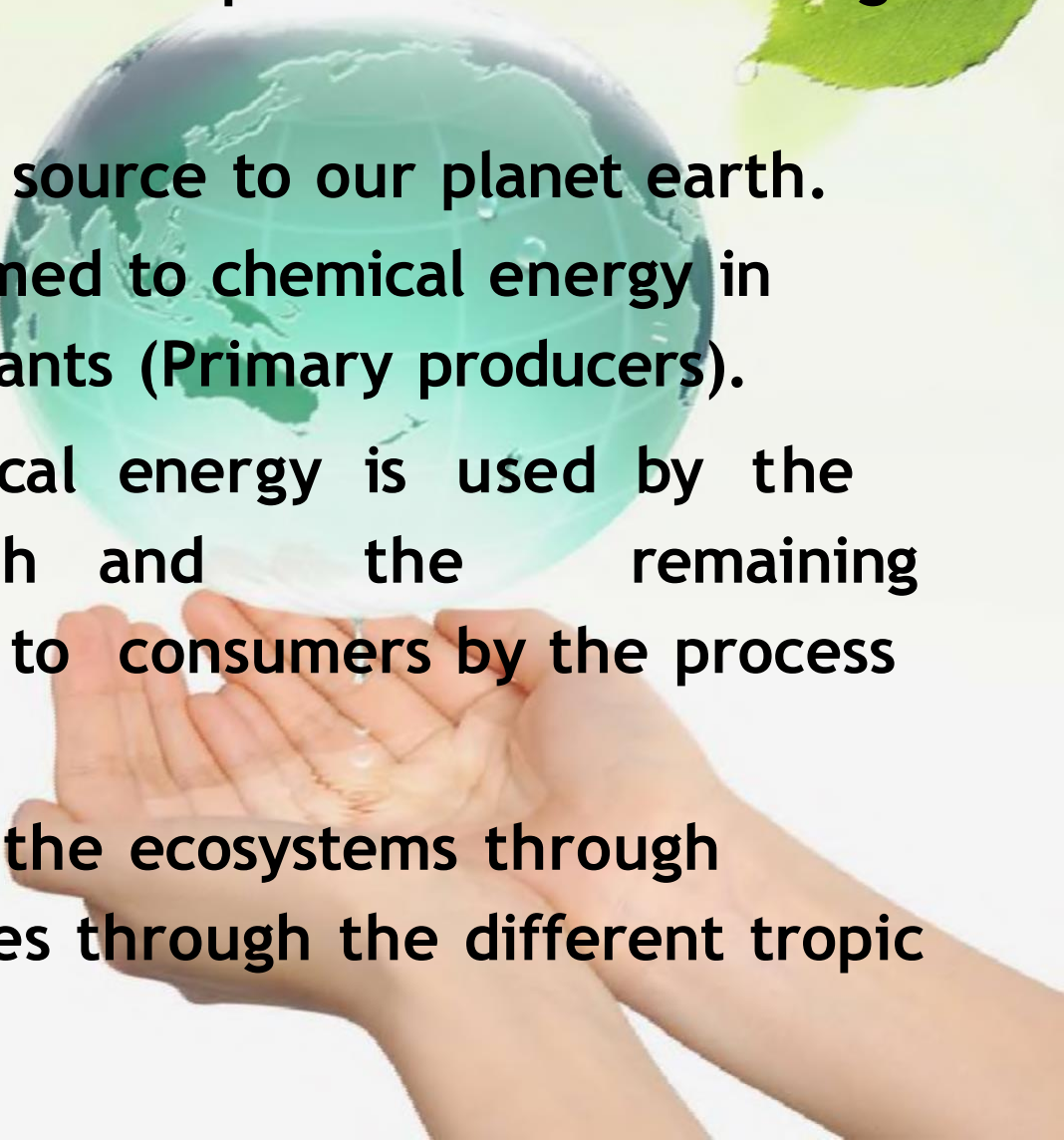


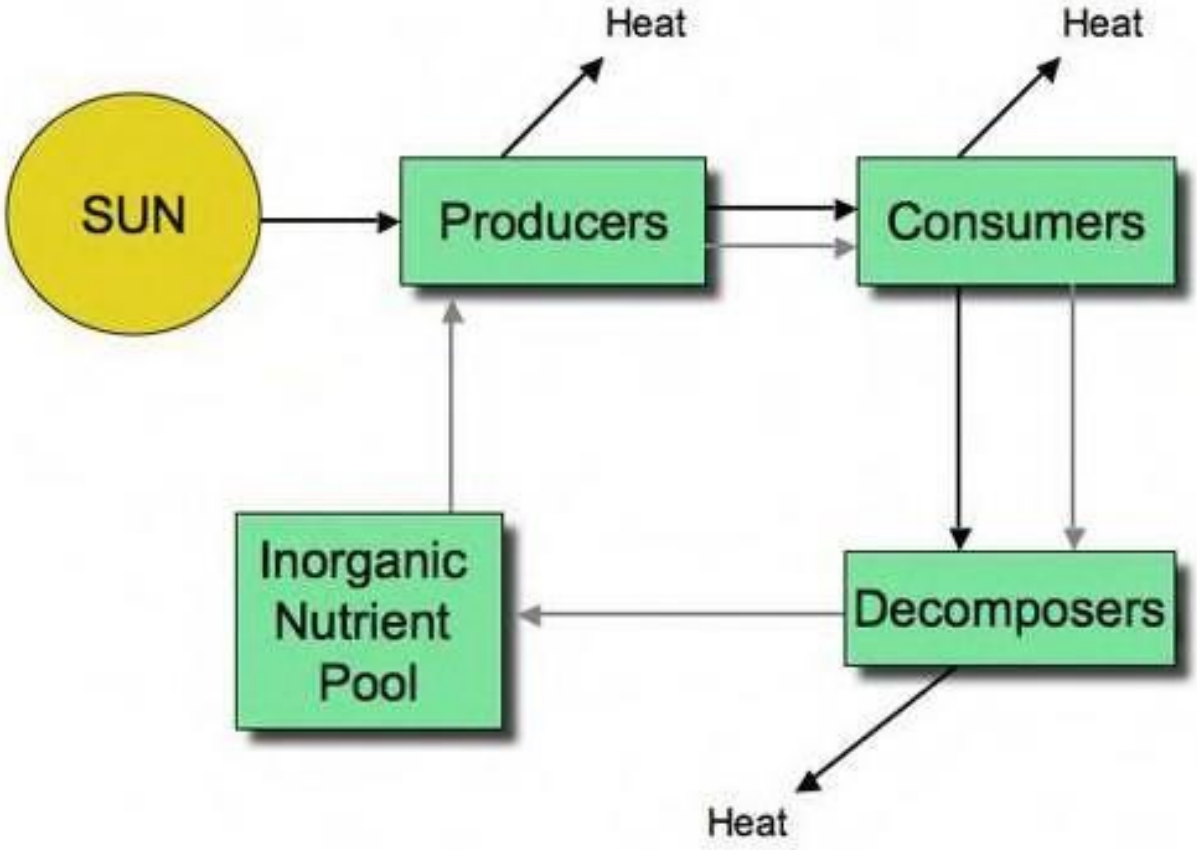
The functioning of an ecosystems may be understood by studying the following terms.

- Energy and material flow.
- Food chains
- Food webs
- Food pyramids

ENERGY FLOW IN THE ECOSYSTEMS

- Energy is the most essential requirement for all living organisms.
- Solar energy is the only source to our planet earth.
- Solar energy is transformed to chemical energy in photosynthesis by the plants (Primary producers).
- 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 or feeding levels.




Heat
Heat
SUN
Producers
Consumers
Inorganic
Nutrient
Pool
Decomposers
Heat

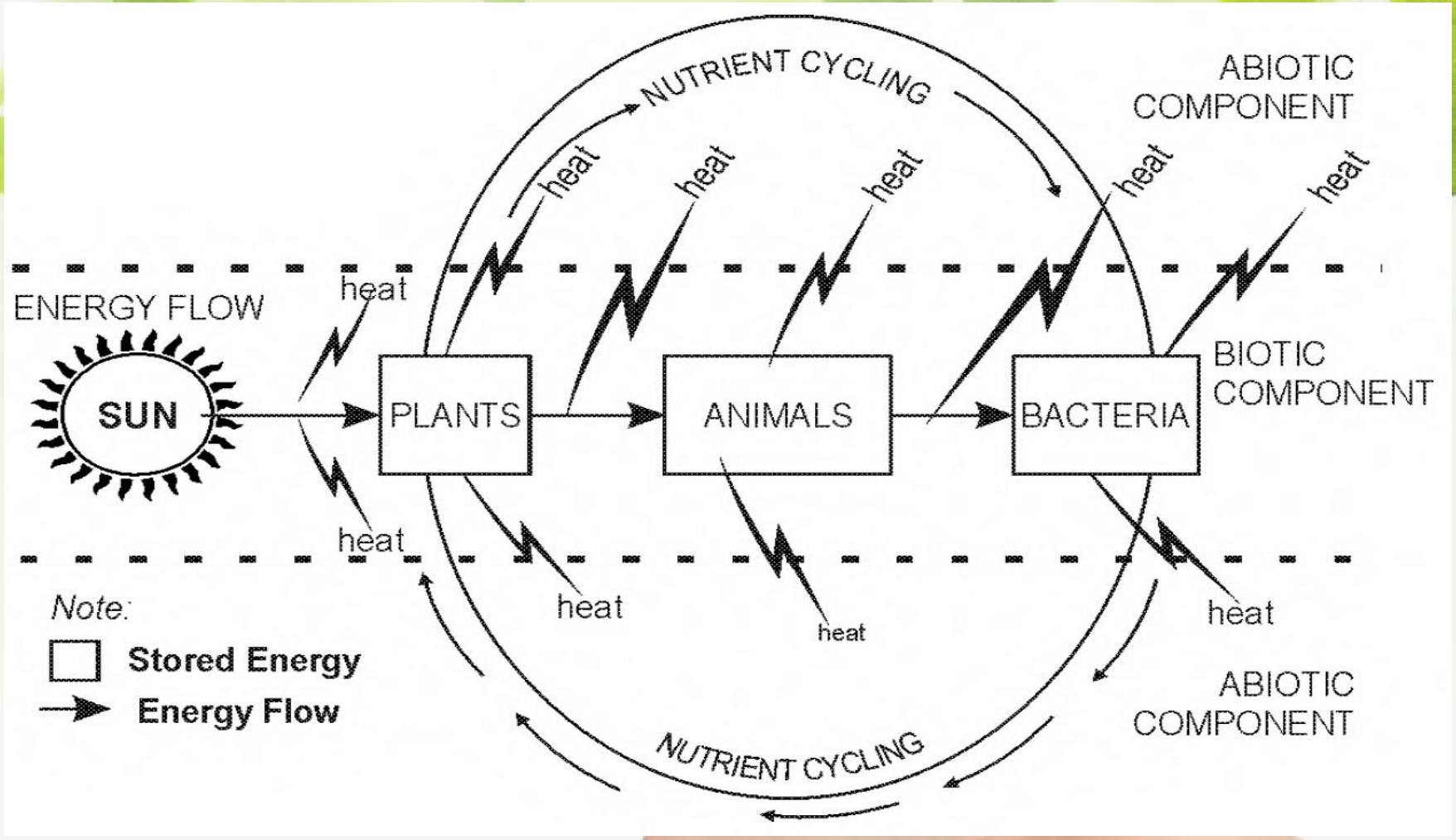
The flow of energy in an ecosystem follows the laws of thermodynamics.

I law of thermodynamics - “Energy neither can be created nor destroyed, but it can be converted from one from to other”.

Energy for an ecosystem comes from the sun. It is absorbed by plants, it is converted into chemical energy. This chemical energy utilised by consumers transform into heat.

II law of thermodynamics - “Whenever energy is transformed, there is a loss of energy through the release of heat”.

Energy is transferred between tropic levels in the form of heat as it moves from one tropic level to another tropic level. The loss of energy takes place through respiration, work, running, hunting etc.,



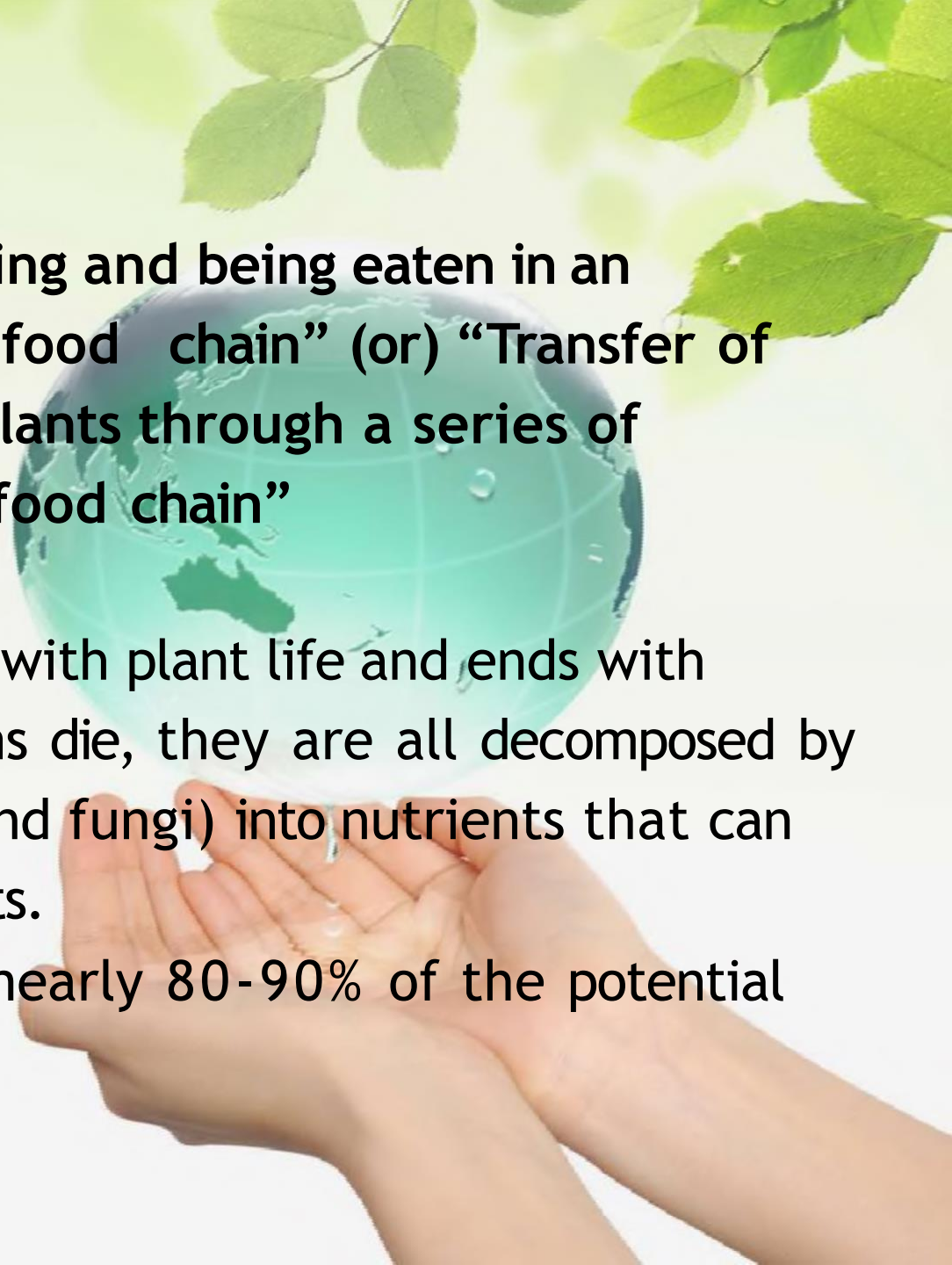
Flow of energy and nutrient cycling from abiotic to biotic and vice versa.

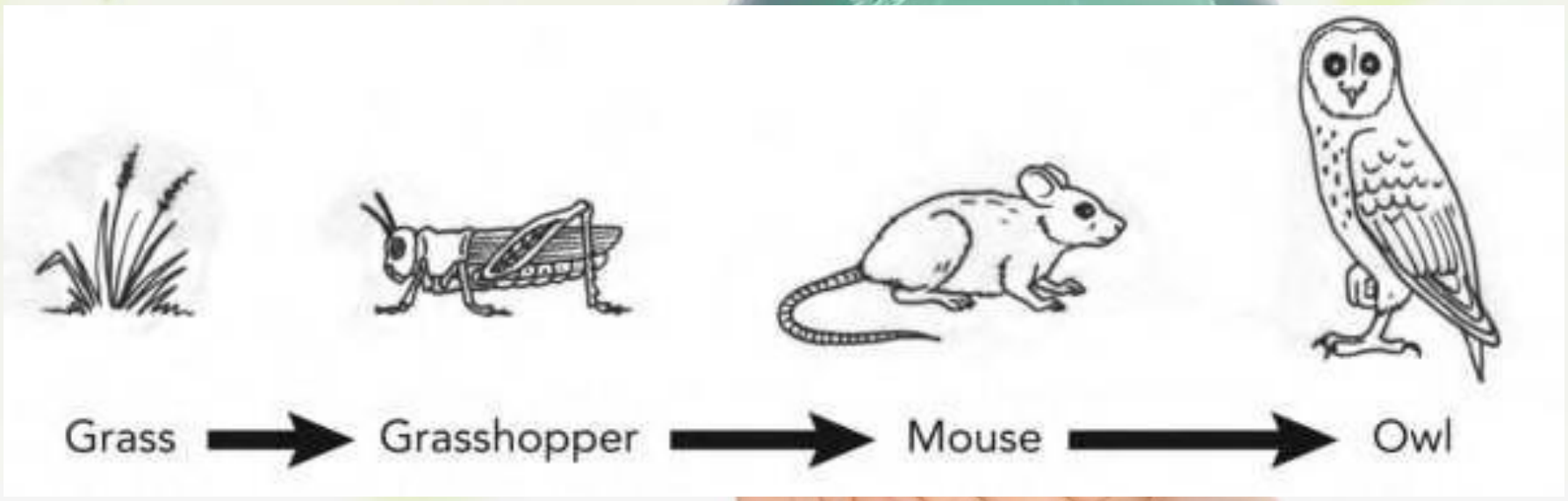
FOOD CHAINS

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"

- A food chain always starts with plant life and ends with animal. 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 level, nearly 80-90% of the potential energy gets lost as heat.

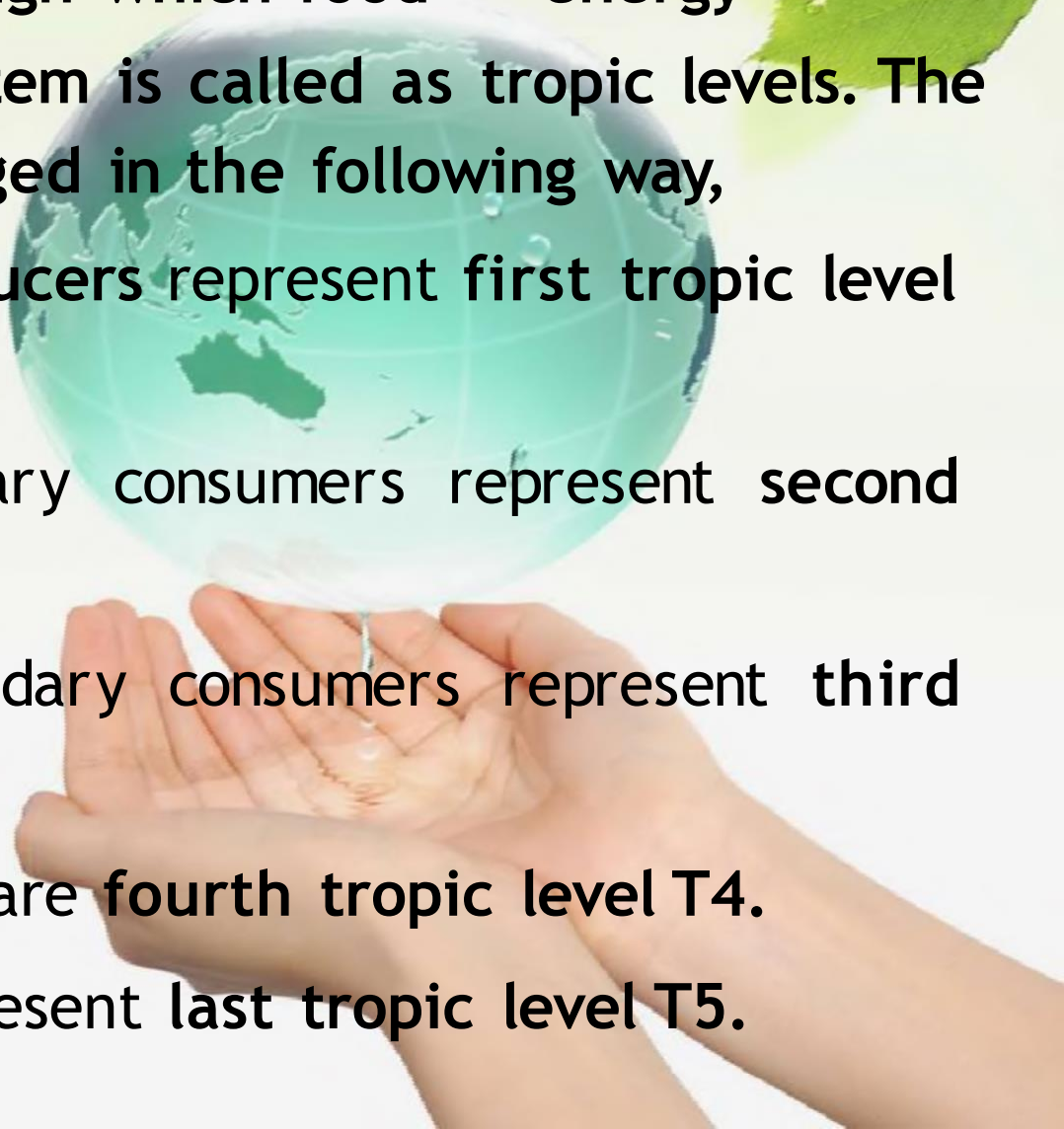


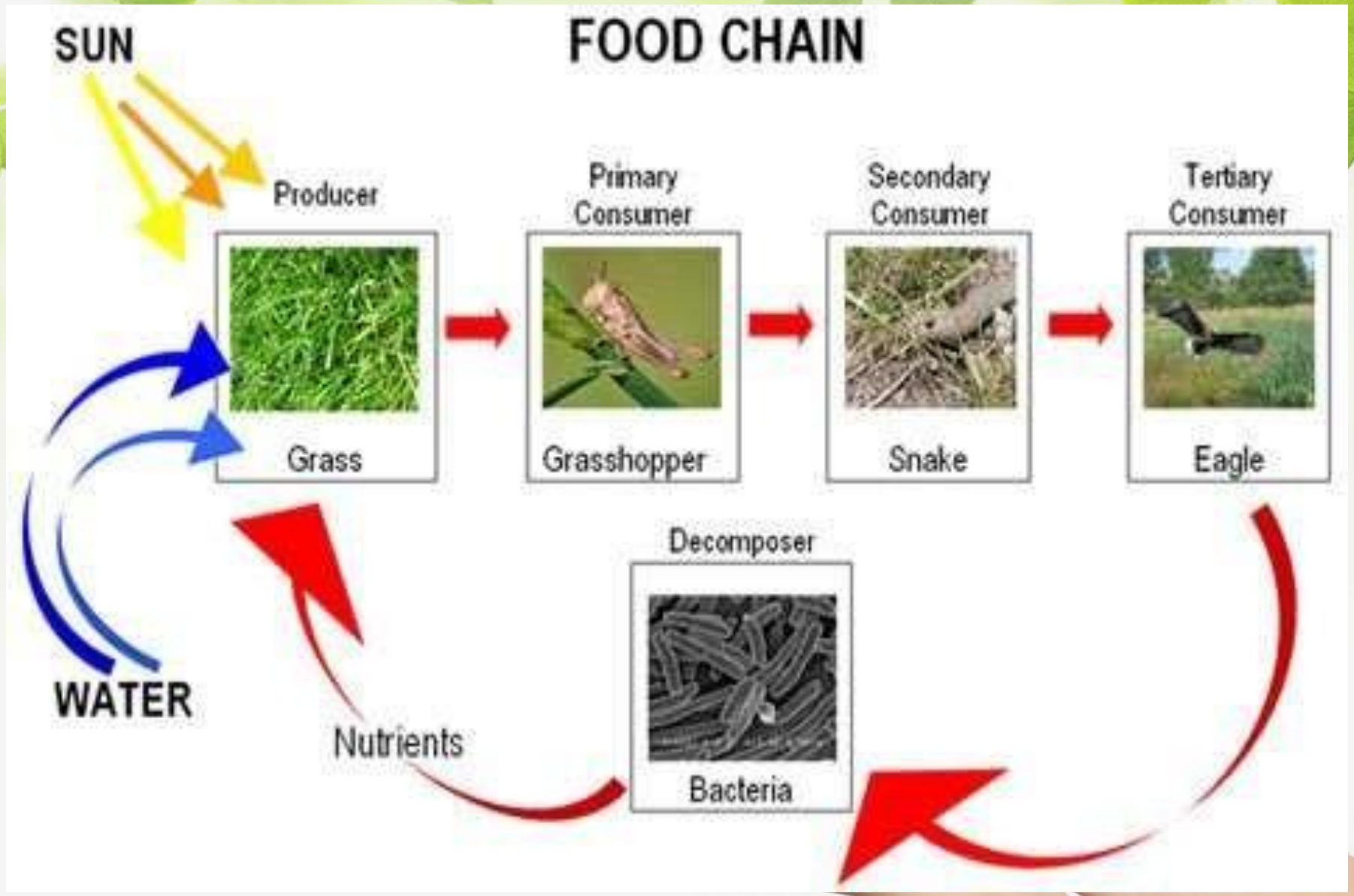

Grass
Grasshopper
Mouse
Owl

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,

- 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.**




FOOD CHAIN
SUN
Producer
Primary Consumer
Secondary Consumer
Tertiary Consumer
Grass
Grasshopper
Snake
Eagle
Decomposer
Bacteria
WATER
Nutrients

Food chains are classified into two main types

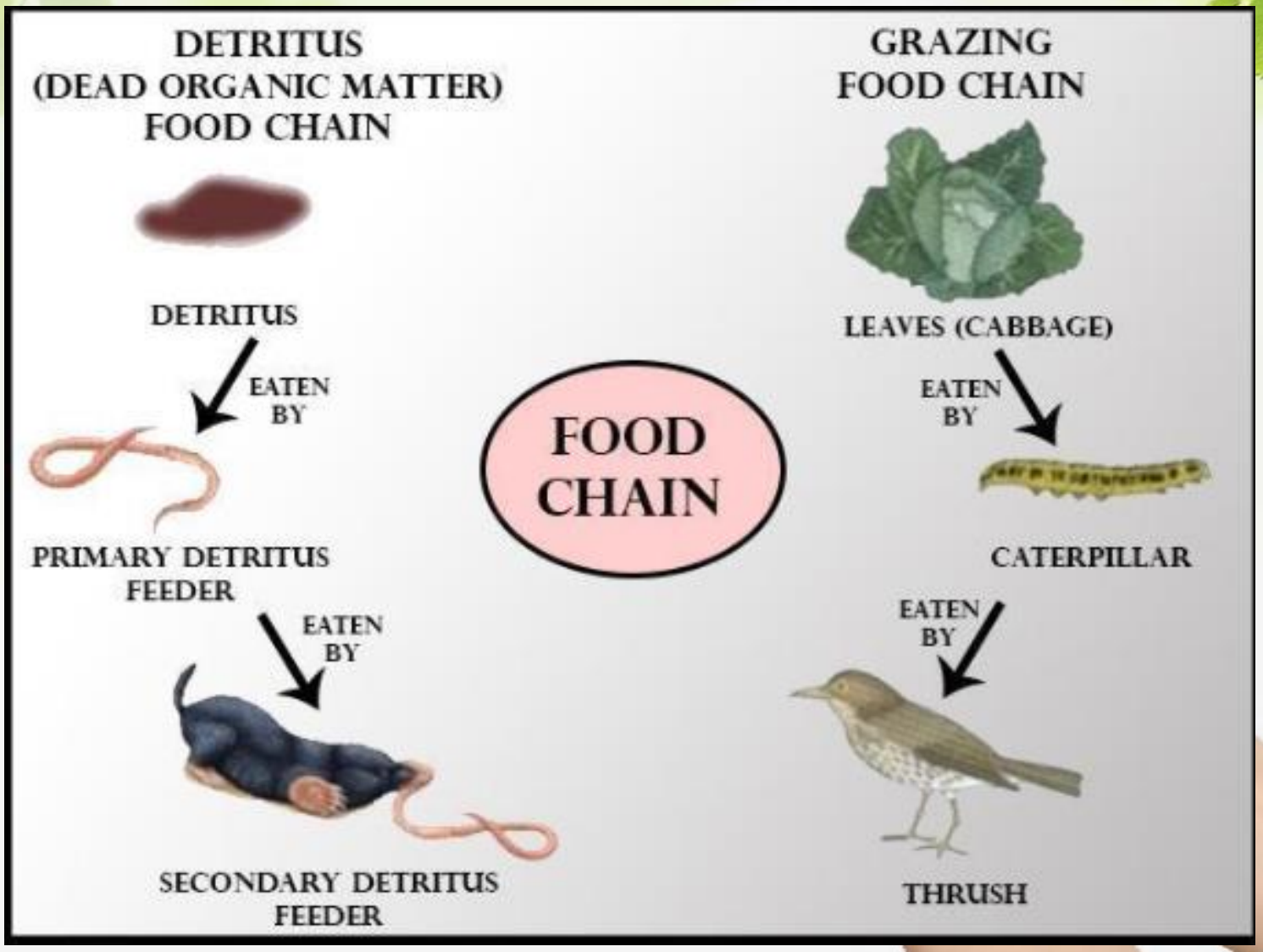
Grazing food chain

Detritus food chain

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

- 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.

