Ecology - Ecosystem

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- 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

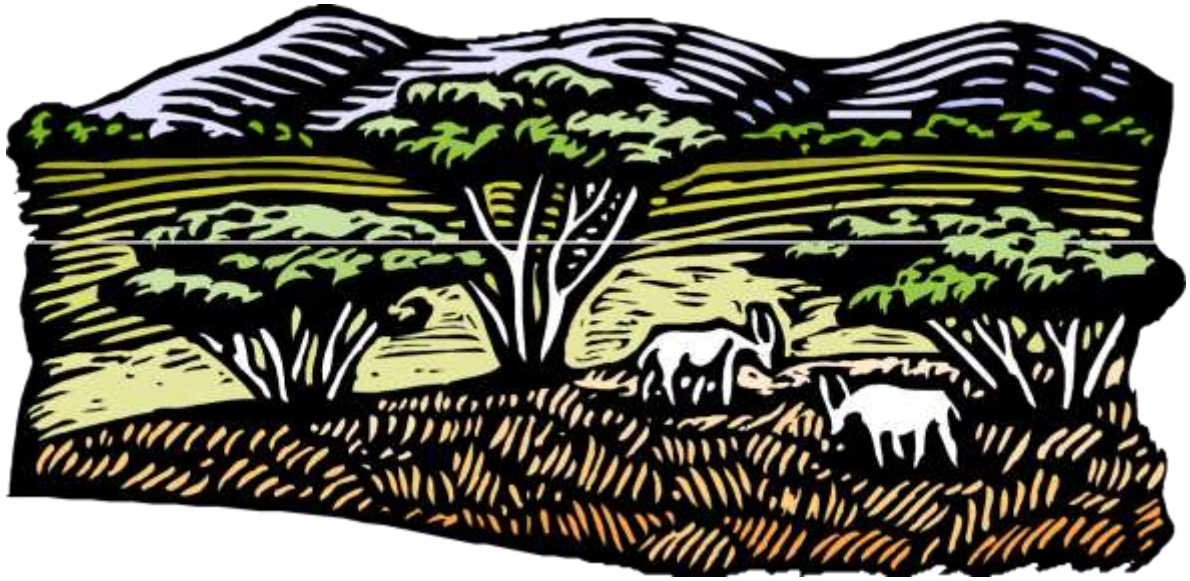
Ecology is study of interactions between

Light
Water
Wind
Nutrients in soil
Heat
Solar radiation Atmosphere, etc.

Living organisms…

Plants Animals

Microorganisms in soil, etc.



Ecosystem

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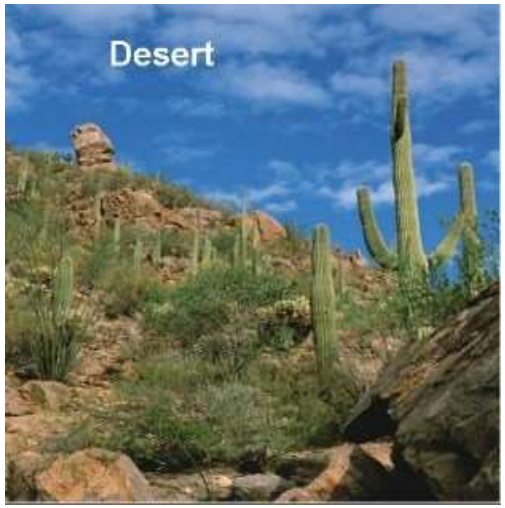
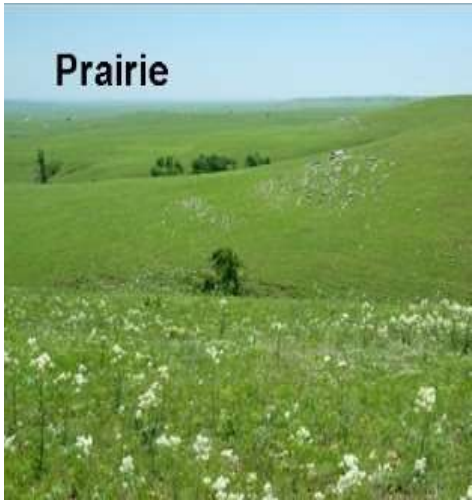
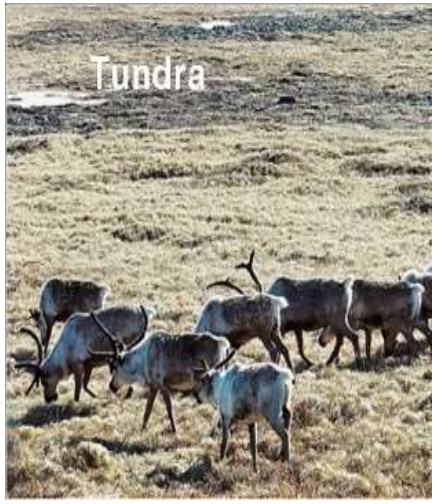