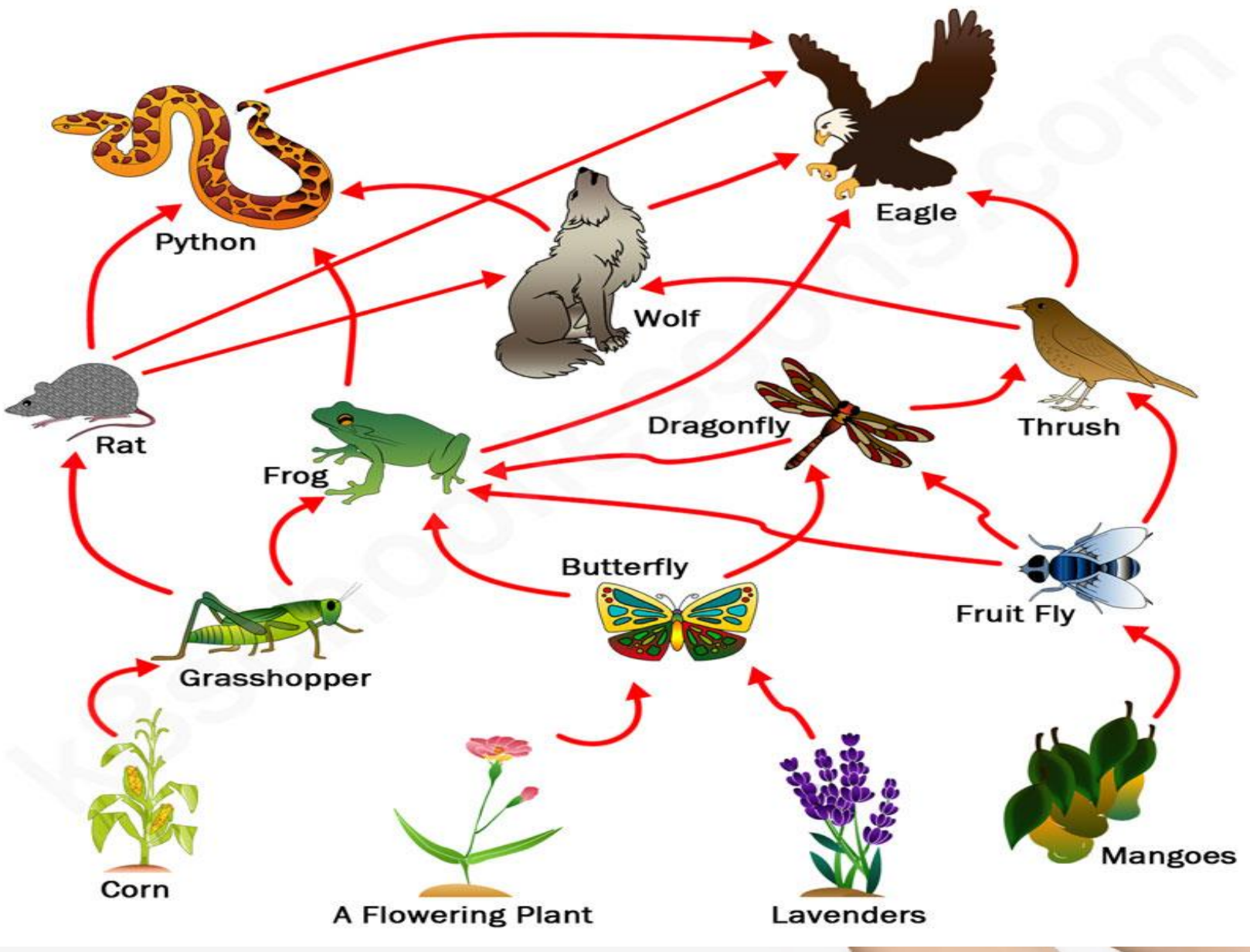
The following diagram shows that grazing food chain and detritus food chain are interconnected to each other but are not isolated.

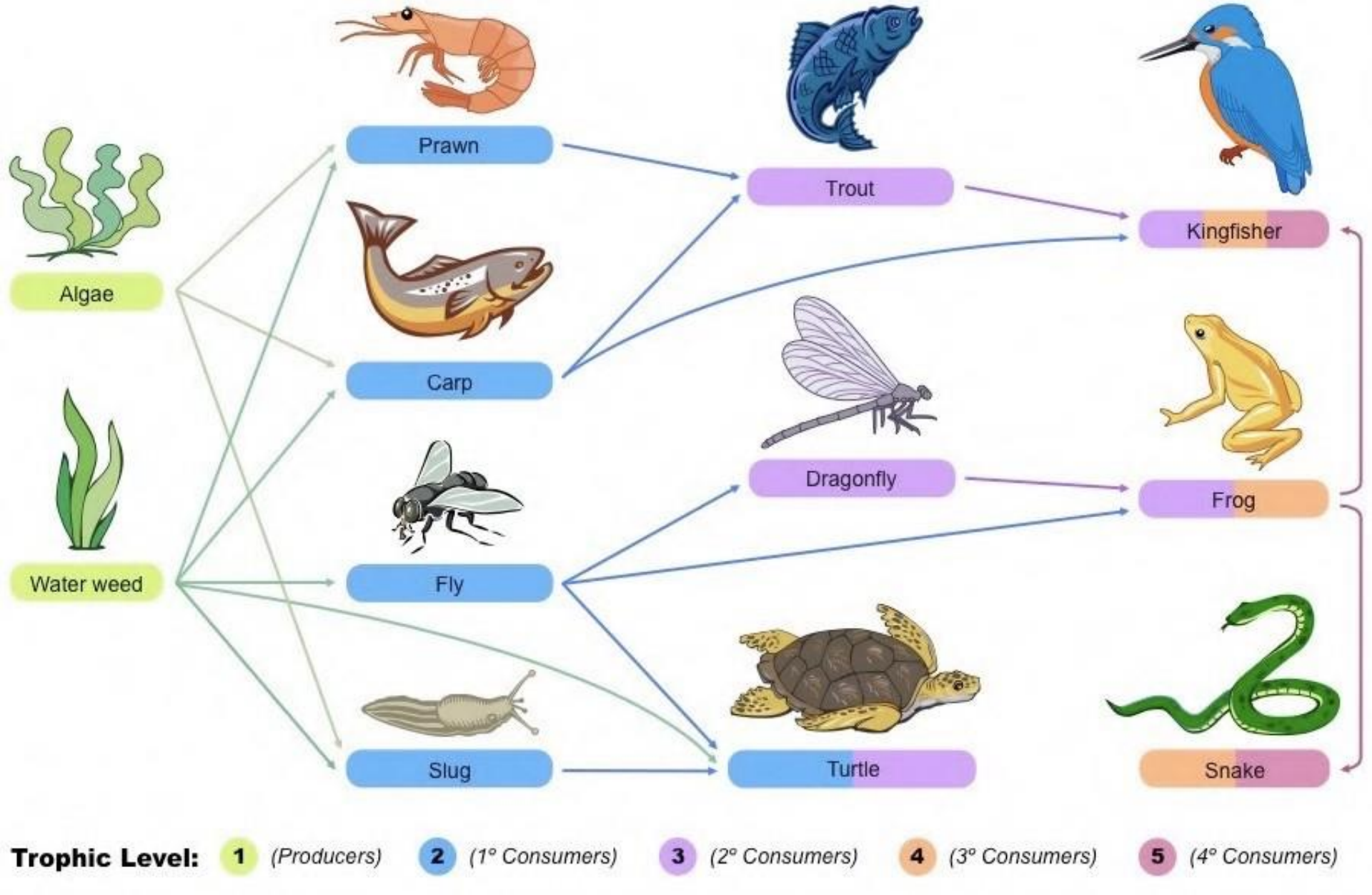


FOOD WEB

- 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 are a number of opportunities of eating and being eaten at each tropic level.
- Grass may be eaten by insects, rats, deer's, etc., these may be eaten by carnivores (snake, fox, tiger). Thus there is a interlocking of various food chains called food webs

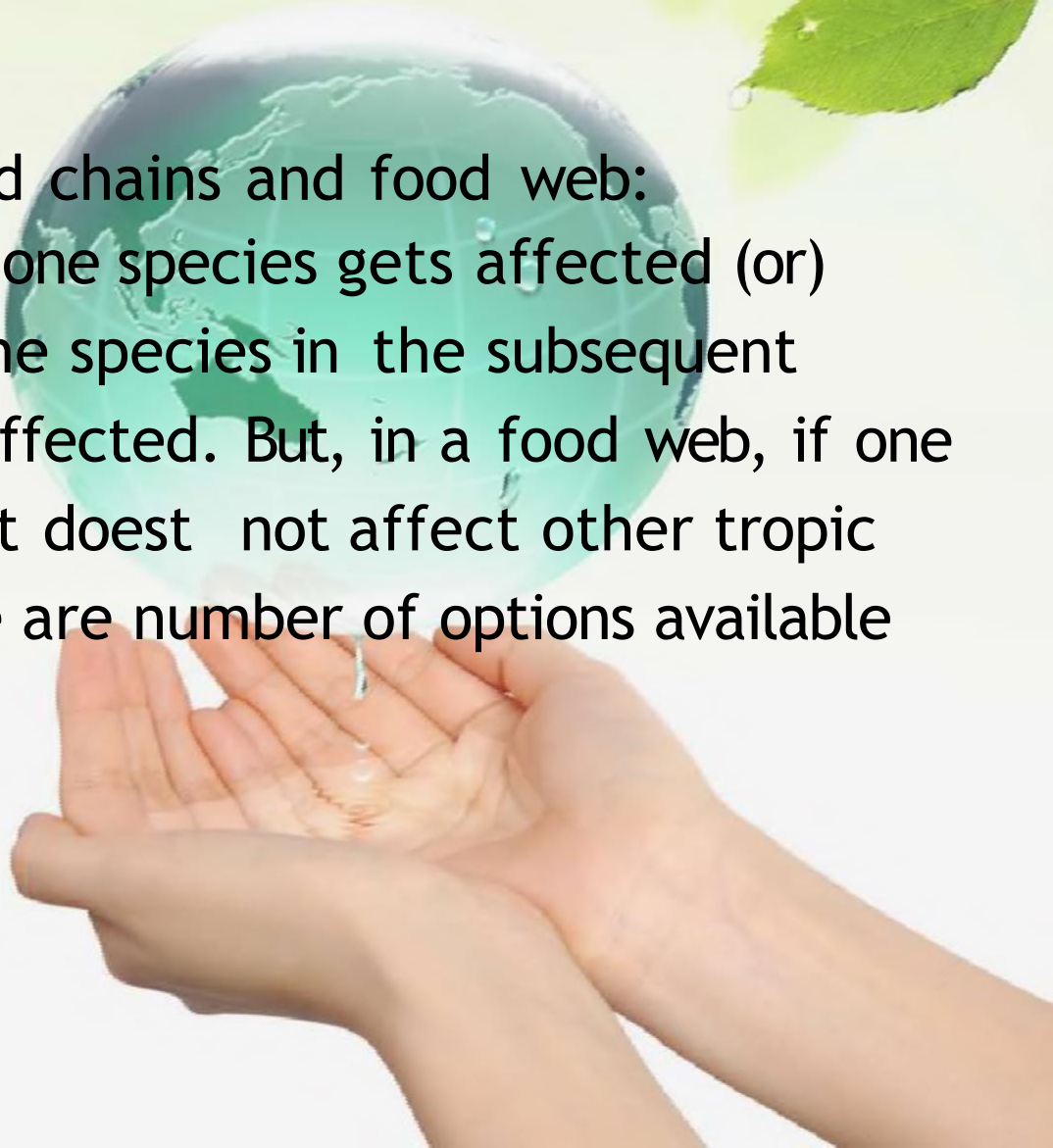
A Food Web

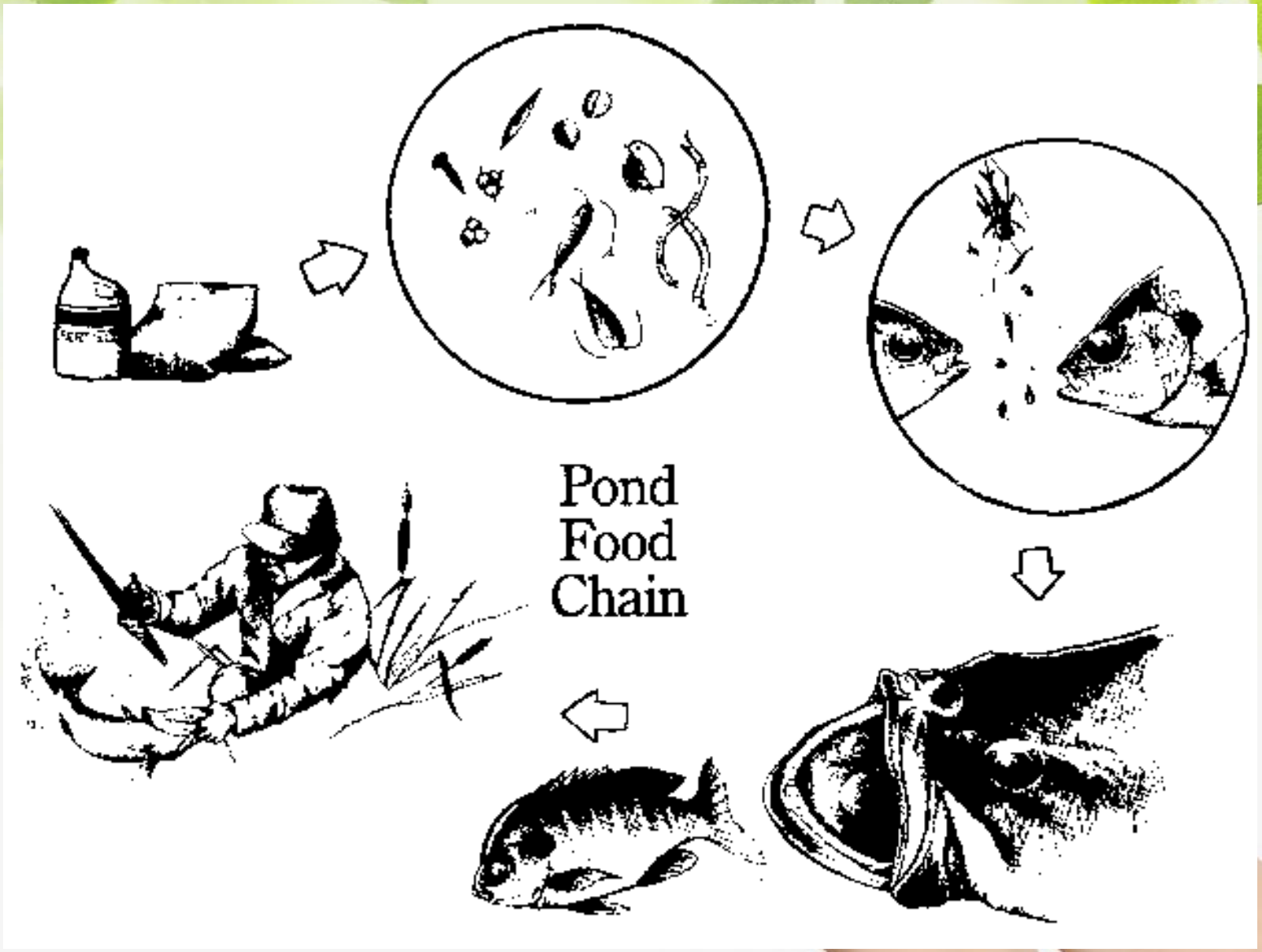

Python
Eagle
Wolf
Rat
Frog
Dragonfly
Thrush
Butterfly
Fruit Fly
Grasshopper
Corn
A Flowering Plant
Lavenders
Mangoes


Algae
Water weed
Prawn
Carp
Fly
Slug
Trout
Dragonfly
Turtle
Kingfisher
Frog
Snake
Trophic Level: 1 (Producers) 2 (1° Consumers) 3 (2° Consumers) 4 (3° Consumers) 5 (4° Consumers)

Difference between food chains and food web:

In a linear food chain 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.




Pond
Food
Chain

Significance of food chains and food webs

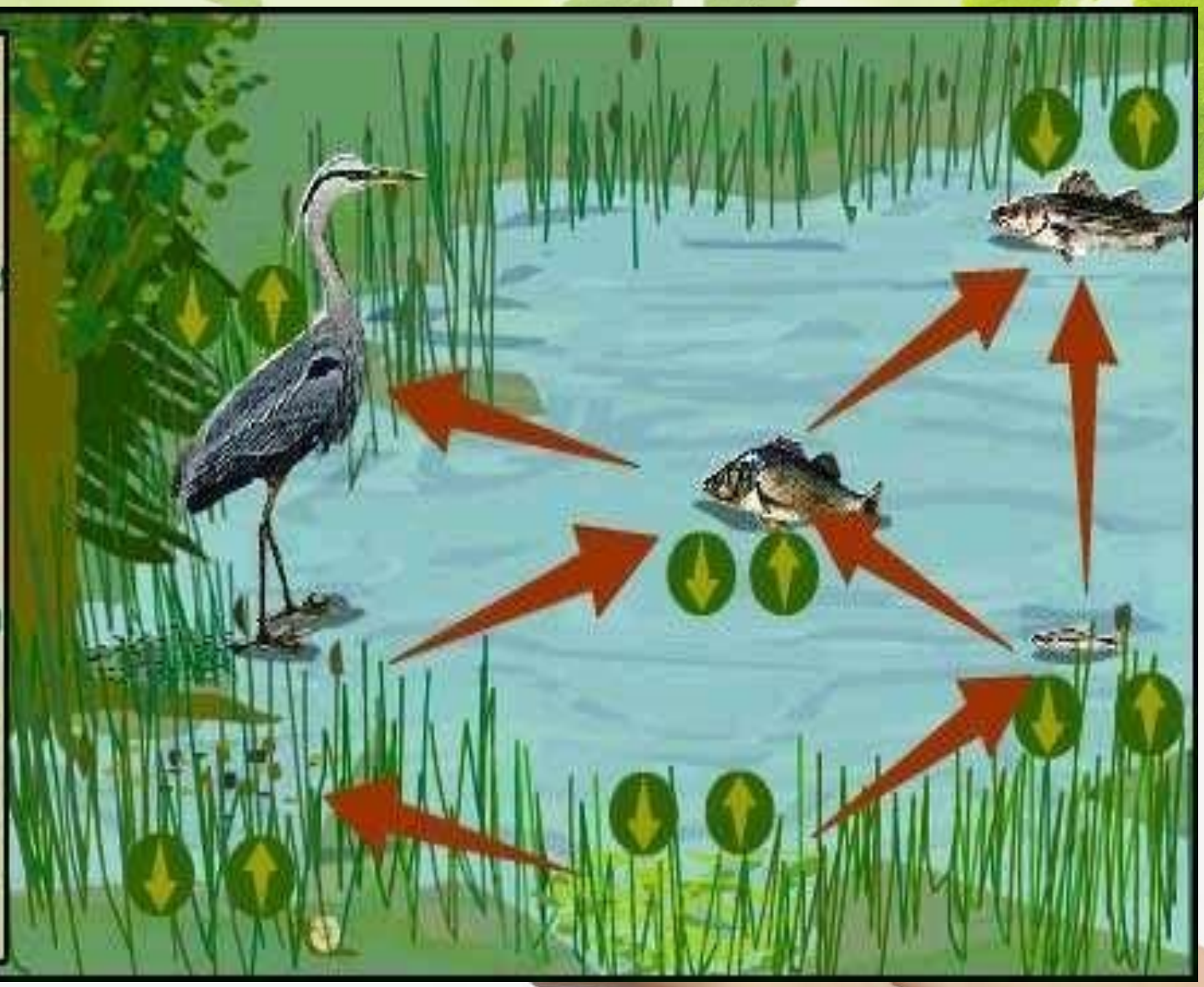
- Food chains and food webs play a very important role in the ecosystem. Energy flow and nutrient cycling takes place through them.
- They maintain and regulate the population size of different tropic levels, and thus help in maintaining ecological balance.
- They have the property of bio-magnification. 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.**

Food Web of a Pond

What happens when one animal population in a food web increases or decreases?

The impact of the population change ripples through the trophic levels, eventually affecting all species in this food web.

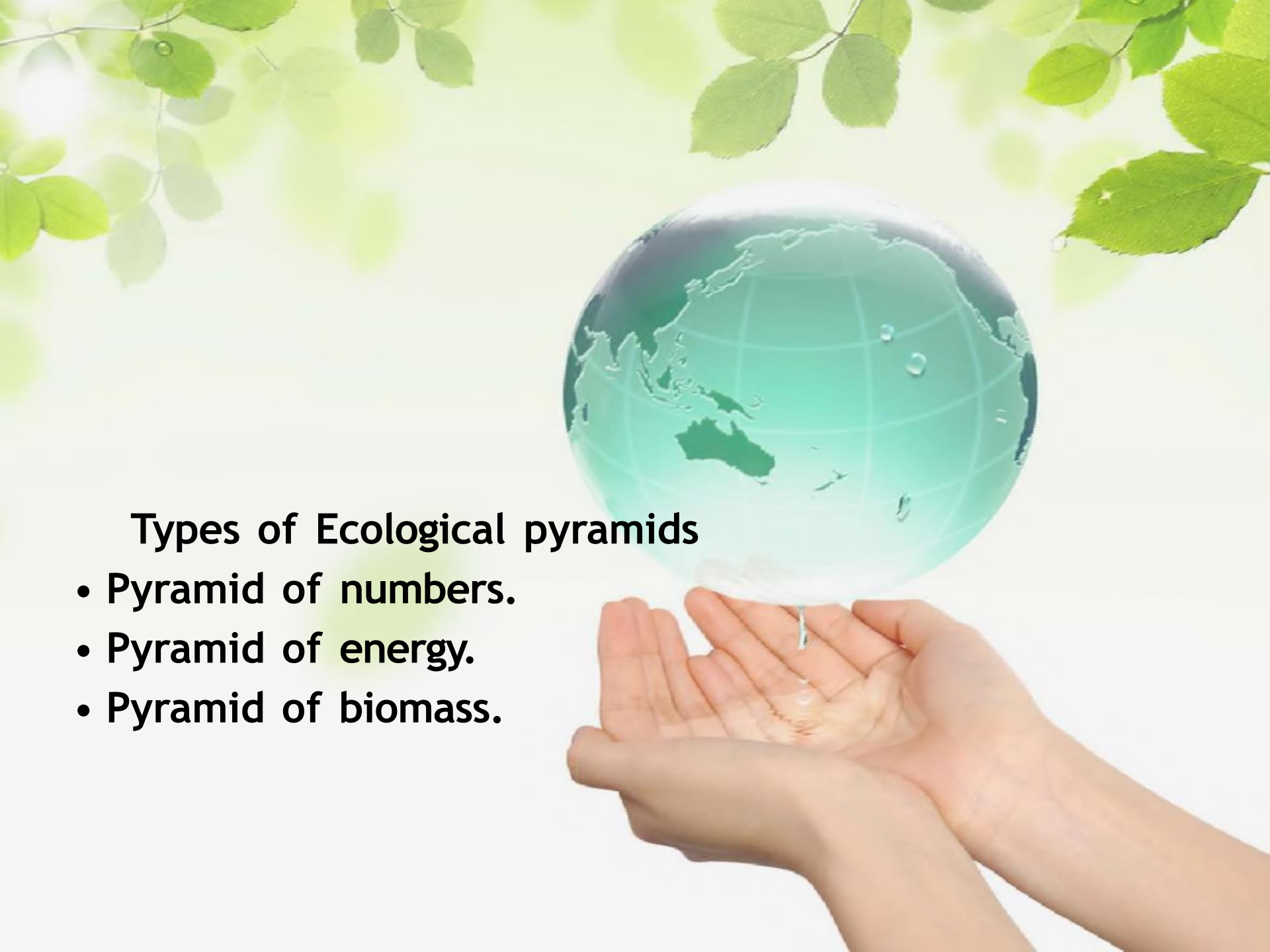
Trace the ripple effects from a change in one species and see!



ECOLOGICAL PYRAMIDS

- “Graphical representation of structure and function of tropic levels of an ecosystem, starting with producers at the bottom and successive tropic levels forming the apex is known as an ecological pyramid.”

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

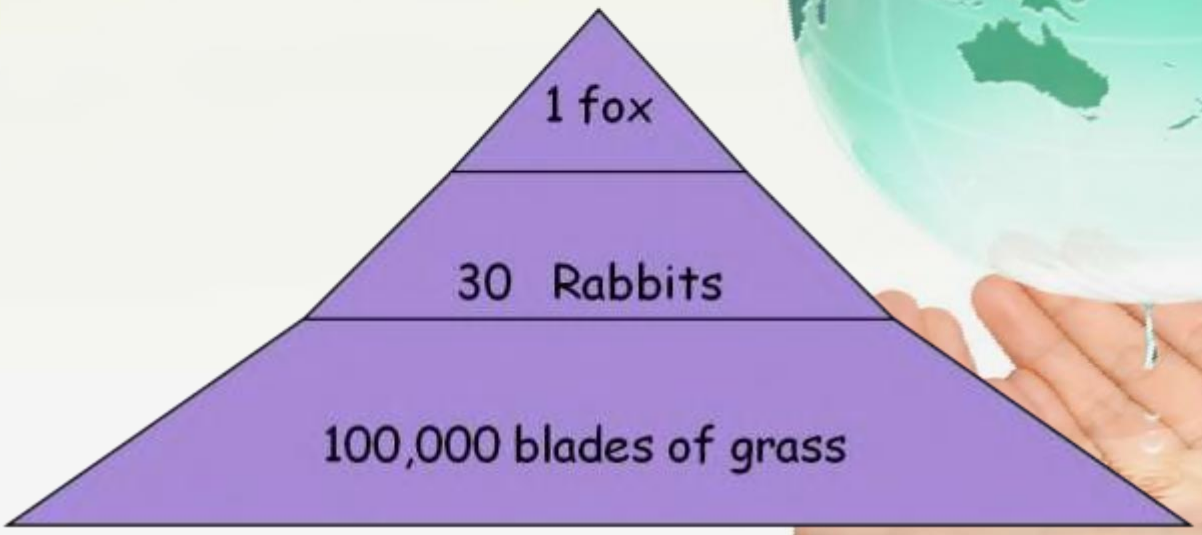


Types of Ecological pyramids

- Pyramid of numbers.
- Pyramid of energy.
- Pyramid of biomass.

Pyramid of Numbers

A pyramid of numbers can be used to show the number of organisms at each stage of a food chain.



Small numbers of large organisms

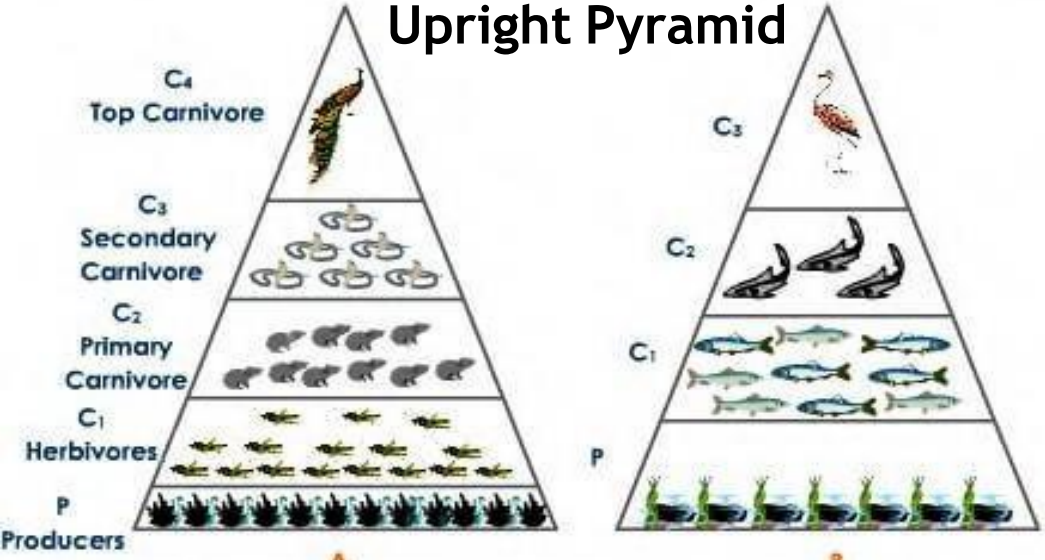
Large numbers of small organisms

It represents the number of individual organisms present in each tropic levels.

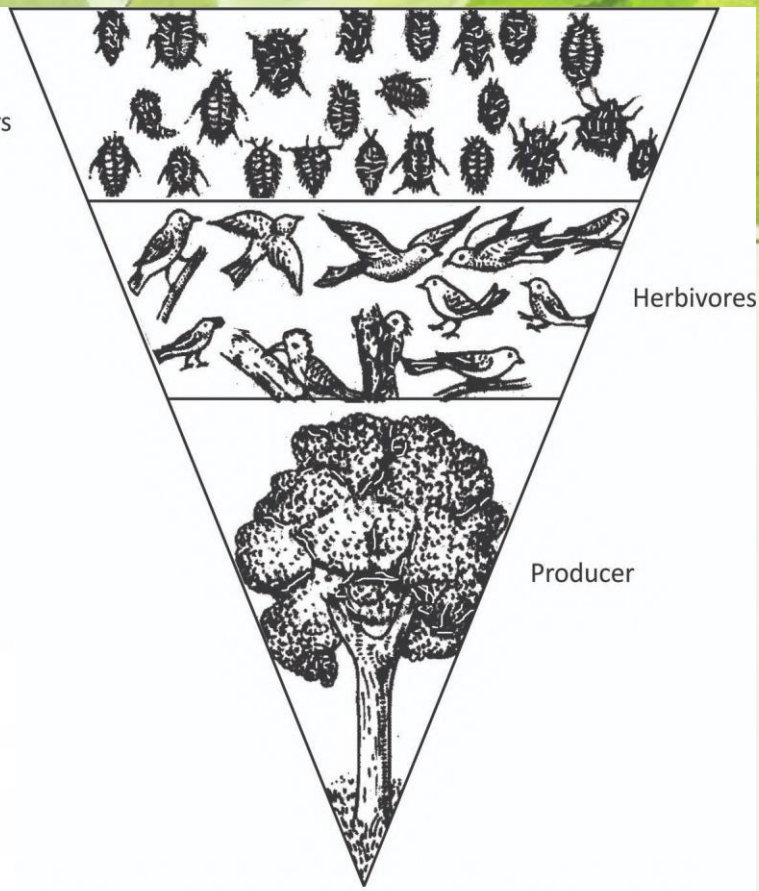
Ex: A grassland Ecosystem

- The producers in the grasslands are grasses, which are in size and large in numbers. So the producers occupy lower tropic level (1St tropic level).
- The primary consumers (herbivores) are rats, the 2nd tropic level. Since the number of rats are lower Compared to the grasses, the size is small.
- The secondary consumers (carnivores) are snakes, which occupy the 3rd tropic level. Since the number of snakes are lower when compared to the rats.
- The tertiary consumers (carnivores) are eagles, which the next tropic level. The number and size of the last level is till smaller.

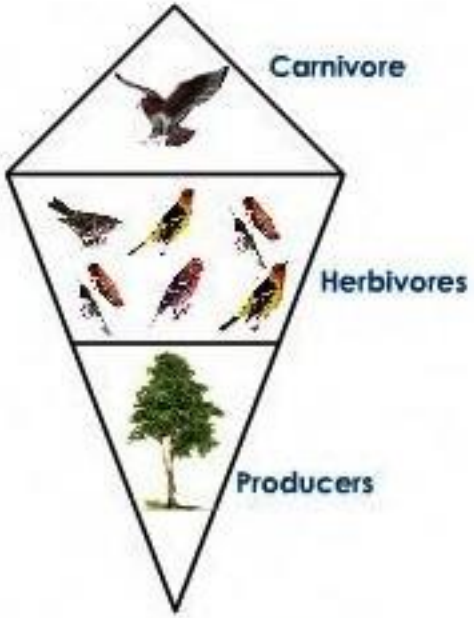
Upright Pyramid



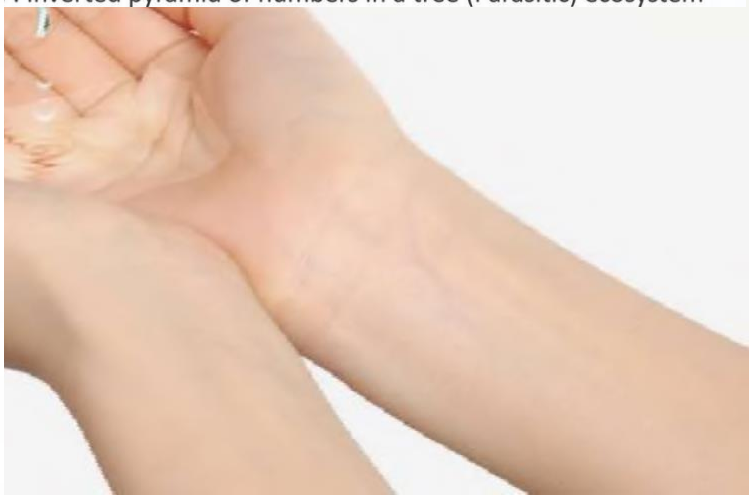
Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond



: Inverted pyramid of numbers in a tree (Parasitic) ecosystem

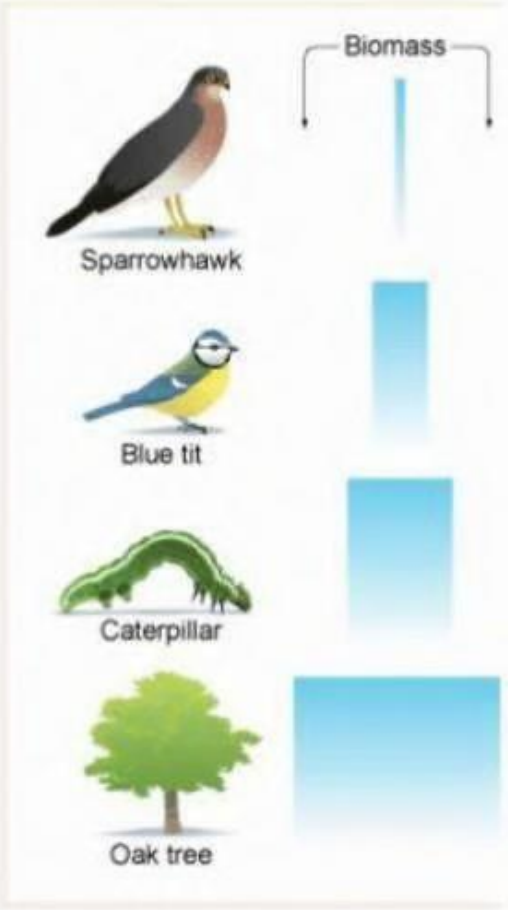


Partly Upright Pyramid of Number



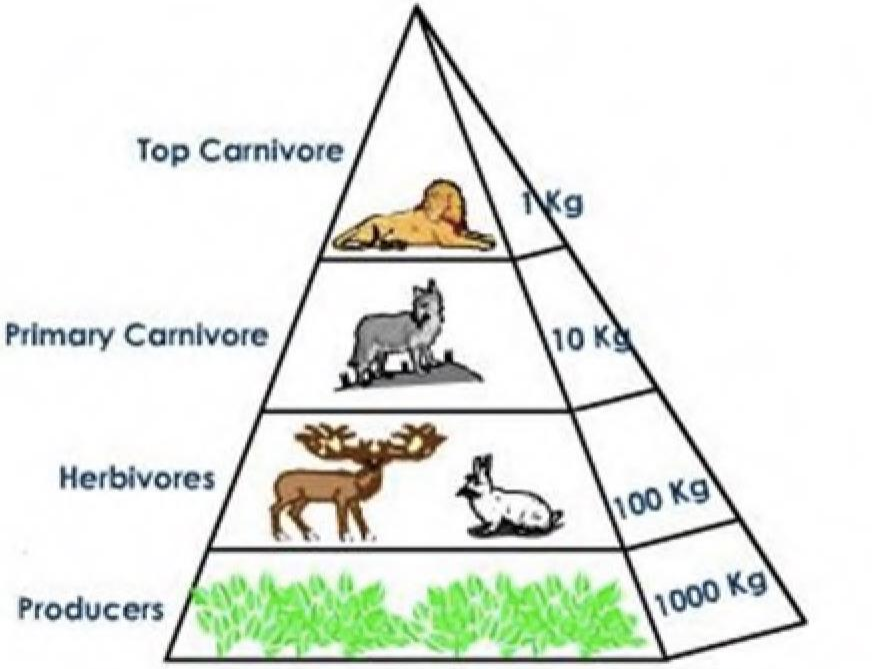
Pyramids of biomass

(mass of tissue of living organism)

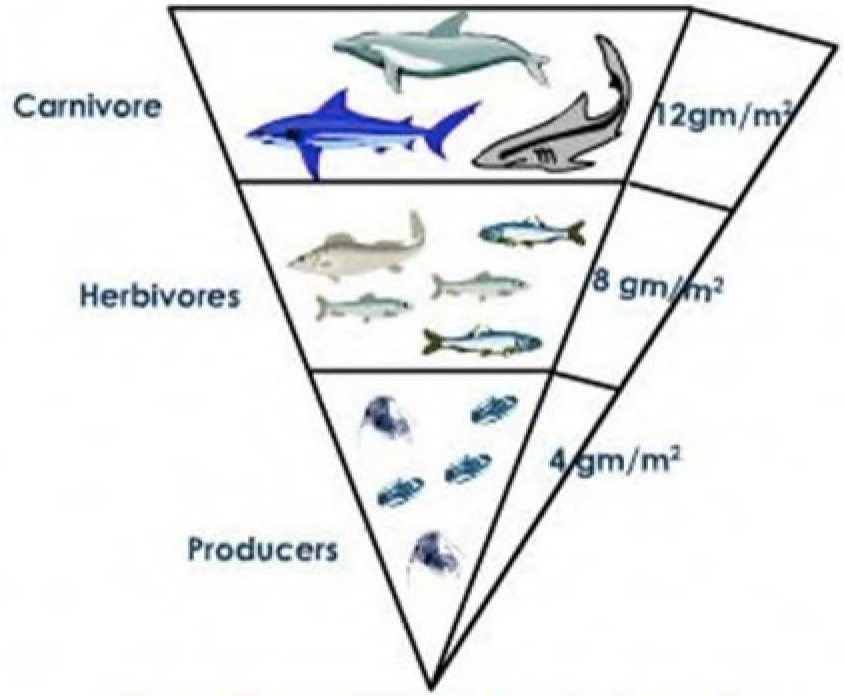


A pyramid of biomass is a graphical representation of biomass present in a unit area of various trophic levels. It shows the relationship between biomass and trophic level quantifying the biomass available in each trophic level.

Pyramid of biomass - *upright or inverted*



Upright Pyramid of biomass in a Terrestrial Ecosystem



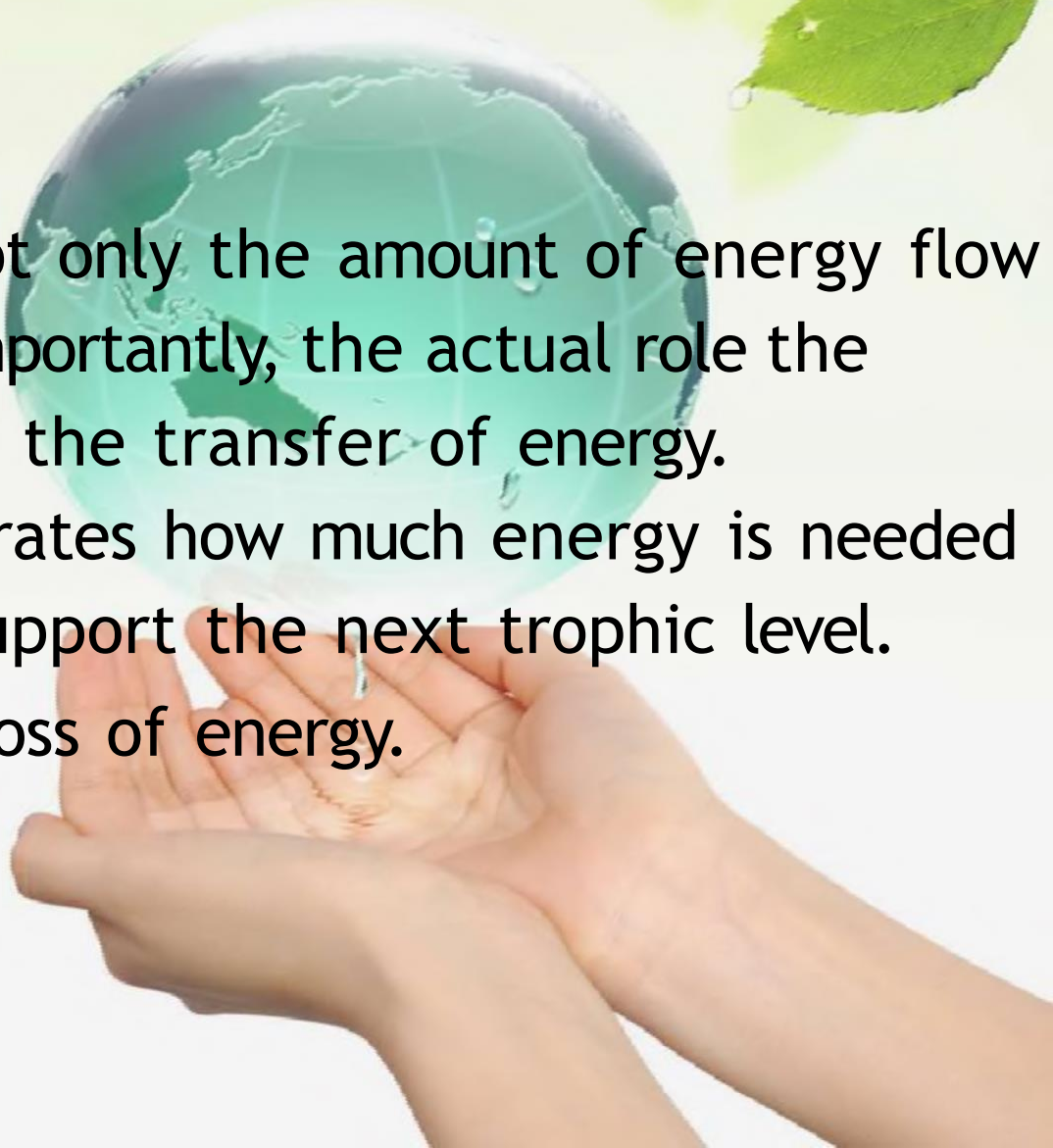
Inverted Pyramid in an Aquatic Ecosystem

Pyramid of Biomass

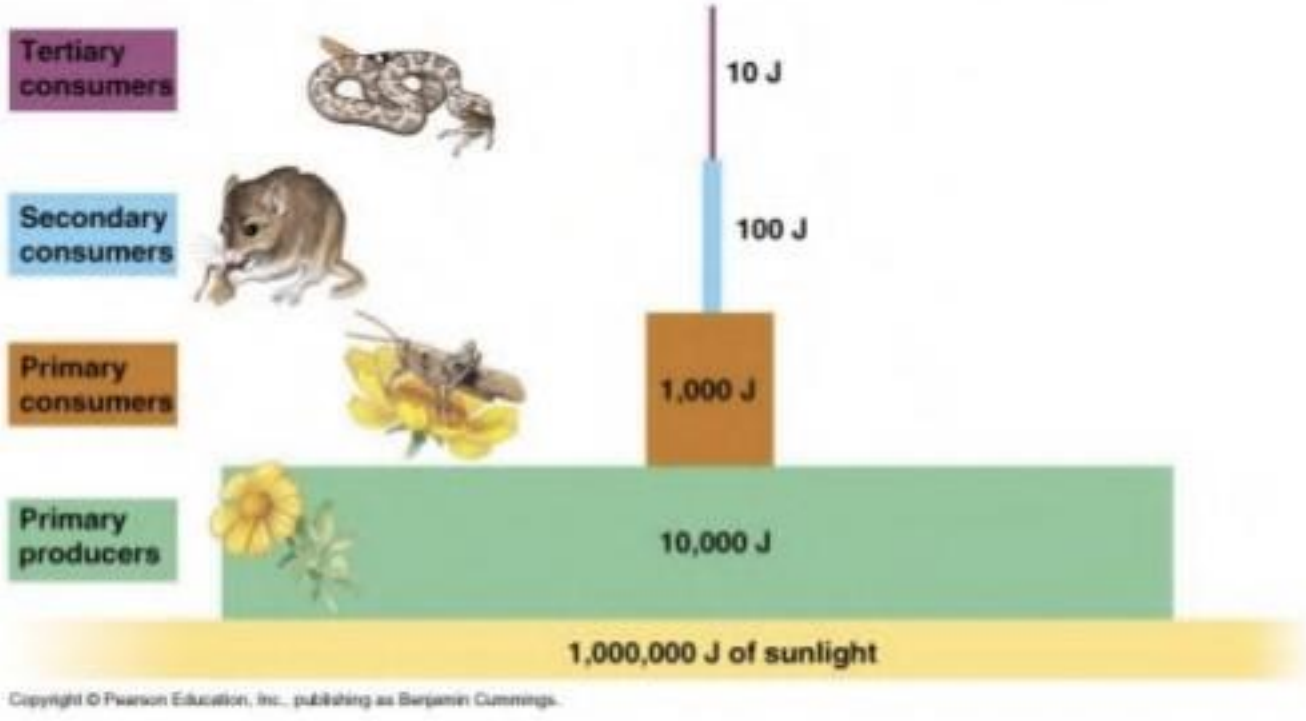
- It represents the total amount of biomass (mass or weight of biological material or organism) present in each tropic levels.
  Ex: A forest ecosystem
- The above figure shows that there is a decrease in the biomass from the lower tropic level to the higher tropic level. This because the trees (producers) are maximum in the forest, which contribute a huge biomass. The next tropic levels are herbivores (rabbit, deer) and carnivores (snakes, fox). Top of the tropic level contains few tertiary consumers (lion, tiger), the biomass of which is very low.

Pyramid of Energy

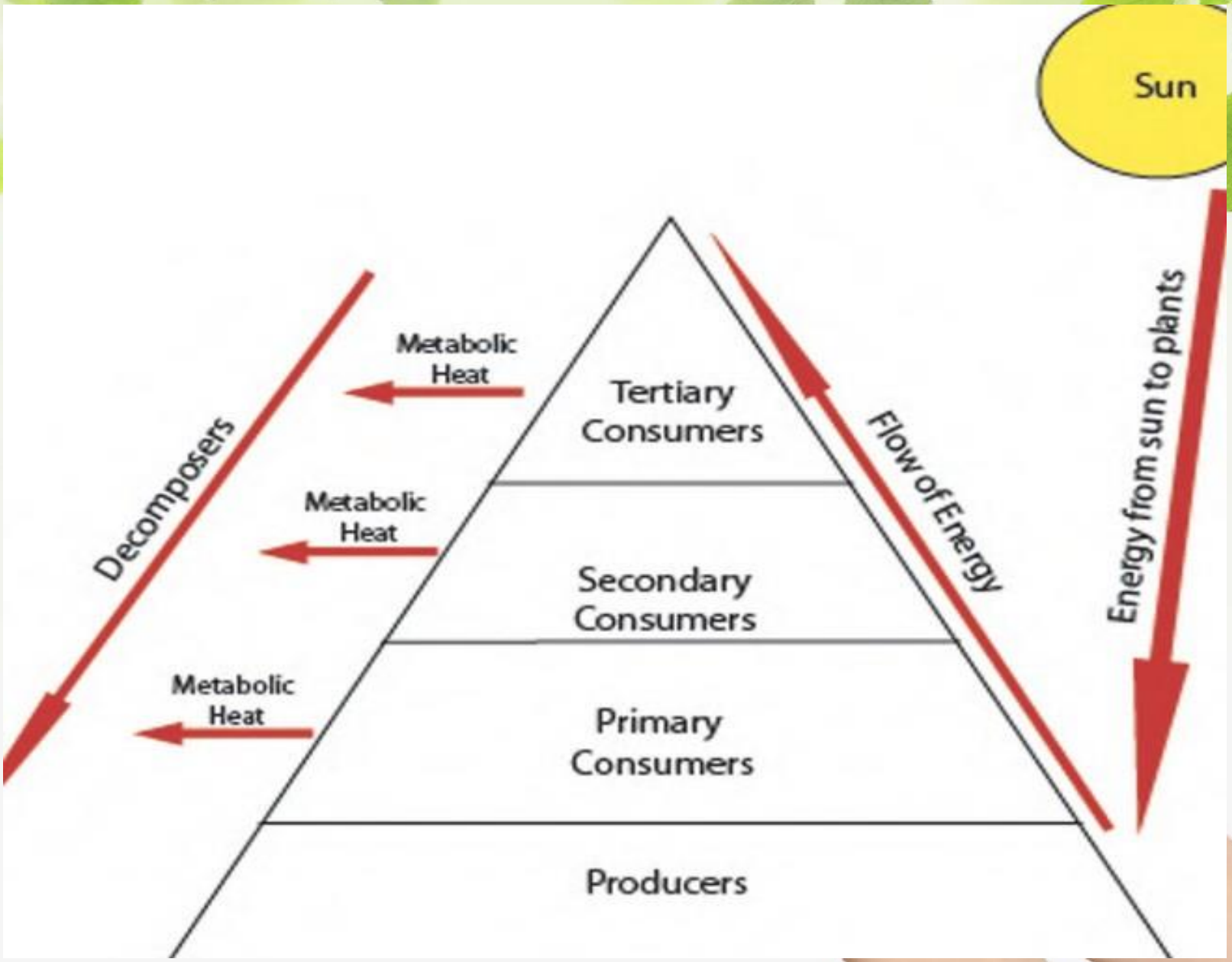
- This pyramid indicates not only the amount of energy flow at each level, but more importantly, the actual role the various organisms play in the transfer of energy.
- An energy pyramid illustrates how much energy is needed as it flows upwards to support the next trophic level.
- Always there is a huge loss of energy.



Trophic Levels



Notice that only 10% is moved to the next level.
Where does the rest go?


Sun
Energy from sun to plants
Flow of Energy
Decomposers
Metabolic Heat
Metabolic Heat
Metabolic Heat
Tertiary Consumers
Secondary Consumers
Primary Consumers
Producers

Energy flow

- Universal energy flow model

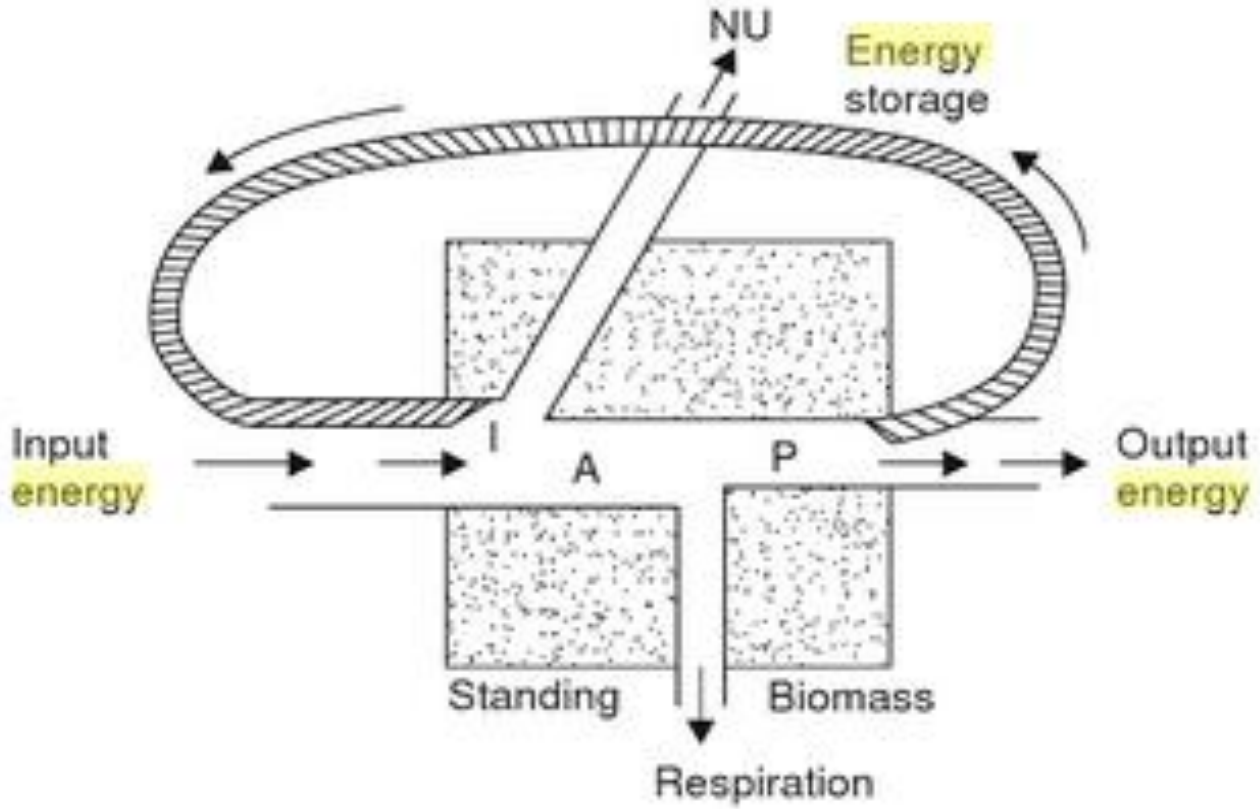
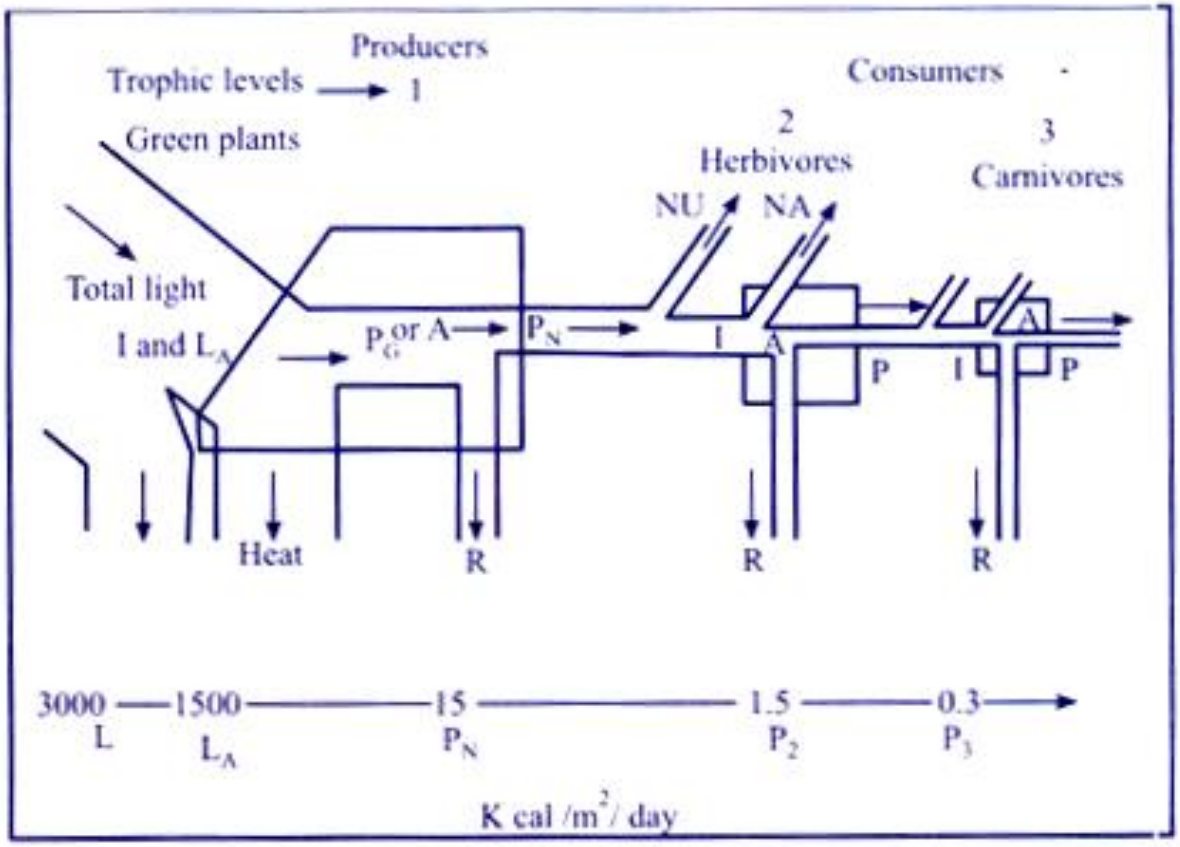


Fig. 3.8. Universal energy flow model applicable to all living components (I = Energy input; A : assimilated energy ; P = Production ; NU = Energy not used.

Energy flow

- Single channel energy flow model



[I- total energy input, L_A – light absorbed by plant cover, P_G – gross primary production, A – total assimilation, P_N – net primary production, P – Secondary production, NU – Energy not used (stored), NA – Energy not assimilated by consumers (egested), R – respiration. Bottom line in the diagram shows the order of the magnitude of energy losses expected at major transfer points, starting with a solar input of 3,000 Kcal per square meter per day. (After E.P. Odum, 1963)]

- Double channel or Y-shaped energy flow model

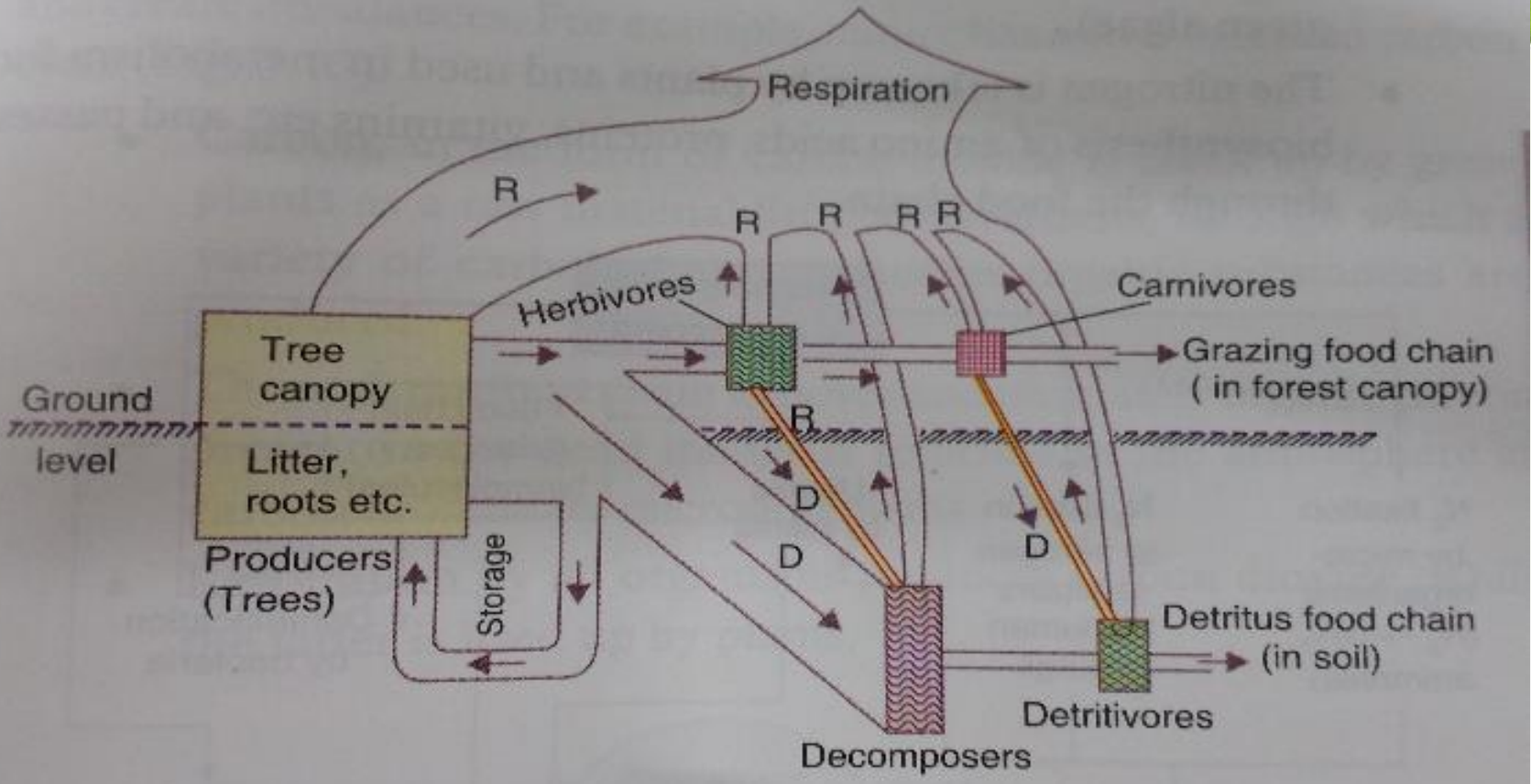
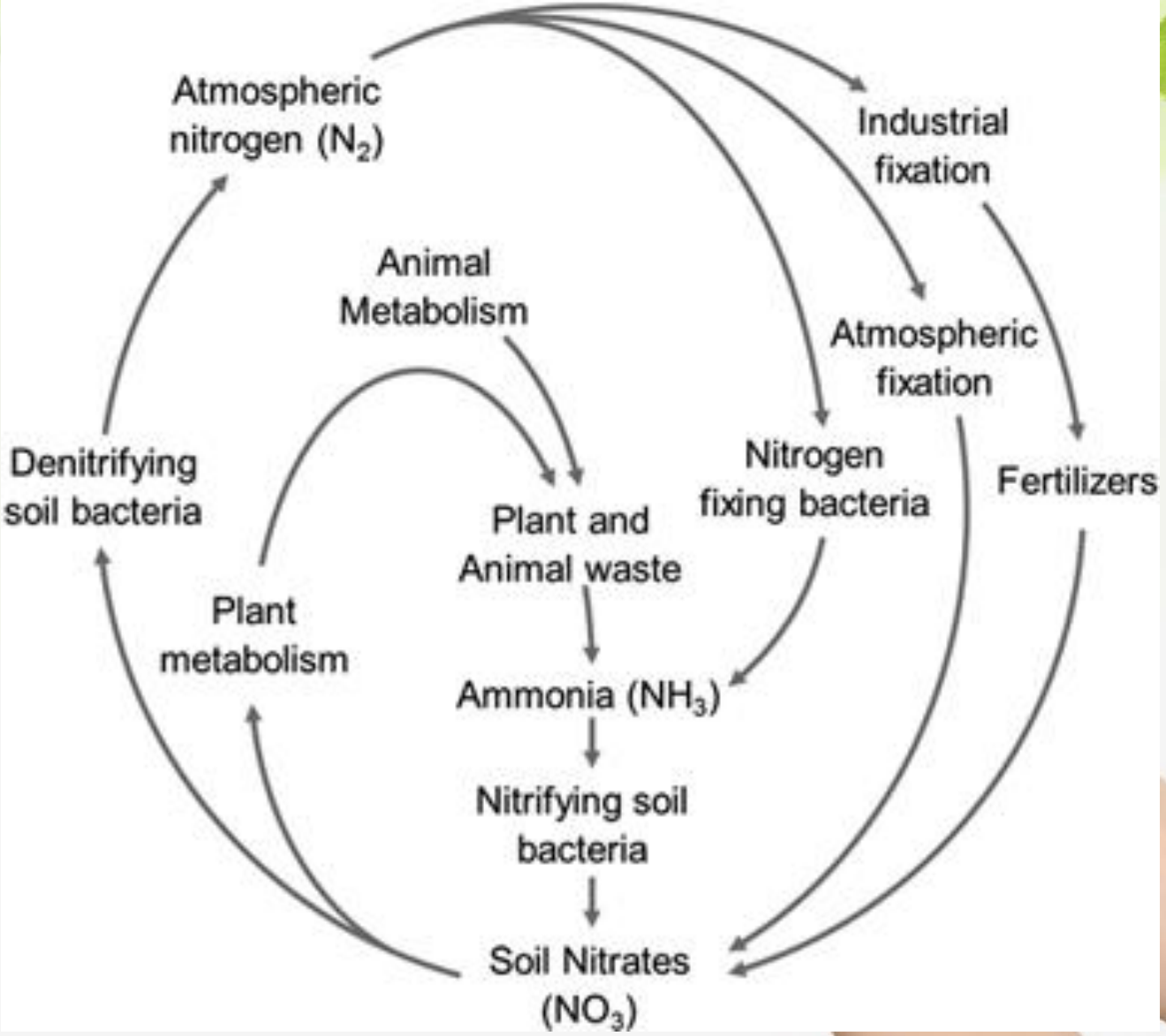


Fig. 3.13 Y-shaped or 2-channel energy flow model showing energy flow through the grazing food chain and the detritus food chain (R = Respiration, D = Detritus or dead matter).

Nutrient cycles

- Nitrogen



- Carbon

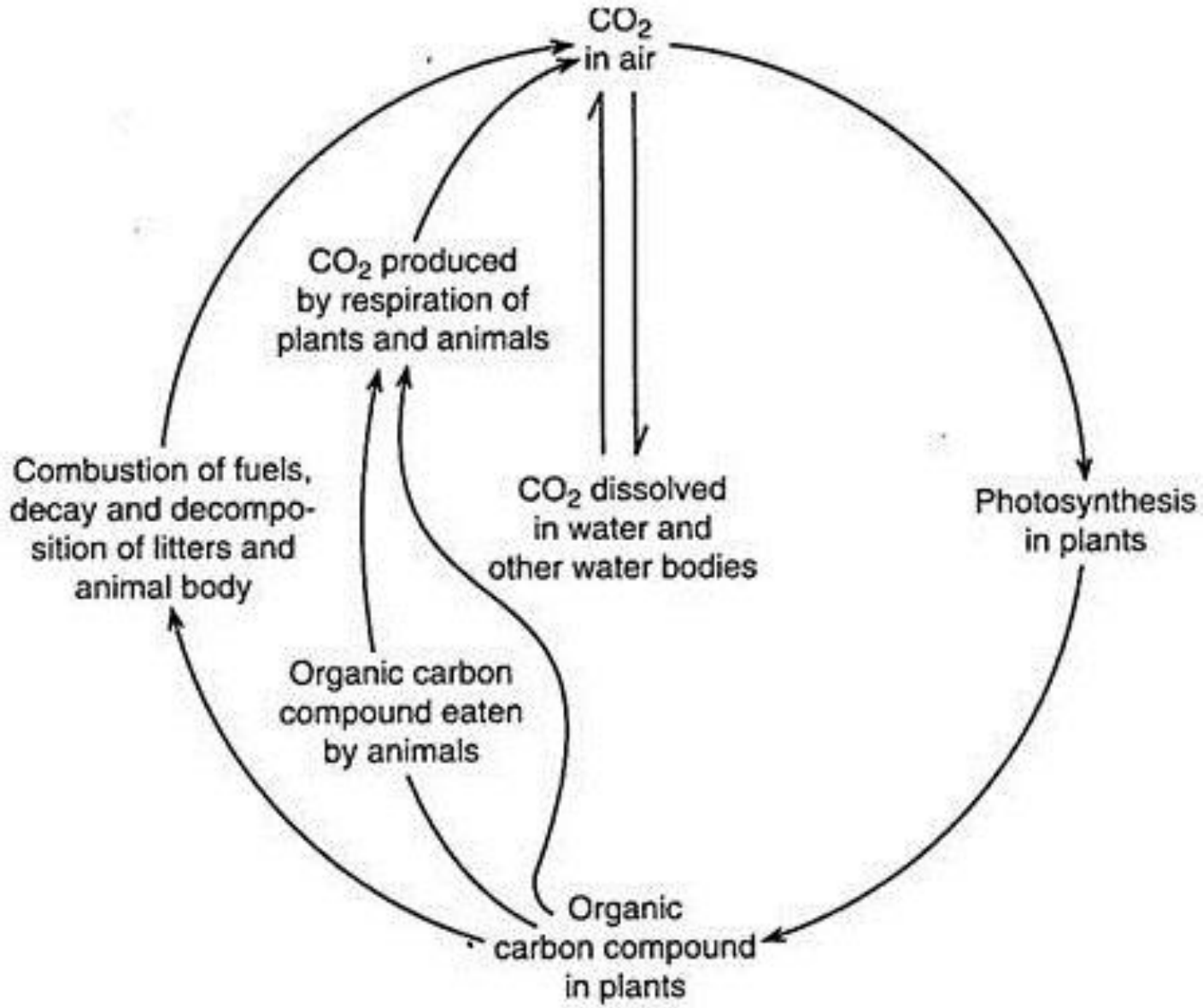
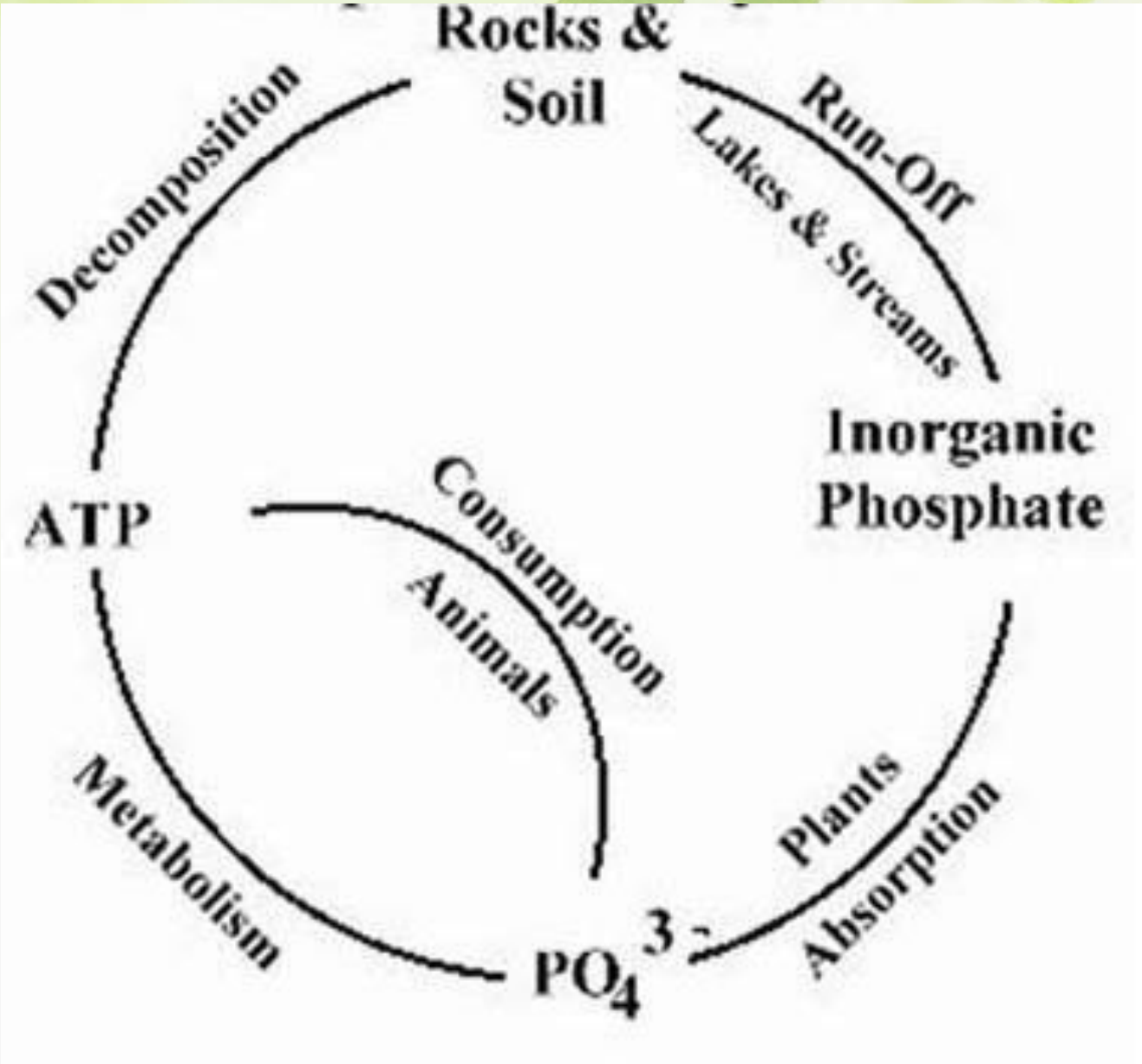


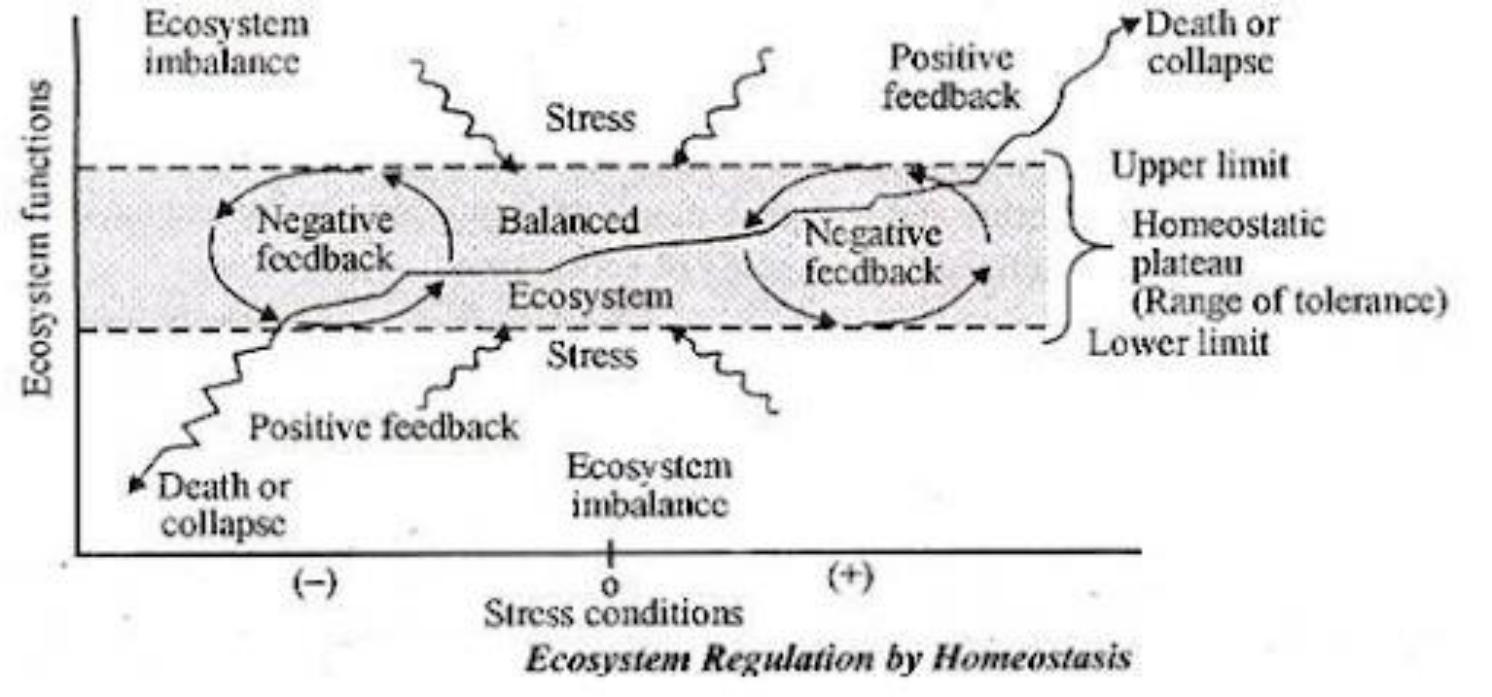
Fig. 2.33 : Carbon cycle

- Phosphorus


Rocks &
Soil
Run-Off
Lakes & Streams
Inorganic
Phosphate
Plants
Absorption
PO_4^{3-}
Metabolism
ATP
Consumption
Animals
Decomposition

Homeostasis

- The ecosystem , by itself, tries to resist the change and maintain itself in equilibrium.
  - Positive feedback
  - Negative feedback



Ecosystem Regulation by Homeostasis

Succession

- Ecological succession is the gradual process by which ecosystems change and develop over time.
- It is therefore a series of predictable temporary communities or stages leading up to a climax community.
- Each stage/temporary community is called a successional stage or seral stage.
- Each step prepares the land for the next successional stage.
- All habitats are in the state of constant ecological succession.

- An established species and impact of external natural forces, which try to alter the environmental condition of that area. Ex. Hardwood tree replacing red pine
- Ecosystem is continuously changing and reorganizing as well as ecological succession refers to orderly that changes happening in composition or structure of ecosystem

Types of Succession

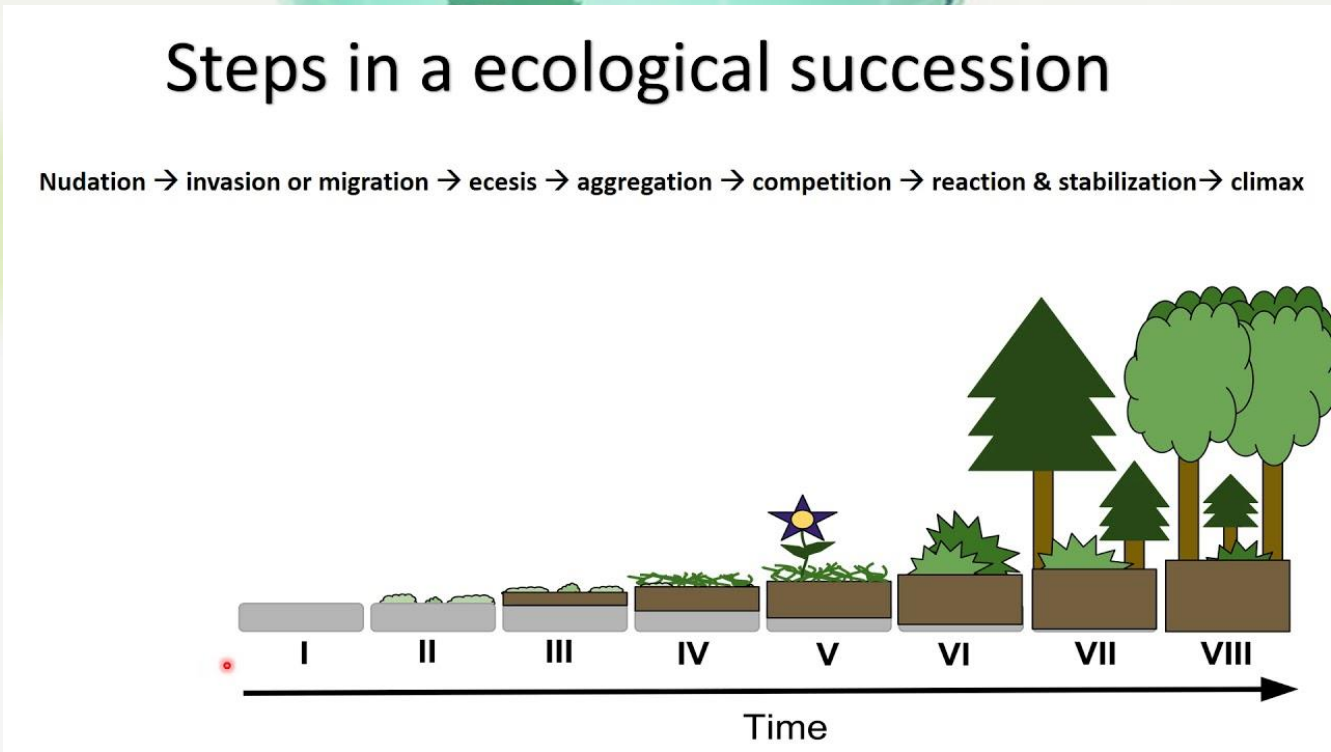
- Primary succession
  - Primary succession refers to a series of community changes which occur on an entirely new habitat which has never been colonized before. For example, a newly quarried rock face or sand dunes. (pioneer and climax community).
- Secondary succession
  - Secondary succession refers to a series of community changes which take place on a previously colonized, but disturbed or damaged habitat. For example, land obtained after felling trees in a woodland, land clearance, or fire.

Succession starting on different types of area

- Hydrarch / Hydrosere
  - Pond, swamp, bog
- Mesarch / Mesosere
  - Area with adequate moisture
- Xerarch / Xerosere
  - Lithosere: On bare rock
  - Psammosere: On sand
  - Halosere: On saline soil

Process of ecological succession

- Nudation
- Invasion
  - Migration (dispersal)
  - Ecesis (establishment)
  - Aggregation
- Competition
- Reaction
- Stabilization



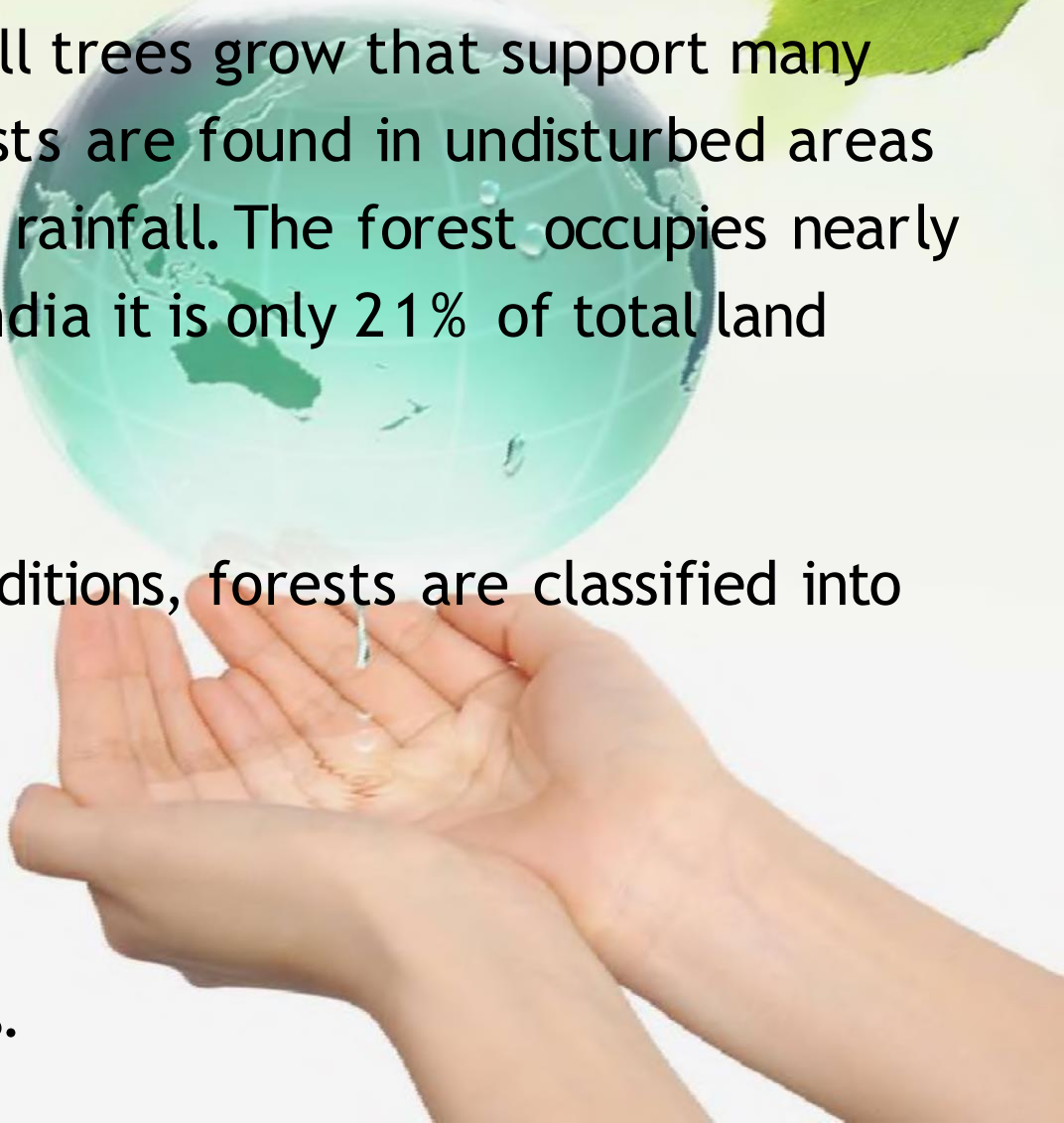
FOREST ECOSYSTEM

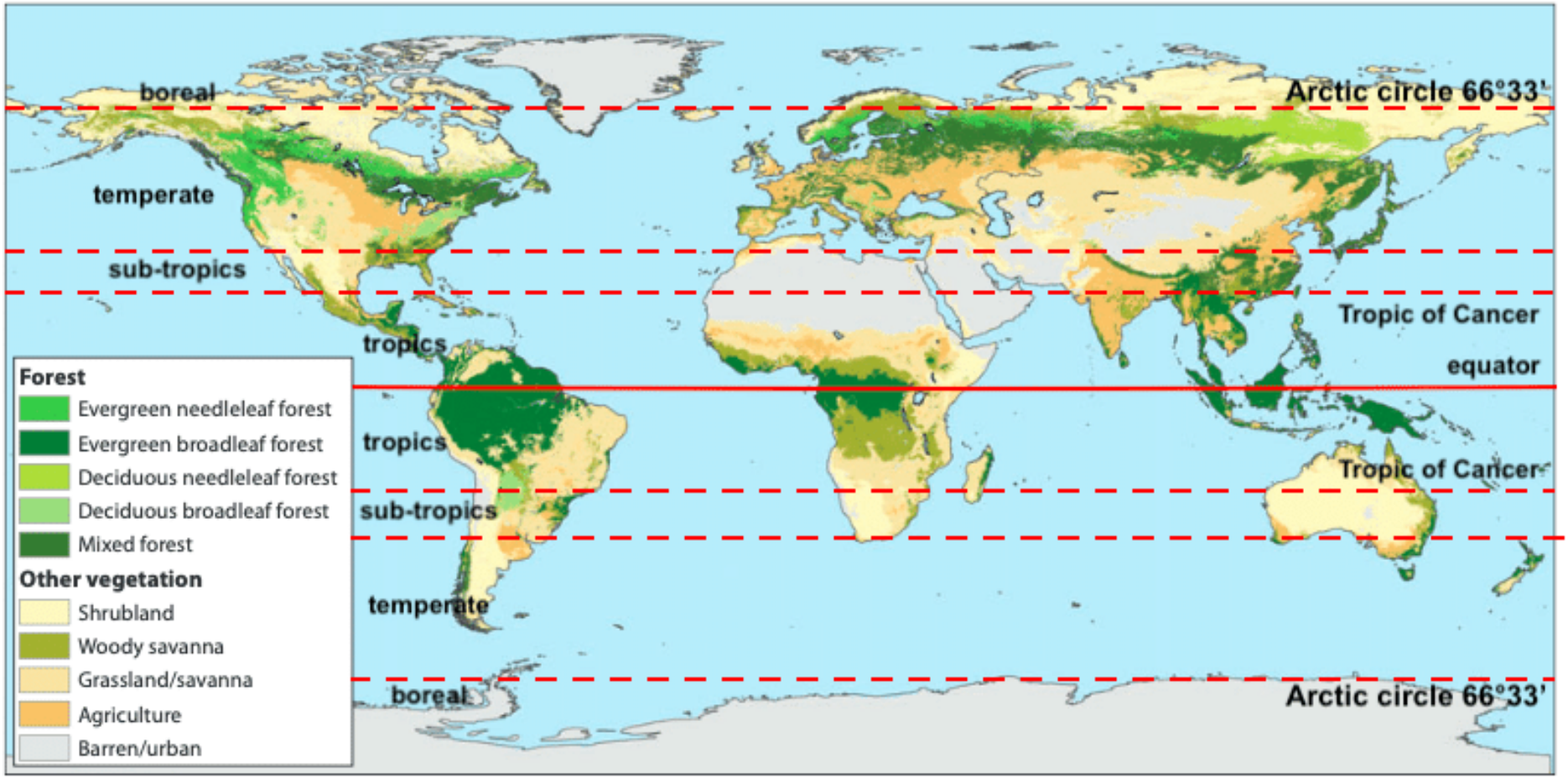
A forest is an area with a high density of trees. A forest ecosystem is one in which tall trees grow that support many animals and birds. The forests are found in undisturbed areas receiving moderate to high rainfall. The forest occupies nearly 31% of the world's land in India it is only 21% of total land area.

Types of forest ecosystem

Based upon the climate conditions, forests are classified into

- Tropical Rain forests.
- Tropical deciduous forests.
- Tropical scrub forests.
- Temperate rain forests.
- Temperate deciduous forests.



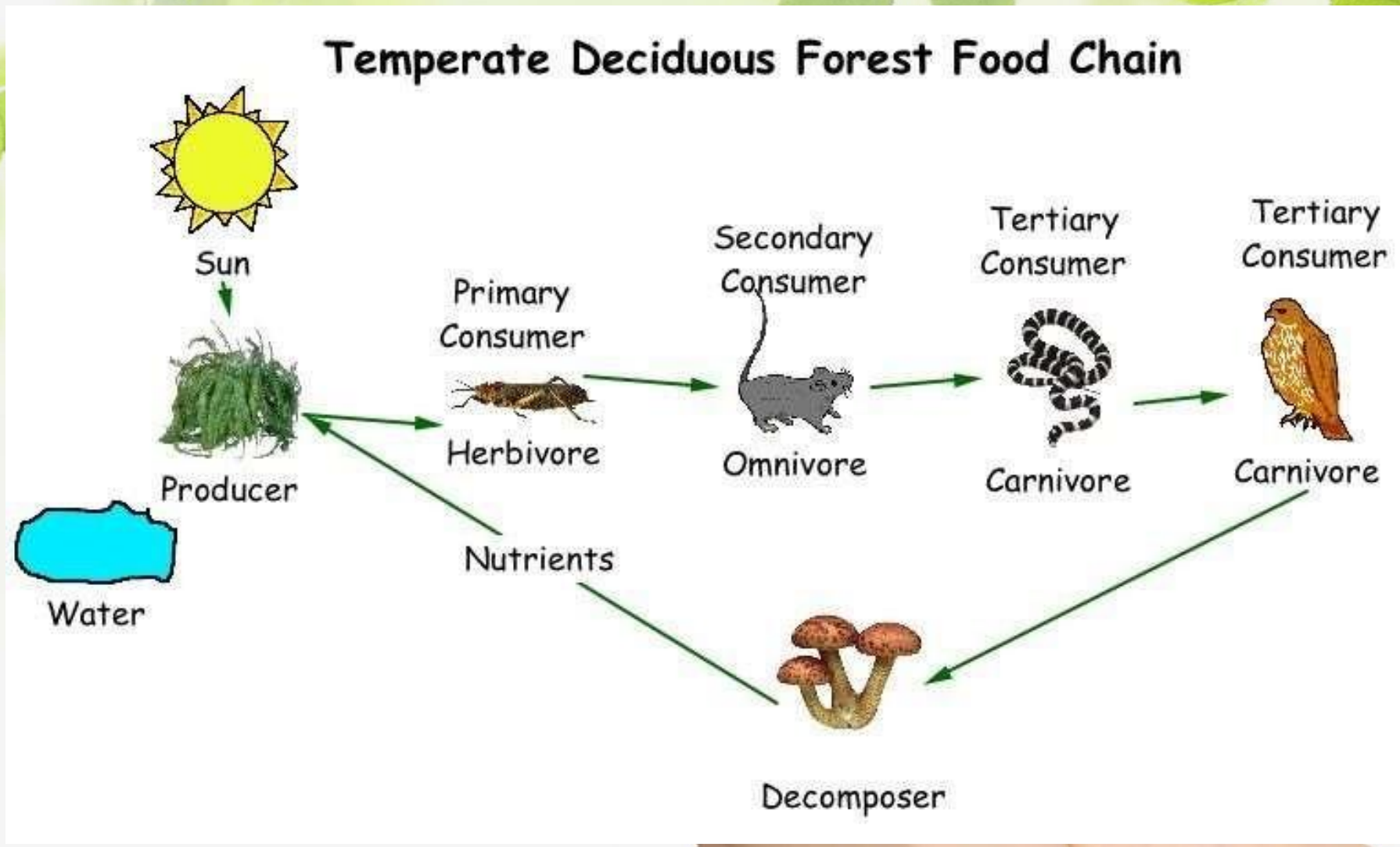

boreal
temperate
sub-tropics
tropics
tropics
sub-tropics
temperate
boreal
Arctic circle 66°33'
Tropic of Cancer
equator
Tropic of Cancer
Arctic circle 66°33'
Forest
Evergreen needleleaf forest
Evergreen broadleaf forest
Deciduous needleleaf forest
Deciduous broadleaf forest
Mixed forest
Other vegetation
Shrubland
Woody savanna
Grassland/savanna
Agriculture
Barren/urban

Points of difference	TROPICAL EVERGREEN FOREST	TROPICAL DECIDOUS FOREST	MEDITERRANEAN FOREST	TEMPERATE SOFTWOOD FOREST
				
REGION	Tropical regions of the world where heavy rainfall occurs throughout the year. Western Africa, western India.	In monsoon areas of the world. India, Myanmar, South China, East Brazil & Central parts of America.	In regions around the Mediterranean sea. Shores of Europe, Asia, North Africa, South-Western parts of South Africa.	In the higher latitudes of the northern hemisphere, and high mountains of Europe, Asia, North Canada and USA.
RAINFALL	Receives approx 200 cm rainfall.	Receives approx 100 to 200 cm rainfall.	Receives moderate rainfall during winters.	Rainfall is in the form of snow in winters.

Points of difference	TROPICAL EVERGREEN FOREST	TROPICAL DECIDOUS FOREST	MEDITERRANEAN FOREST	TEMPERATE SOFTWOOD FOREST
FEATURES	*Trees are tall, upto 60 metres. *Leaves are broad. *Always appear green, as do not shed their leaves .	*Trees are medium height upto 30-40 met. *Leaves are medium size. * Shed their leaves in dry summer to conserve moisture.	*Trees are of medium height. *Leaves are spiny, waxy, small, leathery-textured.	*Trees are tall and conical in shape. *Leaves are needle-shaped. *Always appear green as do not shed their leaves.
EXAMPLES	Ebony, mahogany, rubber, rubber wood.	Teak, Sal, sheesham, bamboo, eucalyptus.	Cork, olive, citrus fruit trees.	Pine, fur, spruce, silver fir, chestnut, walnut.
OTHER NAME	Tropical rain forest	Tropical monsoon forest.	-Same -	Coniferous forest.

Characteristics of forest ecosystems

- Forests are characterised by warm temperature and adequate rainfall, which make the generation of number of ponds, lakes etc.,
- The forest maintains climate and rainfall.
- The forest support many wild animals and protect biodiversity.
- The soil is rich in organic matter and nutrients which support the growth of trees.
- Since penetration of light is so poor, the conversion of organic matter into nutrients is very fast.


Temperate Deciduous Forest Food Chain
Sun
Producer
Water
Primary Consumer
Herbivore
Secondary Consumer
Omnivore
Tertiary Consumer
Carnivore
Tertiary Consumer
Carnivore
Nutrients
Decomposer

Structure and Function of forest ecosystem

I. Abiotic components

The abiotic components include basic inorganic & organic compounds present in the soil & atmosphere. In addition minerals, the occurrence of litter is characteristic features of majority of forests.

II. Biotic components

1. Producers: In a forest, the producers are mainly trees produce food by photosynthesis. Apart from trees, climbers, epiphytes, shrubs and ground vegetation. Dominant species of trees in forest are Dalbergia, Tectona grandis, Lichens, Fern, Pine, Cedar.

2. Consumers

Primary consumers (herbivores): They directly depend on the plants for their food.

Ex: Ants, flies, insects, mice, deer, squirrels. Larger animals such as Elephants, Deer, Giraffe etc.

Secondary consumers (primary carnivores):They directly depend on the herbivores for their food.

Ex: Lizards, snakes, birds, fox.

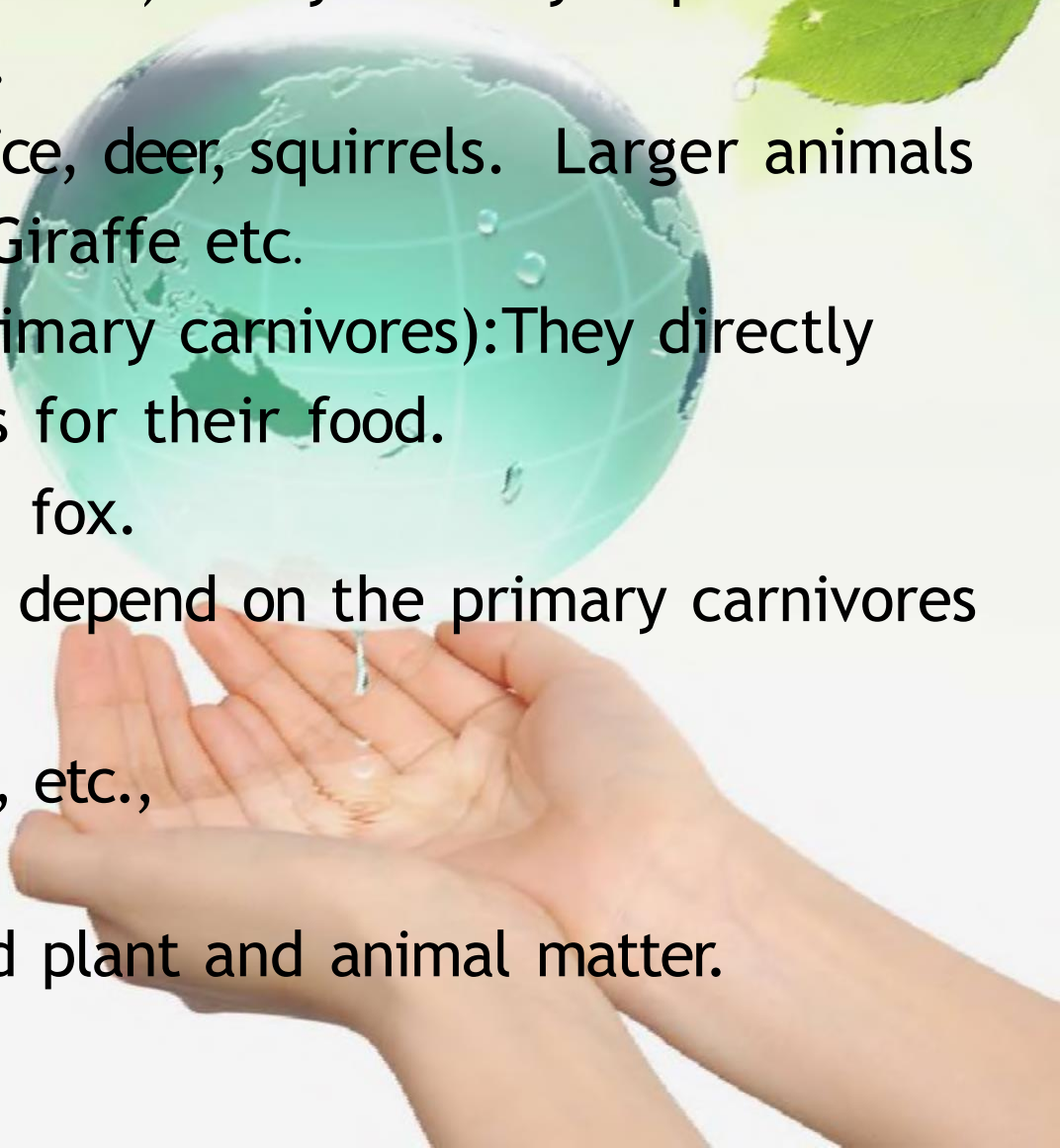
Tertiary consumers :They depend on the primary carnivores for their food.

Ex: Animals like tiger, lion, etc.,

3. Decomposers

They decompose the dead plant and animal matter.

Ex: Bacteria and fungi.





Producers: Different tree species





Consumers in a Forest Ecosystem

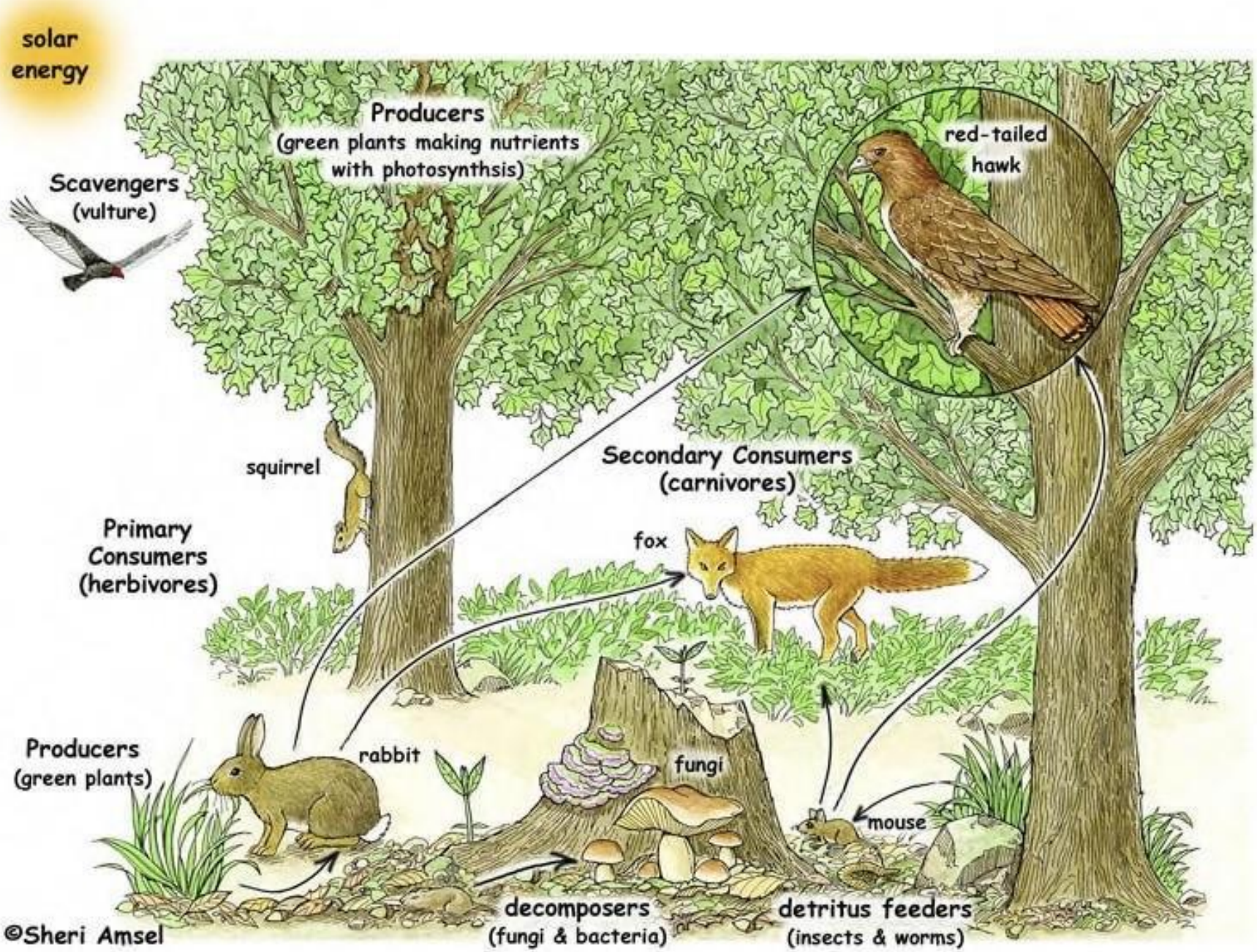

Decomposers in a Forest ecosystem

It provides numerous environmental services like;

- Nutrient cycling,
- Maintaining biodiversity
- Providing wildlife habitat
- Affecting rainfall patterns
- Regulating stream flow
- Storing water
- Reducing flooding
- Preventing soil erosion
- Reclaiming degraded land & many more….

Apart from environmental values, forest ecosystems have some traditional values as well.

- Fire Wood & Timber.
- Fruits.
- Gums.
- Herbs & drugs.


solar energy
Producers
(green plants making nutrients with photosynthsis)
Scavengers
(vulture)
red-tailed hawk
squirrel
Secondary Consumers
(carnivores)
Primary Consumers
(herbivores)
fox
Producers
(green plants)
rabbit
fungi
mouse
decomposers
(fungi & bacteria)
detritus feeders
(insects & worms)
©Sheri Amsel

GRASSLAND ECOSYSTEM

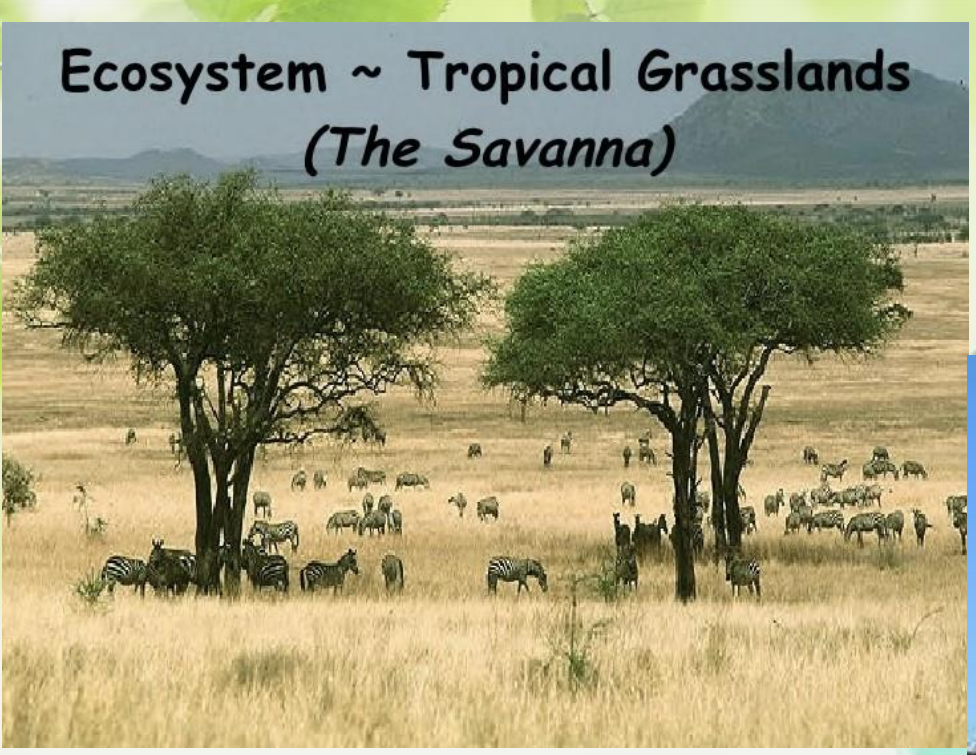
Grassland occupies about 20% of earth's surface. In addition to grass some trees and shrubs are/also present in grasslands. Limited grazing helps to improve the net primary production of the grasslands. But, overgrazing leads degradation of these grasslands resulting in desertification.

Types of grassland ecosystem

Depending upon the climate conditions grassland are classified into three types

- Tropical grasslands
- Temperate grasslands
- Polar grasslands

Ecosystem ~ Tropical Grasslands
(The Savanna)



Features of different types of grassland

Tropical grasslands

They are found near the borders of tropical rain forests. Characterised by high temperature and moderate rainfall (40 to 100 cm). It is also known as Savanna type. Tall grasses with scattered shrubs and stunted trees and animals like zebras, giraffes, antelopes, etc., are observed here.

Temperate grasslands

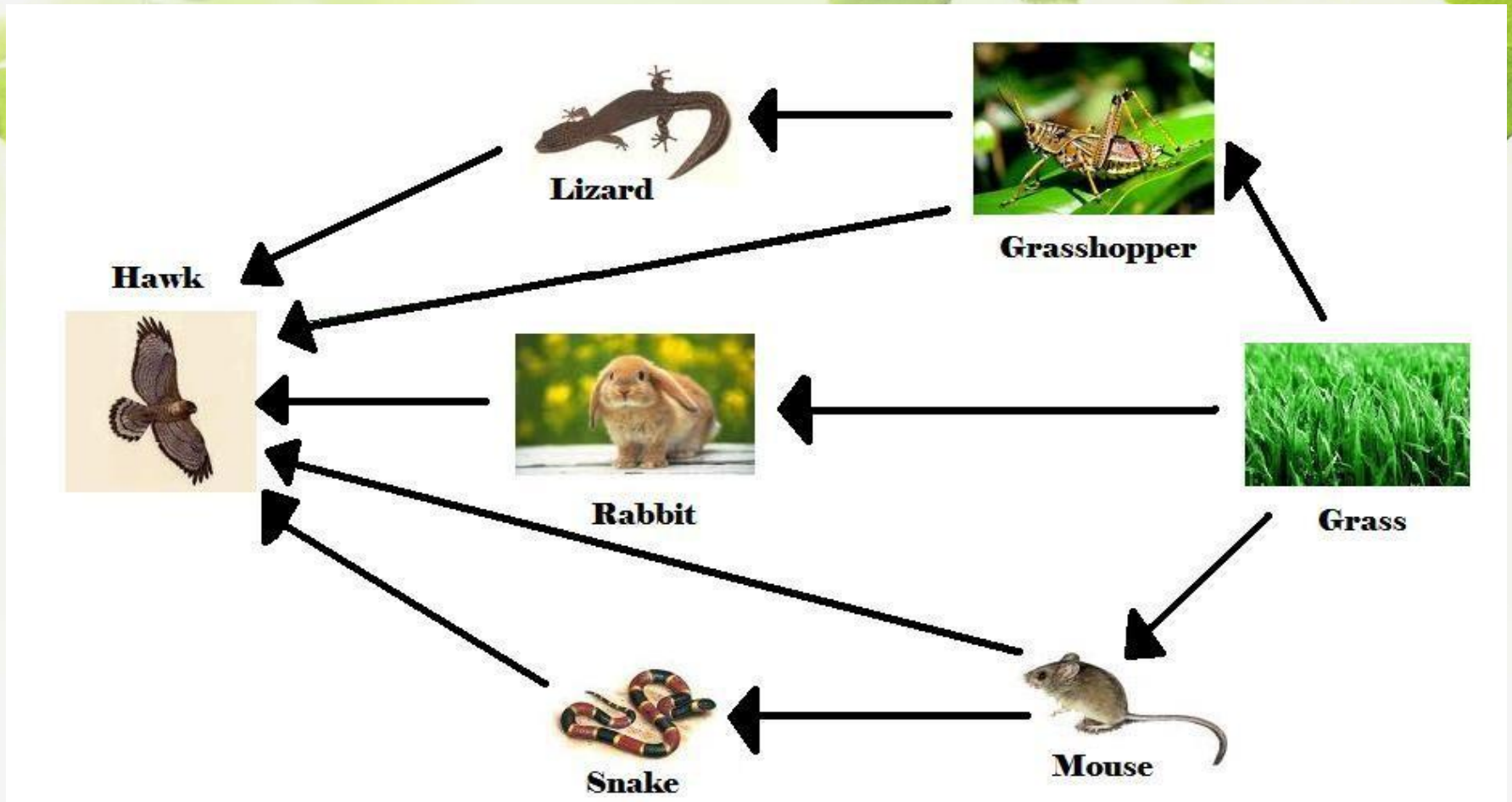
They are usually found in the centres of continents, highly sloped hills. They are characterised by very cold winters and hot summers: Intense grazing and summer fires, do not support shrubs or trees to grow.

Polar grasslands

They are found in arctic polar regions. They are characterised by severe cold and strong winds along with ice and snow. In summers several small annual plants grow. There are animals like arctic wolf, weasel, arctic fox, etc.,

Characteristics of Grassland Ecosystems

- Grassland ecosystem is a plain land occupied by grasses.
- Soil is very rich in nutrients and organic matter.
- Since it has tall grass, it is ideal place for grazing animals.
- It is characterised by low or uneven rainfall.


Lizard
Grasshopper
Hawk
Rabbit
Grass
Snake
Mouse

Structure and function of the grassland Ecosystems

Abiotic components: Nutrients, H, 0, N, P, S, etc.,

These abiotic components are supplied by $C0_2$, H_2O, C, Nitrate, phosphates and sulphates.

Biotic Components

Producers: They produce food.

Ex: Grasses, Herbs and shrubs.

Consumers:.

Primary consumers (herbivores) :They depend on grasses for their food Ex: Insects, cows, buffaloes, deer, sheep, etc.,

Secondary consumers (carnivores) :They feed on herbivores.

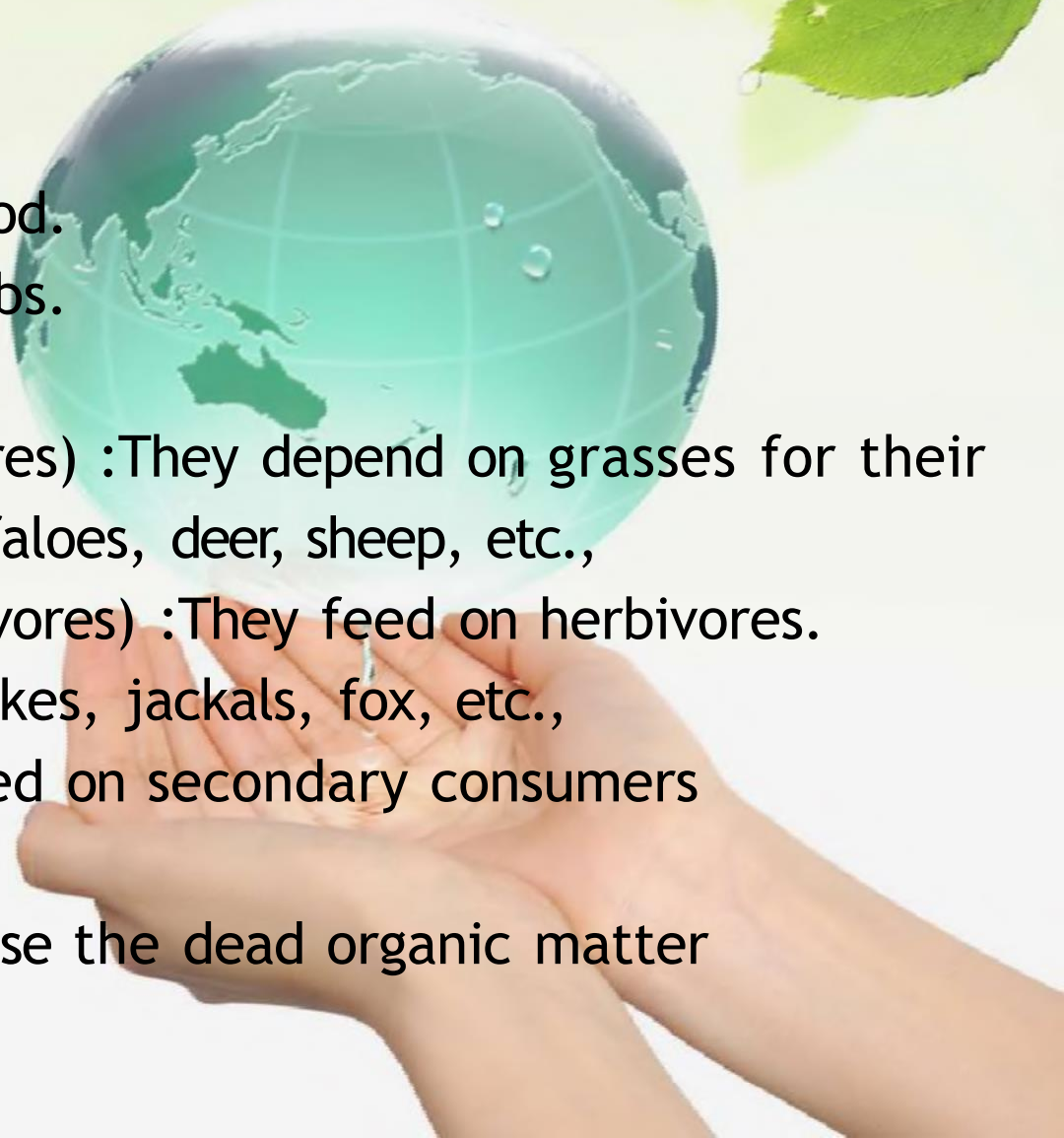
Examples: Lizards, birds, Snakes, jackals, fox, etc.,

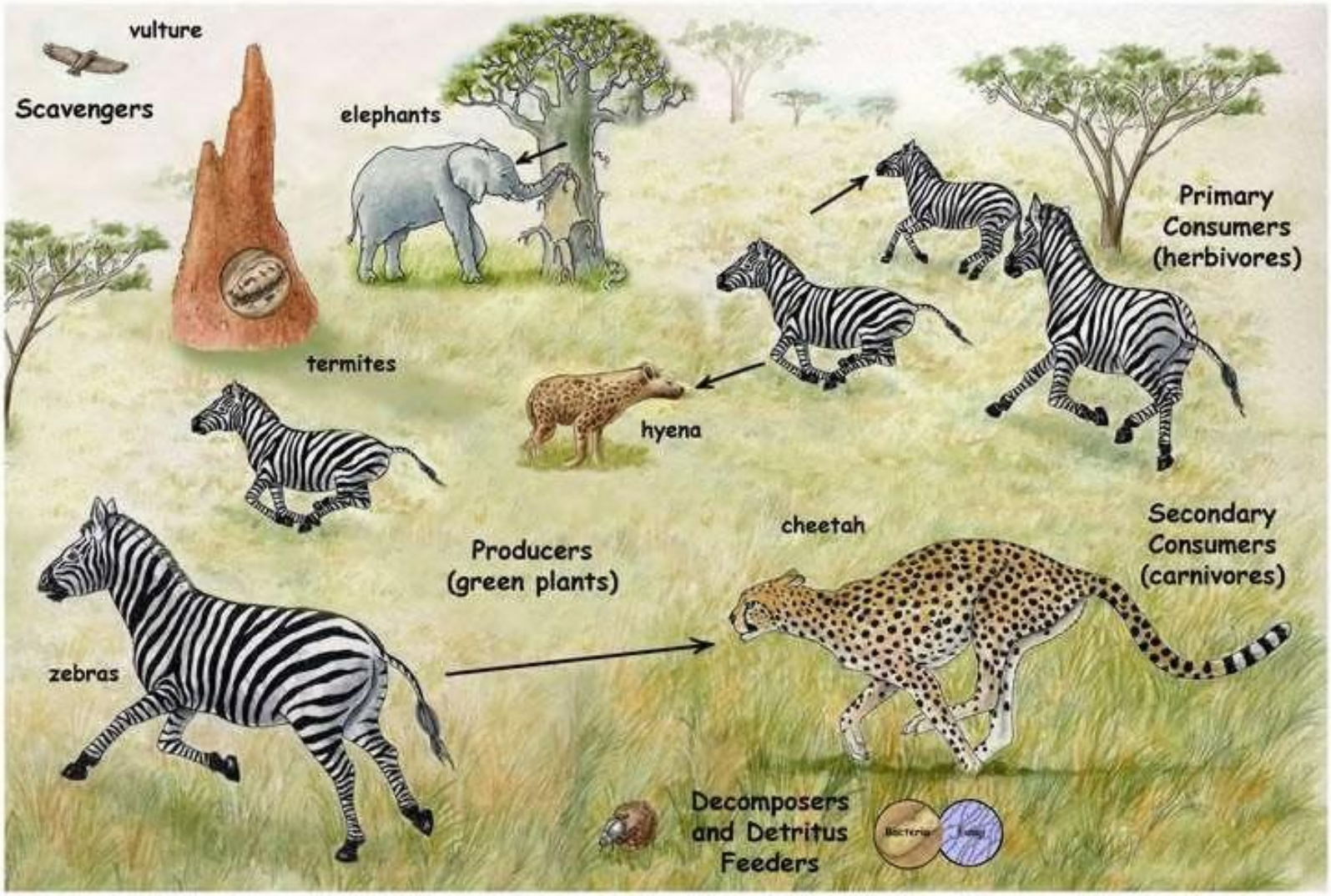
Tertiary consumers: They feed on secondary consumers

Ex: Hawks, eagle, etc.,

Decomposers :They decompose the dead organic matter

Ex: Fungi and bacteria.




vulture
Scavengers
elephants
termites
hyena
Primary
Consumers
(herbivores)
zebras
Producers
(green plants)
cheetah
Secondary
Consumers
(carnivores)
Decomposers
and Detritus
Feeders
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Importance:

- Grasslands are of vital importance for raising livestock for human consumption and for milk and other dairy products
- Grasslands provided home to many different animals that were hunted and domesticated
- They are used as grazing area for cattle
- They Maintain Biodiversity
- Protects restored habitat for many plants and animals including pheasant, ducks, songbirds and endangered species

DESERT ECOSYSTEMS

Introduction

Desert occupies about 14% of our worlds land area. It is characterised by less than 25 cm rainfall. The atmosphere is dry and hence it is a poor insulator .

Types of desert ecosystems

Based on the climatic conditions, deserts are classified into three types.

- Tropical deserts.
- Temperate deserts.
- Cold deserts.

Features of different types of deserts

Tropical desert is an environment of extremes, it is the driest and hottest place on earth. Rainfall is sporadic and in some years no measurable precipitation falls at all.

- Africa: Sahara desert.
- Rajasthan: Thar desert.

Temperate desert is a barren area of land where little precipitation occurs (less than 10%), characterised by very hot summer and very long-lasting frost in Winter time. Ex: Atacama (Chile), Mojave (California).

Cold deserts have hot summers but extremely **cold** winters. These are found in high, flat areas, called plateaus. Ex: Gobi desert (China and Mongolia), Ladakh.

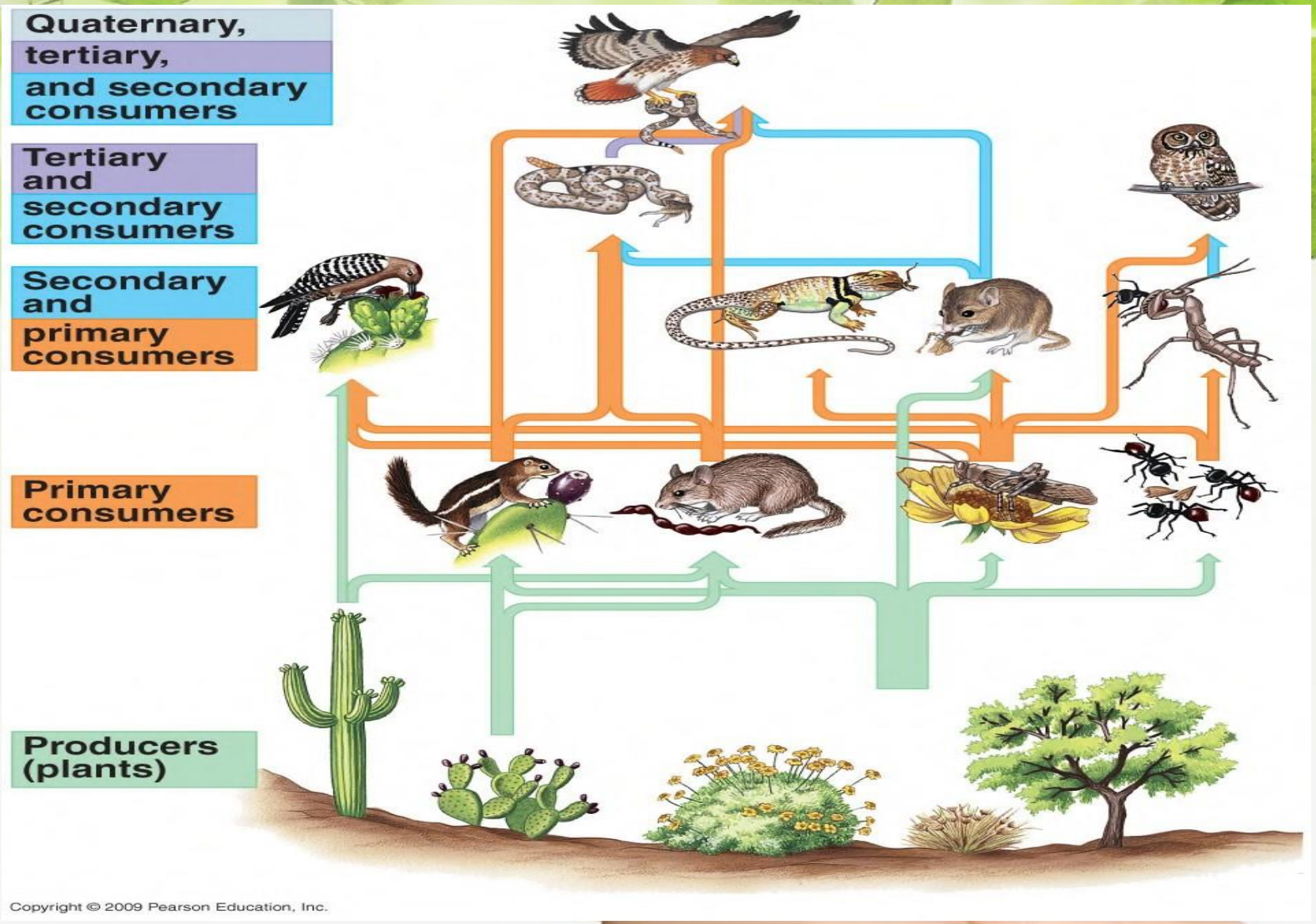
Characteristics of Desert ecosystem

The desert air is dry and the climate is hot. Annual rainfall is less than 25 cm. The soil is very poor in nutrients and organic matter, Vegetation is poor.

Structure and functions of the desert ecosystems

I. Abiotic Components

Intense solar radiation, lashing winds, and little moisture i.e. less than 10 inches (25 cm) of rainfall. The nutrient cycling is also very low. The characteristic feature of the abiotic component is lack of organic matter in the soil and scarcity of water.



Desert Ecosystem

II. Biotic Components

Producers: In deserts mostly Succulent (e.g., cacti) plants are found available. They have water inside them to stay alive, waxy coating to prevent intense heat, thorn on the outside to protect them from being eaten.

Ex: Succulents, Shrubs, bushes, some grasses and few trees.

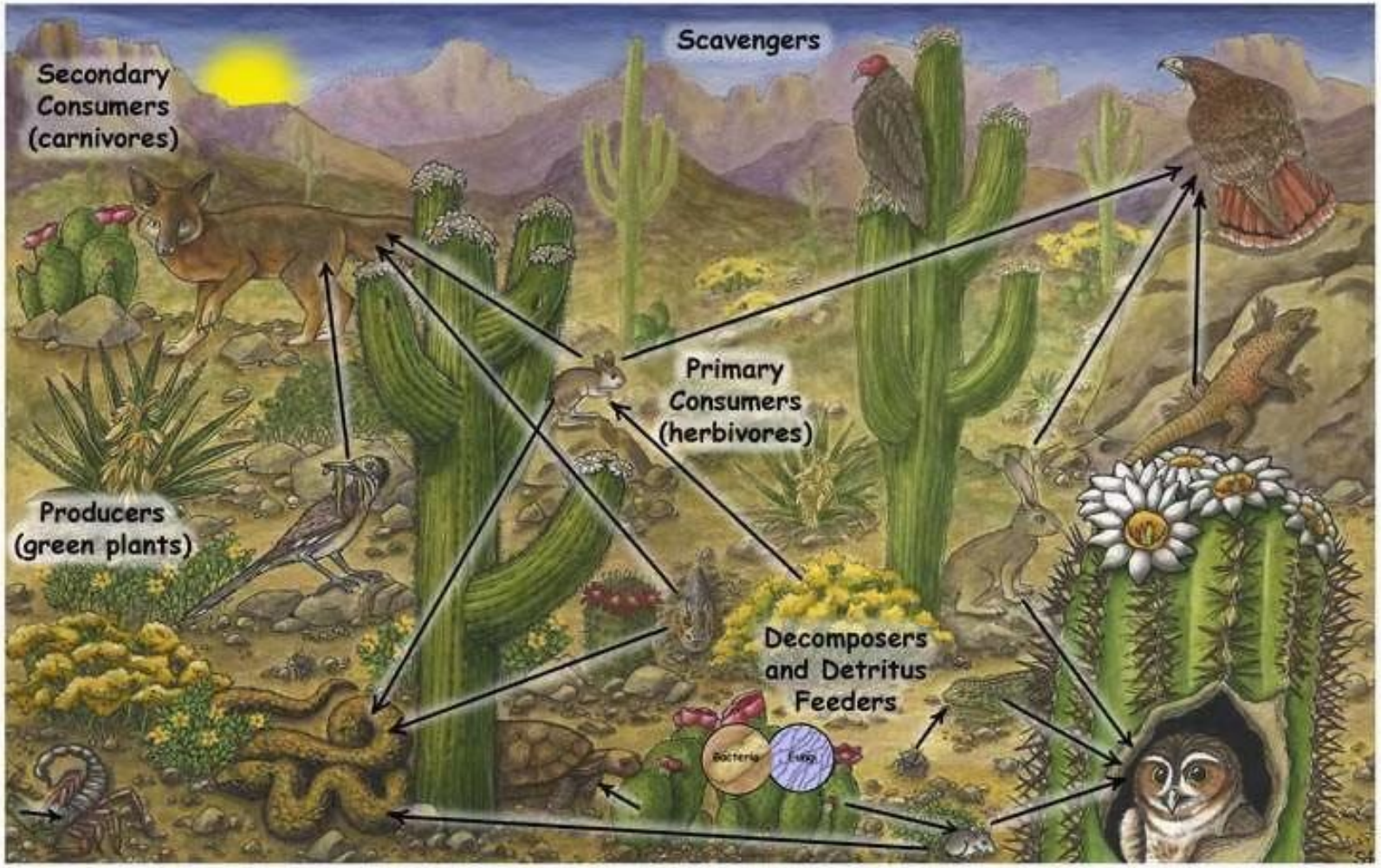
Consumers: These animals dig holes in the ground to live in. They come out at night to find food. Most of the animals can extract water from the seeds they eat.

Ex: Locust, scorpions, snakes, camel, elk etc.

Decomposers: Desert has poor vegetation with a very low amount of dead organic mater. They are decomposed by few fungi and bacteria.

Ex: Fungi and bacteria

Desert Food Web



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AQUATIC ECOSYSTEMS

The aquatic ecosystem deals with water bodies. The major types of organisms found in aquatic environments are determined by the water's salinity.

Types of aquatic life zone

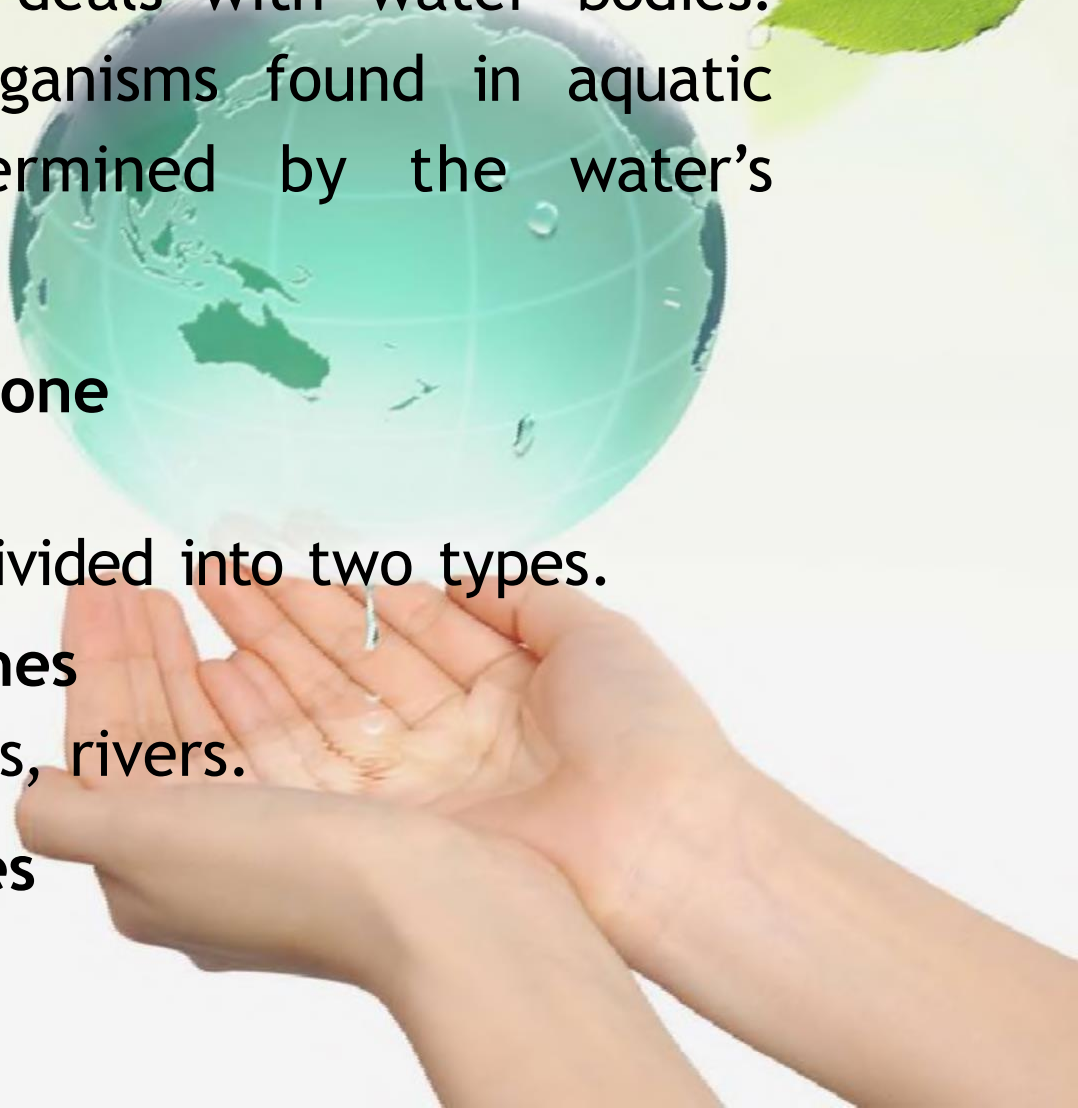
Aquatic life zones are divided into two types.

1. **Fresh water life zones**

   Eg. Ponds, streams, lakes, rivers.

2. **Salt water life zones**

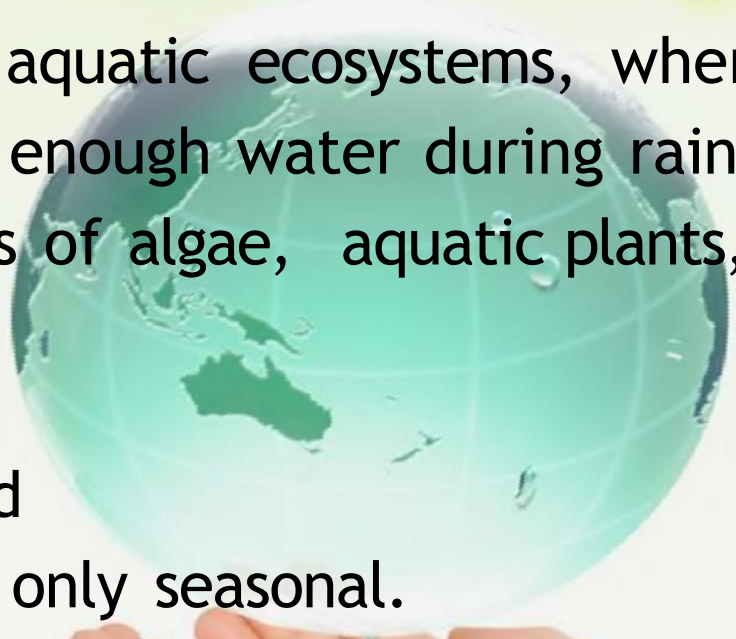
   Eg. Oceans, estuaries.



FRESH WATER ECOSYSTEM POND ECOSYSTEMS

Introduction

A pond is a fresh water aquatic ecosystems, where water is stagnant. It receives enough water during rainy season. It contains several types of algae, aquatic plants, insects, fishes and birds.



Characteristics of pond

- Pond is temporary, only seasonal.
- It is a stagnant fresh water body.
- Ponds get polluted easily due to limited amount of water.
- Pond ecosystems are lentic ecosystems – i.e. they involve stagnant or standing water.

Structure and functions of pond ecosystems

Abiotic components

Ex: Temperature, light, water and organic and inorganic compounds

Biotic Components

- Producers

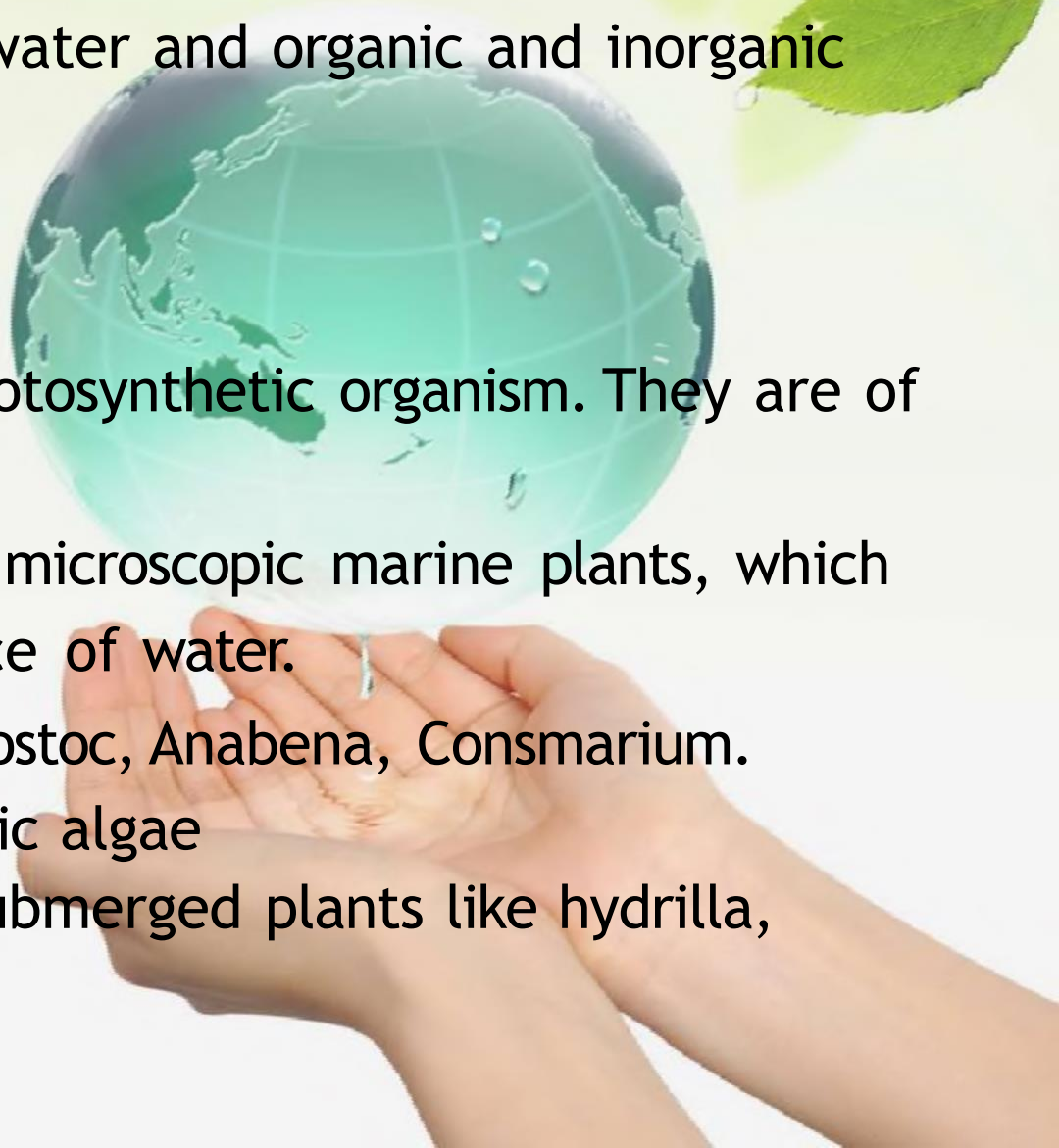
  These include green photosynthetic organism. They are of two types.

- Phytoplankton: These are microscopic marine plants, which freely float on the surface of water.

  Ex: Floating plants like Nostoc, Anabena, Consmarium.

- Microphytes are microscopic algae

  Ex: Floating plants and submerged plants like hydrilla, Jussiaea, wolfia, demna.



Consumers

Primary consumers (Zooplanktons): These are microscopic animals which freely float on the surface of water. Zooplanktons are found along with phytoplankton. They feed on plants (phytoplankton).

Ex: Protozoa, very small fish, ciliates, flagelaltes and protozoans.

Secondary consumers (Carnivores):They feed on zooplankton

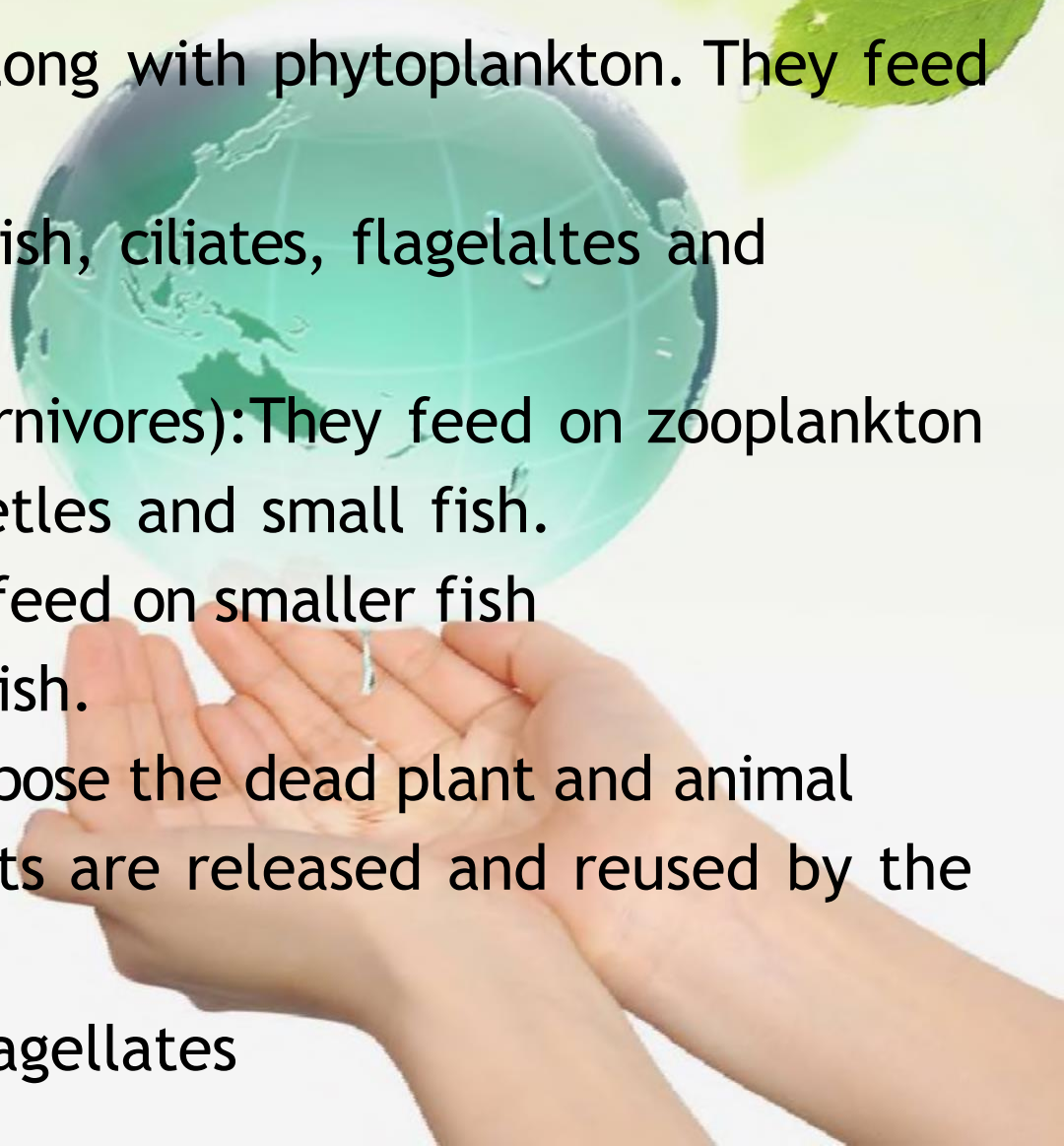
Ex: Insects like water beetles and small fish.

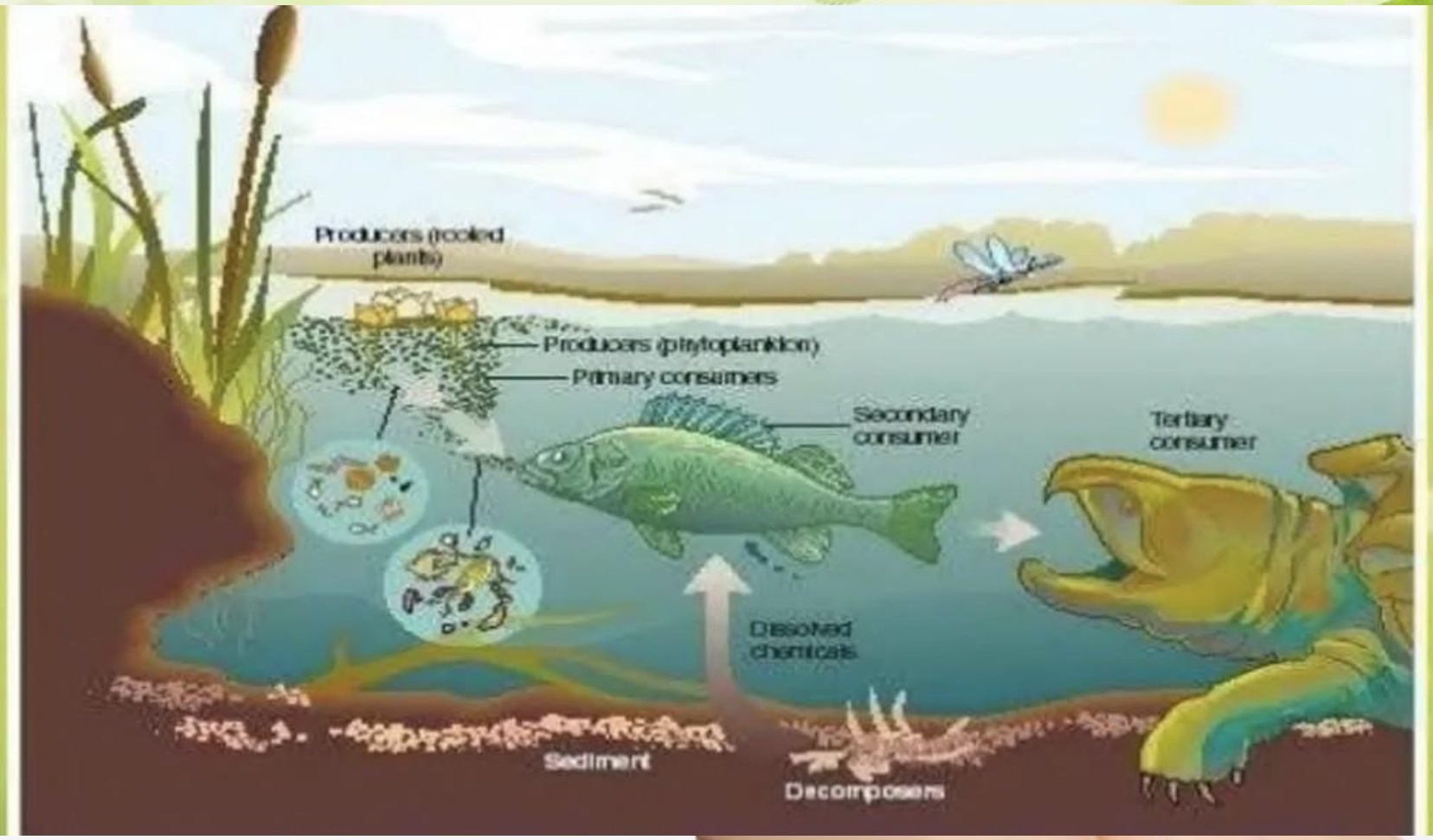
Tertiary consumers :They feed on smaller fish

Ex: Large fish like game fish.

Decomposers: They decompose the dead plant and animal matter and their nutrients are released and reused by the green plants.

Ex: Fungi, bacteria and flagellates




Producers (rooted plants)
Producers (phytoplankton)
Primary consumers
Secondary consumer
Tertiary consumer
Dissolved chemicals
Sediment
Decomposers

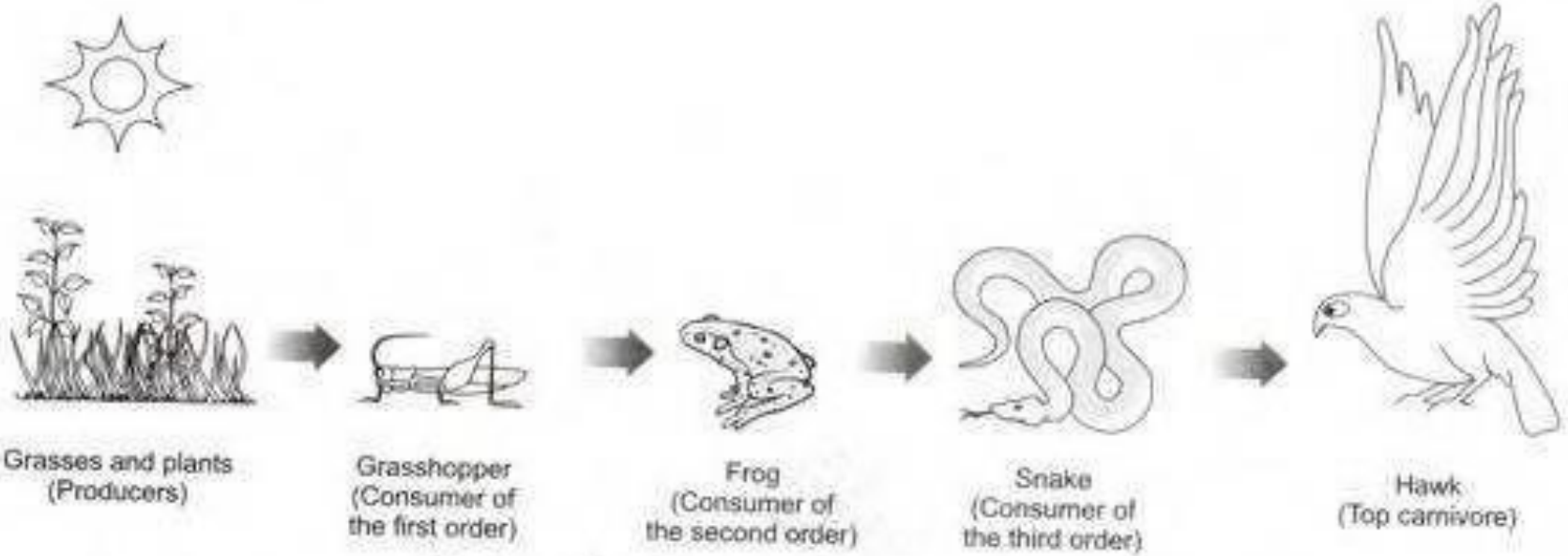


Fig. 8.3 A food chain in a grassland ecosystem

In a freshwater aquatic ecosystem like a pond, the organisms in the food chain include algae, small animals, insects and their larvae, small fish, big fish and a fish-eating bird or animal (Figure 8.4).

Importance of pond ecosystems.

1.Biodiversity: Pond ecosystems are very important habitats for so many different types of fish, birds, plants and crustaceans as well as insects such as dragonflies, damsel flies and pond skaters.

2.Ubiquity: Pond ecosystems can be found on every continent on the planet.

3.Abundance: Pond ecosystems are very abundant. Not only can they be found almost everywhere, they can be found plentifully.

4.Source of hydration: A watering hole in a prairie or desert many species of animals will come to pond. Humans can also use these ecosystems as a source of water.

5. Beauty: Pond ecosystems are very beautiful as well.

LAKE ECOSYSTEM

Lakes are large natural shallow water bodies. Lakes are used for various purposes. Lakes are supplied with water from rainfall, melting snow and streams.

Types of lakes

Some important types of lake are

Oligotrophic lakes : They have low nutrient concentrations

Eutrophic lakes : They are overnourished by nutrients like N and P

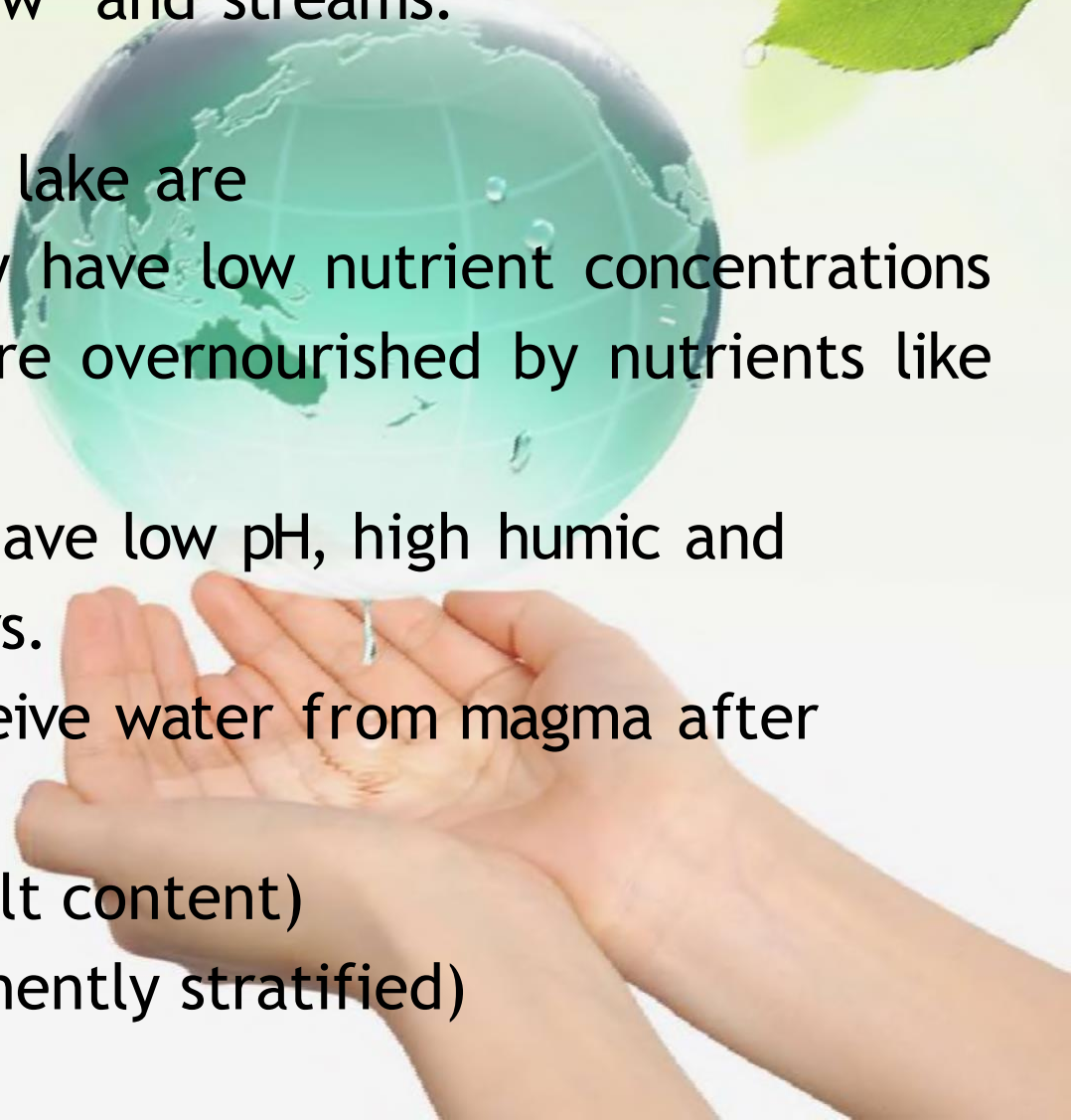
Dystrophic lakes : They have low pH, high humic and content and brown waters.

Volcanic lakes : They receive water from magma after volcanic eruption.

Desert salt lakes (High salt content)

Meromictic lakes (Permanently stratified)

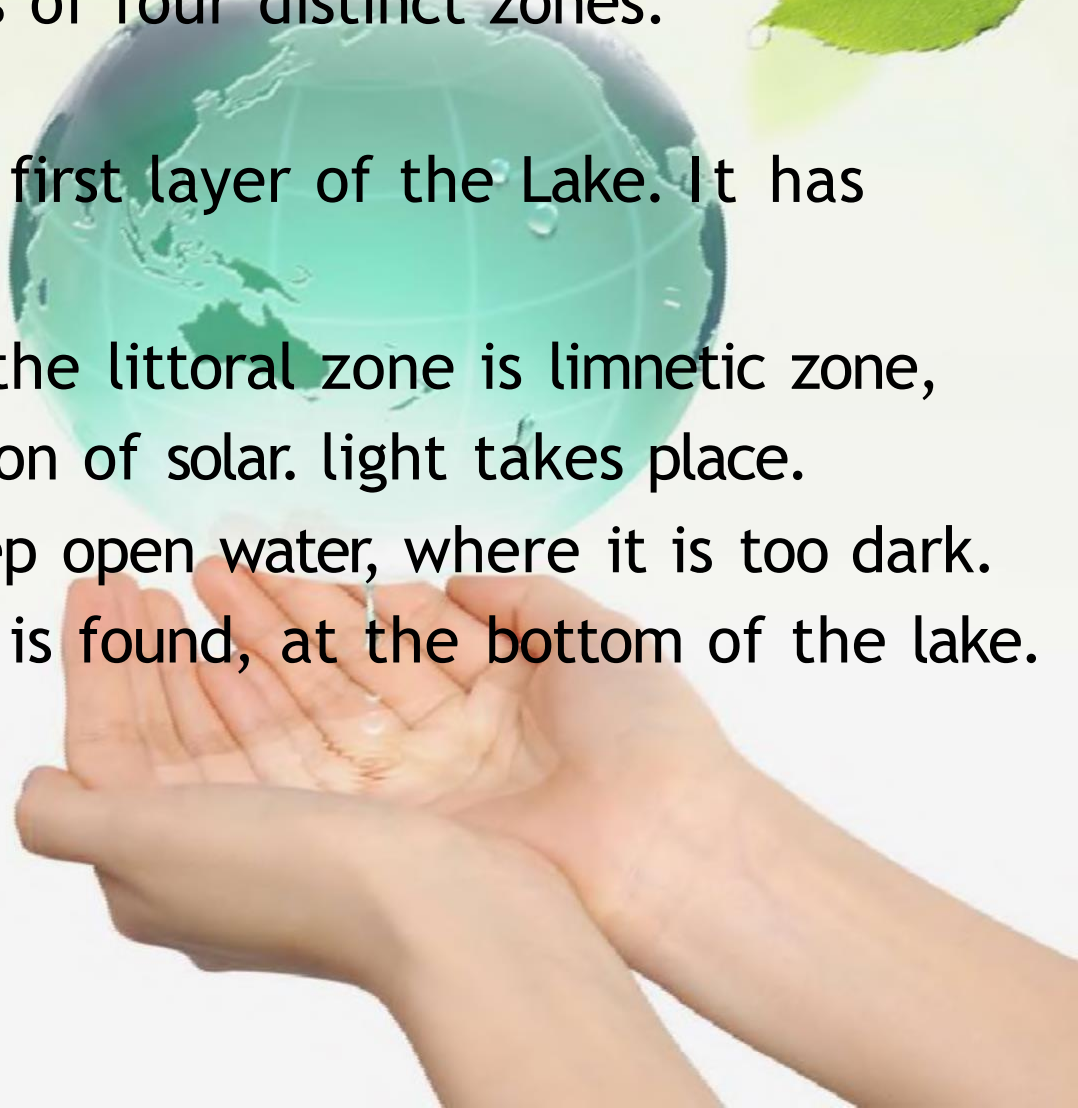
Artificial lakes

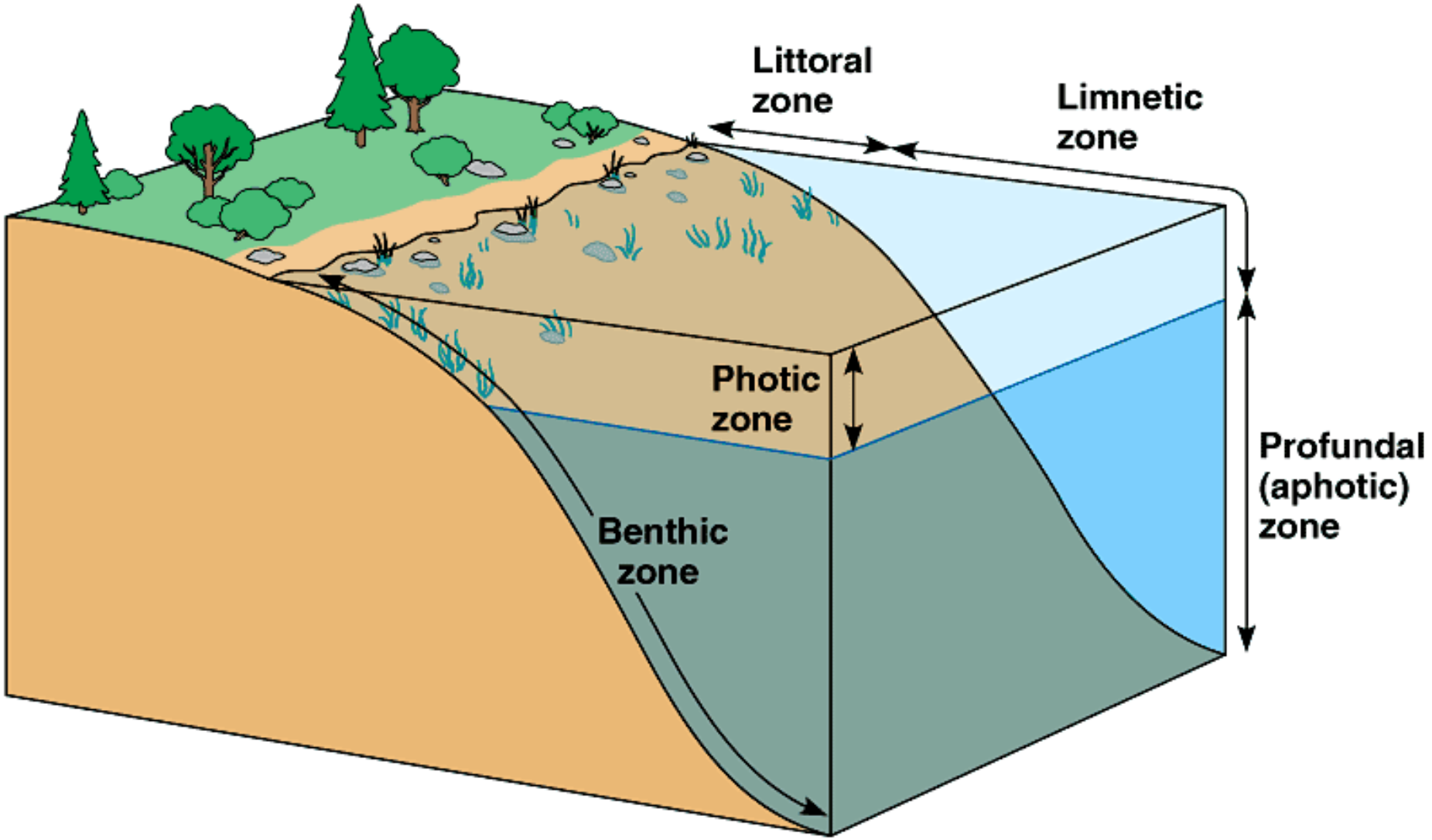


Zones of Lake

Dependingupon their depth and distance from the shore, likes consists of four distinct zones.

- Littoral zones: It is the first layer of the Lake. It has a shallow water.
- Limnetic zone: Next to the littoral zone is limnetic zone, where effect penetration of solar. light takes place.
- Profundal zone: The deep open water, where it is too dark.
- Benthic zone: This zone is found, at the bottom of the lake.





Characteristics of lake ecosystem

- Lake is a shallow fresh water body;
- It is a permanent water body with large Water resources.
- It helps in irrigation and drinking.

Structure and function of lake ecosystem

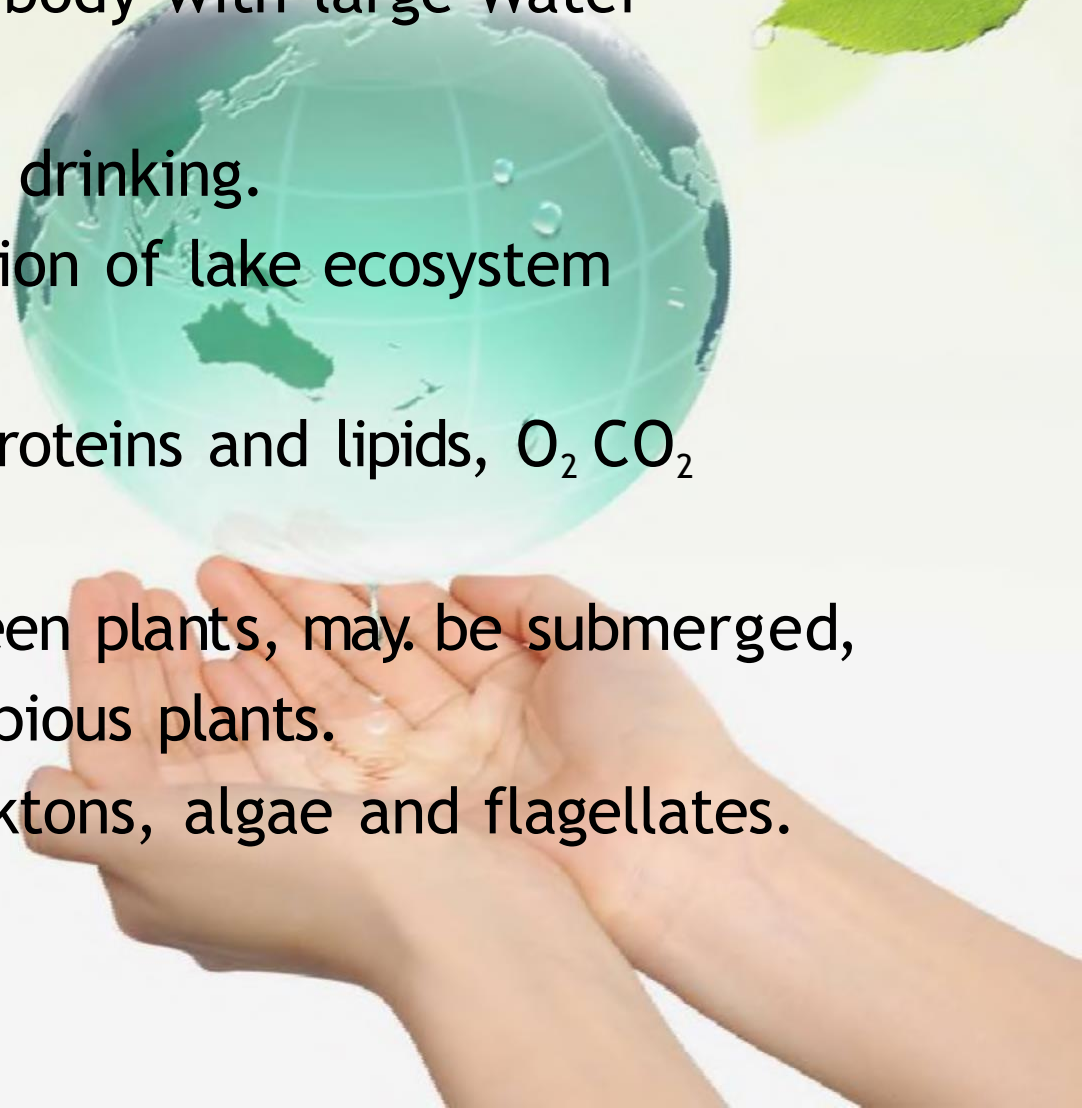
I. Abiotic components

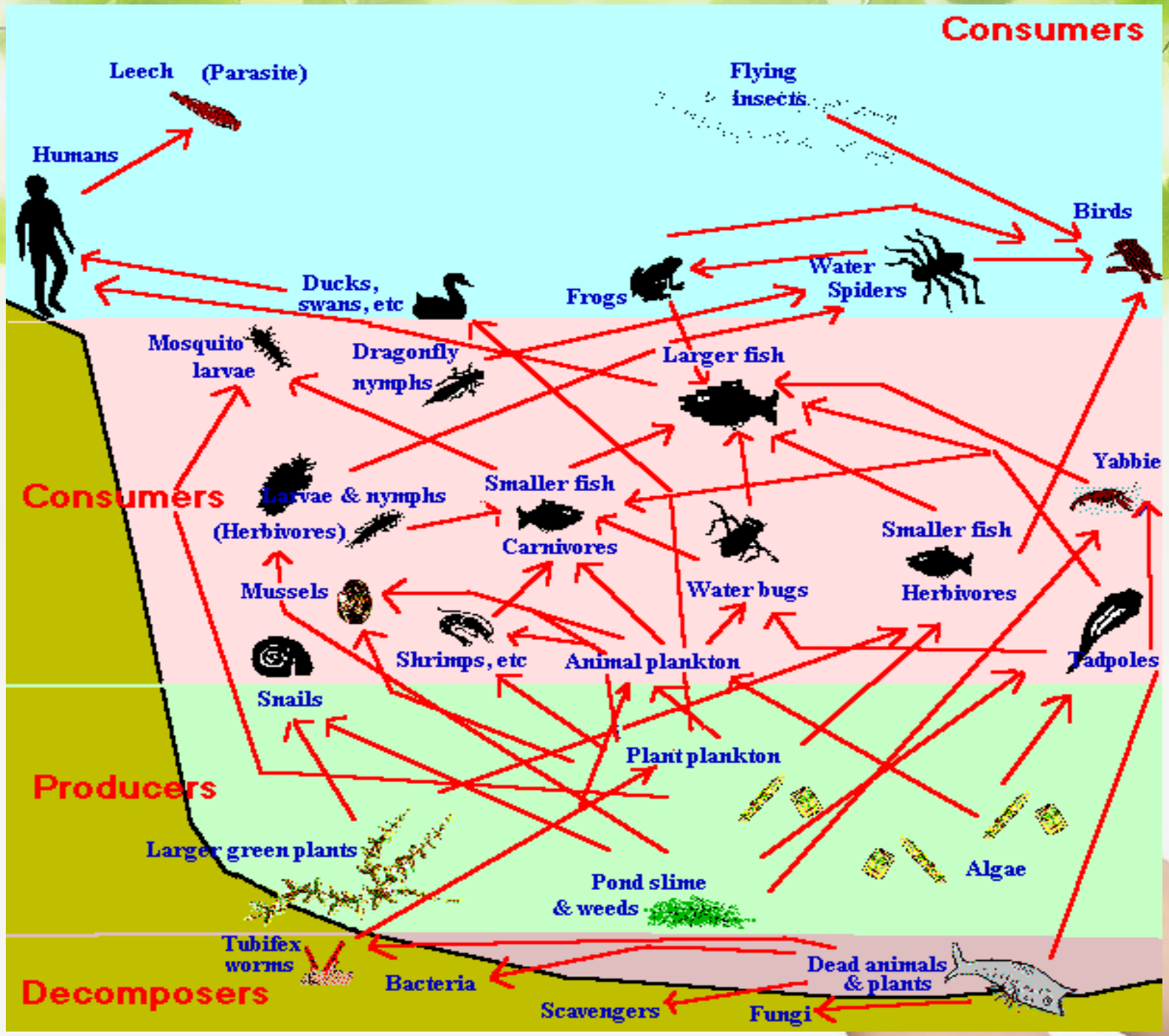
Temperature, light, proteins and lipids, O_2 CO_2

II. Biotic Consumers

Producers: They are green plants, may. be submerged, free floating ad amphibious plants.

Examples: Phytoplanktons, algae and flagellates.




Consumers
Leech (Parasite)
Flying insects
Humans
Birds
Ducks, swans, etc
Frogs
Water Spiders
Mosquito larvae
Dragonfly nymphs
Larger fish
Yabbie
Consumers
Larvae & nymphs (Herbivores)
Smaller fish
Carnivores
Smaller fish
Herbivores
Mussels
Water bugs
Shrimps, etc
Animal plankton
Tadpoles
Snails
Plant plankton
Producers
Larger green plants
Algae
Pond slime & weeds
Tubifex worms
Bacteria
Dead animals & plants
Decomposers
Scavengers
Fungi

2. Consumers

Primary Consumers (Zooplanktons): They feed on phytopankton

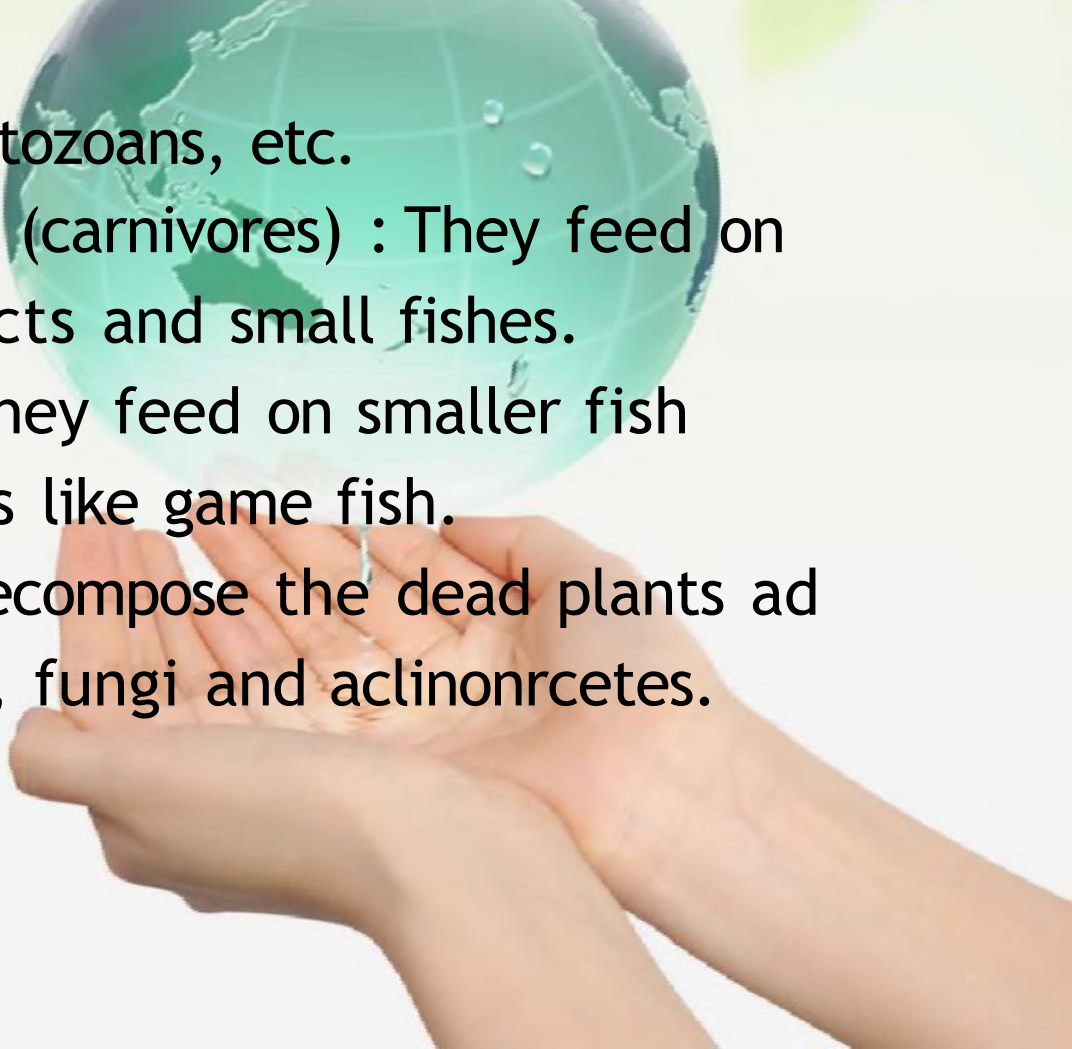
Ex: Ciliates, protozoans, etc.

Secondary consumers (carnivores) : They feed on zooplankton. Ex Insects and small fishes.

Tertiary consumers: They feed on smaller fish

Ex: Large fishes like game fish.

Decomposers: They decompose the dead plants ad animals Ex: Bacteria, fungi and aclinonrcetes.



RIVER (or) STREAM ECOSYSTEM

Introduction

The running water of a stream or a river is usually well oxygenated, because it absorb's oxygen from the air. The number of

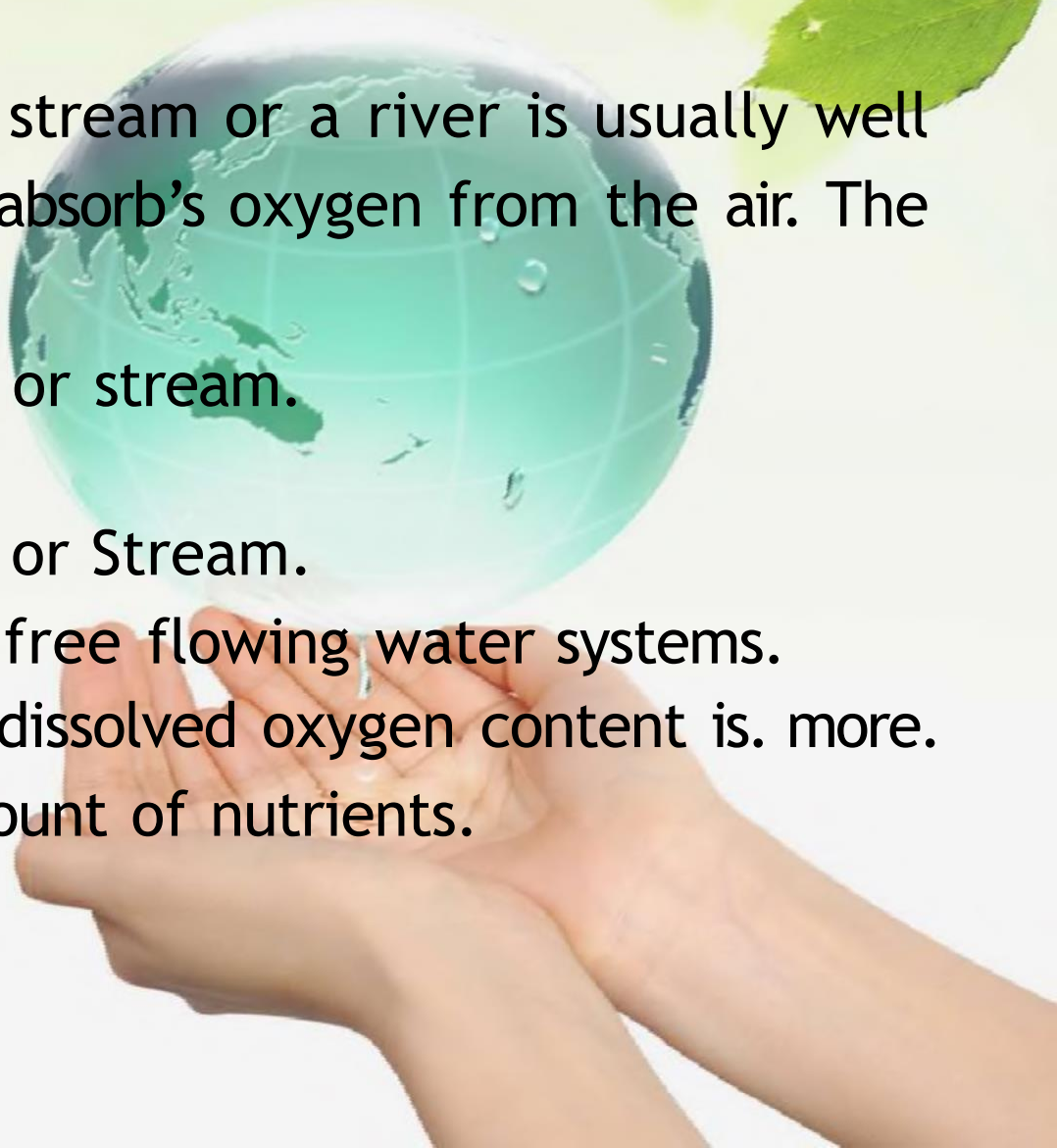
animals are low in river or stream.

Characteristics of River or Stream.

It is a fresh water, and free flowing water systems.

Due to mixing of water, dissolved oxygen content is. more.

River deposits large amount of nutrients.



Structure and function of River or Stream Ecosystem

Abiotic components

Examples : River, Light, Temperature, Chemistry, Substrate

Biotic Components

Producers: Phytoplankton, algae, water grasses, aquatic masses other amphibious plants.

Consumers

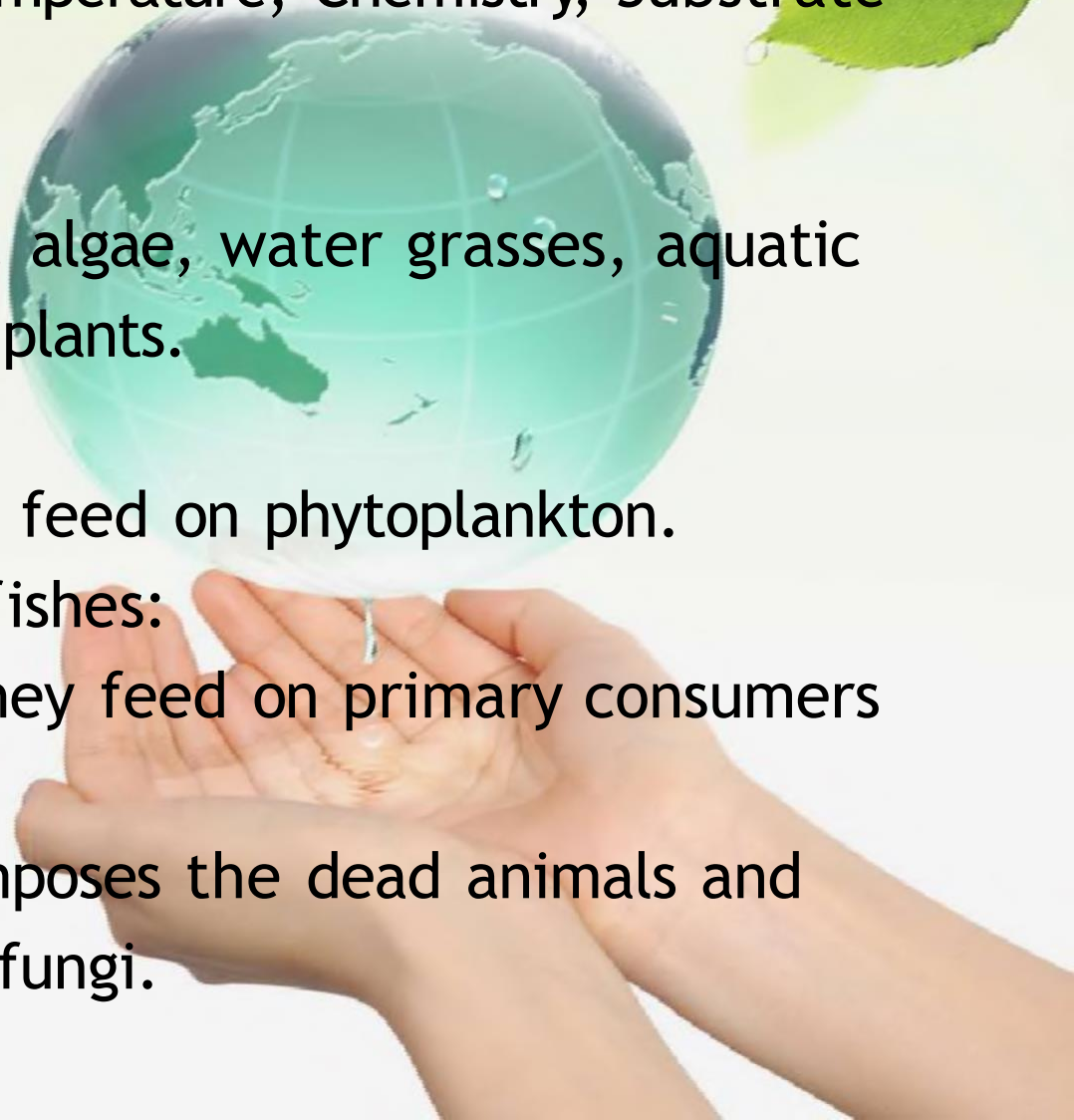
1.Primary consumers: They feed on phytoplankton.

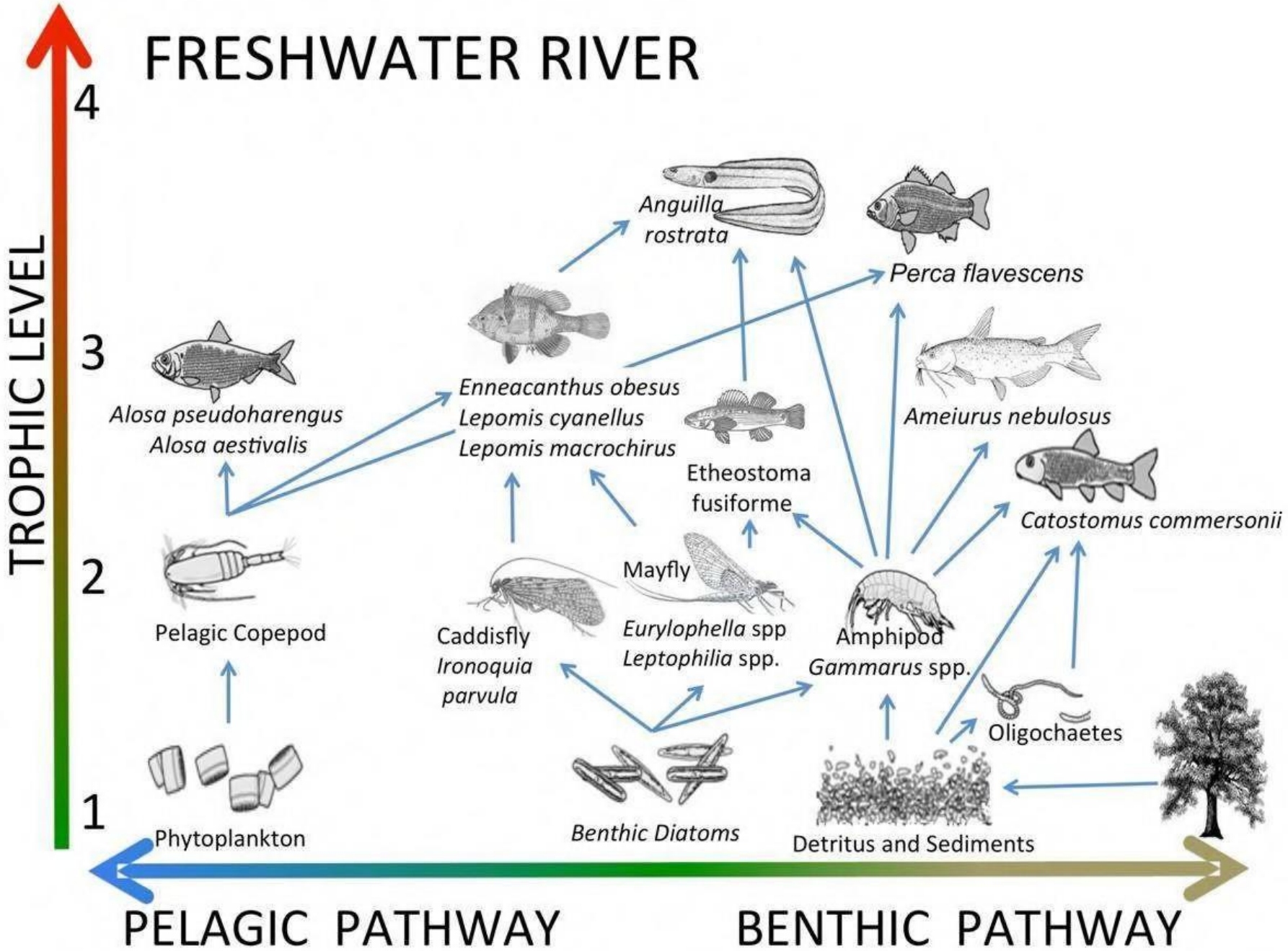
Ex : Water insects, snails, fishes:

2.Secondary consumers: They feed on primary consumers

Ex: Birds

Decomposers: They decomposes the dead animals and plants. Ex :Bacteria and fungi.




FRESHWATER RIVER
TROPHIC LEVEL
4
3
2
1
Anguilla rostrata
Perca flavescens
Alosa pseudoharengus
Alosa aestivalis
Enneacanthus obesus
Lepomis cyanellus
Lepomis macrochirus
Ameiurus nebulosus
Etheostoma fusiforme
Catostomus commersonii
Mayfly
Eurylophella spp
Leptophilia spp.
Pelagic Copepod
Caddisfly
Ironoquia parvula
Amphipod
Gammarus spp.
Oligochaetes
Phytoplankton
Benthic Diatoms
Detritus and Sediments
PELAGIC PATHWAY
BENTHIC PATHWAY

SALT WATER ECOSYSTEMS. OCEAN (MARINE) ECOSYSTEMS

Introduction

Oceans cover more than two thirds of the earth's surface. ocean environment is characterised by its high concentration of salts and minerals. It supplies huge variety of products and drugs. It also provides us iron, magnesium, iron, natural gas.

Zones of Oceans

The oceans have two major life zones.

Coastal zone: It is relatively warm, nutrient rich shallow water. It has high primary productivity because of high nutrients and sunlight.

Open sea: It is the deeper part of the ocean. It is vertically divided into three regions.

- Euphotic zone: It receives abundant light and shows high photosynthetic activity.
- Bathyal zone: It receives dim light and is usually geologically active.
- Abyssal zone: It is the dark zone and is very deep (2000 to metres).

Figure 7-5 Major life zones in an ocean. Ecologists classify ocean habitats and their organisms on the basis of light levels, depth, and bottom type. (Not drawn to scale. Actual depths of zones may vary.)

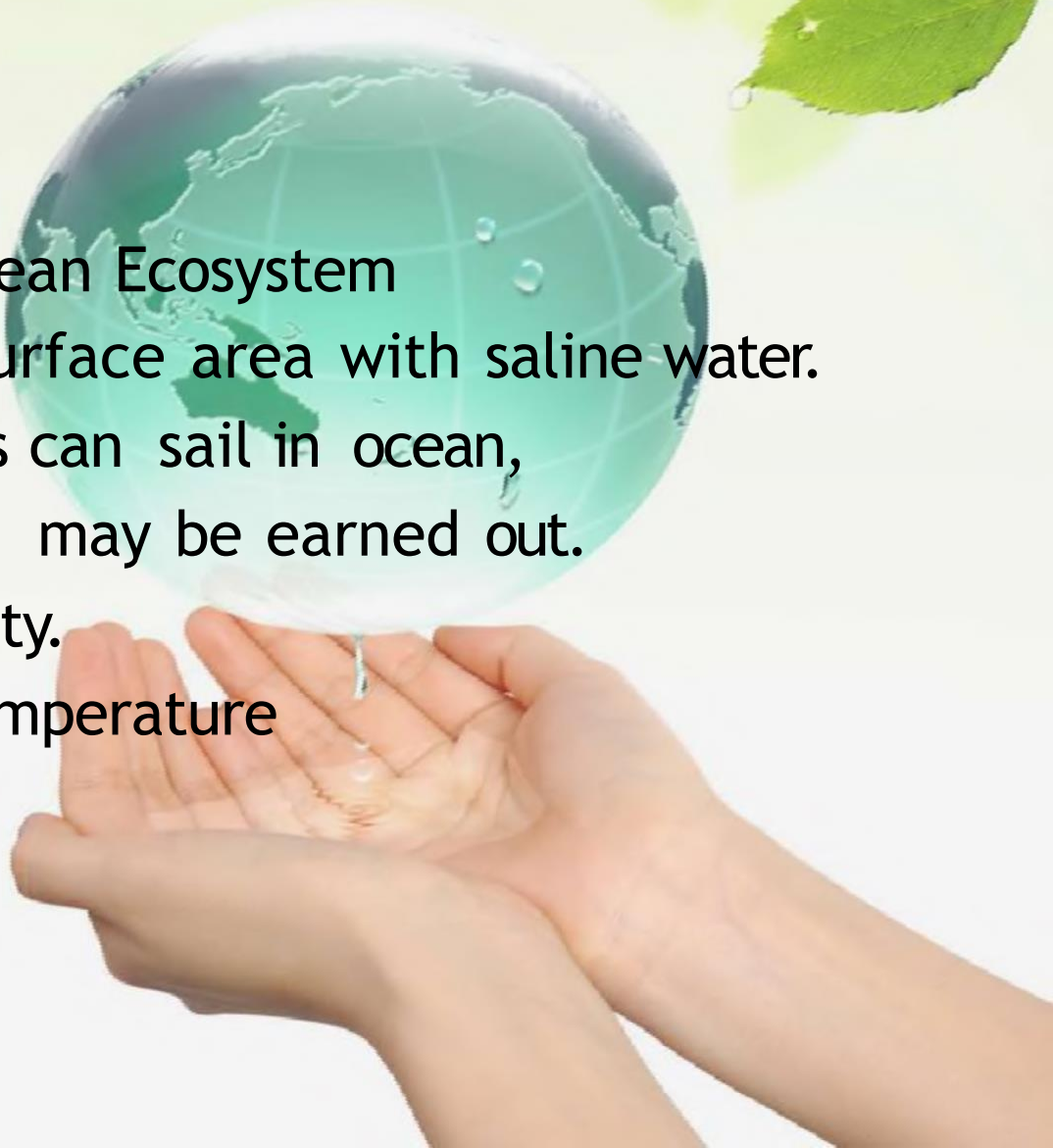
Characteristics of Ocean Ecosystem

It occupies a large surface area with saline water.

Since ship, submarines can sail in ocean, commercial activities may be earned out.

It is rich in biodiversity.

It moderates the- temperature



Structure and function Ecosystems

Abiotic components Examples
Temperature, light, NaCl, K, Ca, and Mg Salts
alkalinity

Biotic components
1. Producers :
Phytoplanktons (diatoms, unicellular algae, etc.,) and marine
plants (sea weeds, chlorophycela, phaeophyceae).

2. Consumers

These are heterotrophic macro consumers. They depend on producers for their nutrition.

Primary consumers (herbivores) :They feed on producers

Ex: Crustaceans, molluscs, fish

Secondary consumers (carnivores) : They feed on herbivores

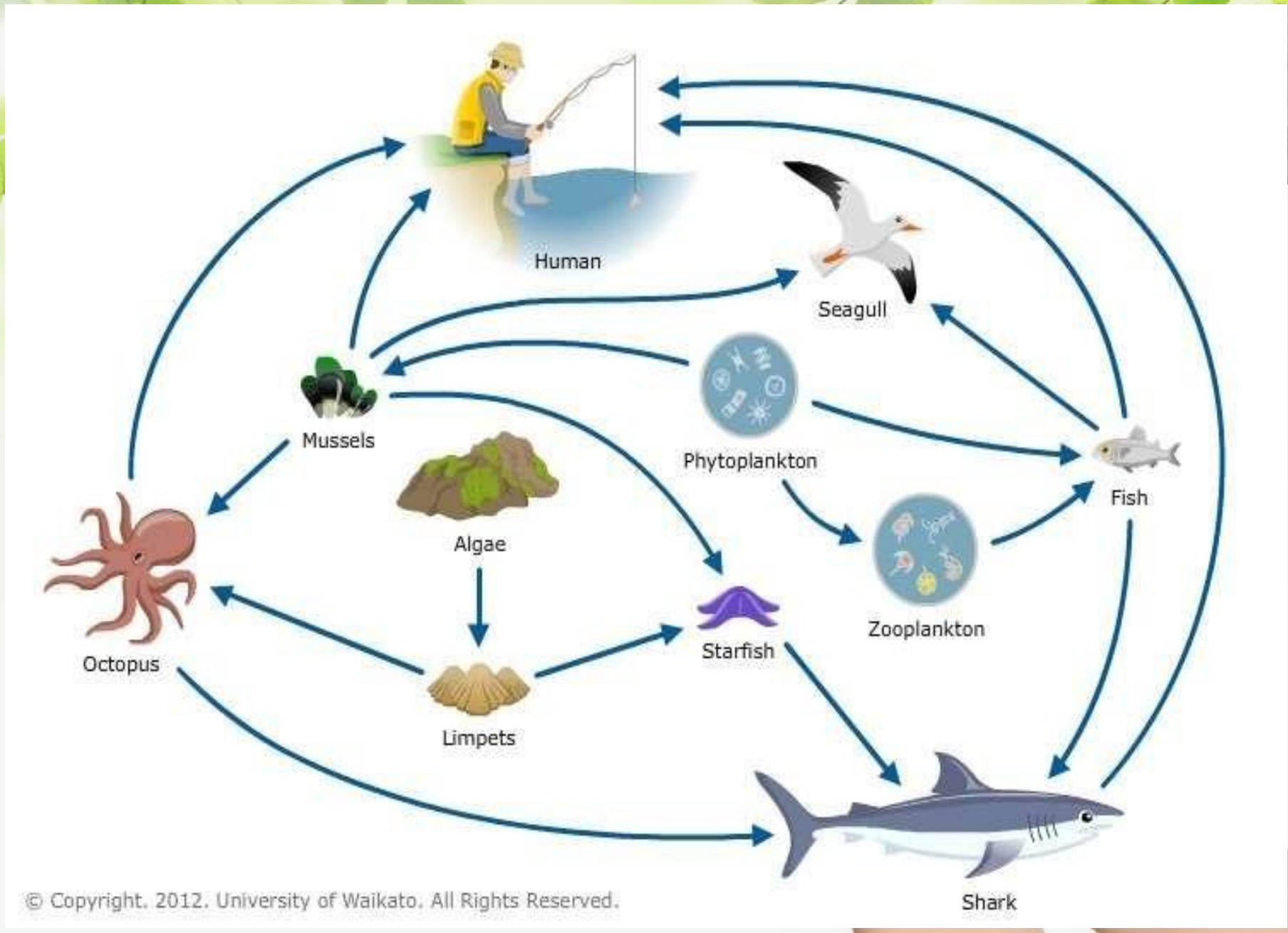
Ex: Herring, mackerel, etc.,

Tertiary Consumers: They are the top consumers. They feed on small

Ex: Cod, Haddock, -etc.,

3.Decomposers: They decompose the dead organic matter.

Ex: Bacteria and some fungi.




Thank You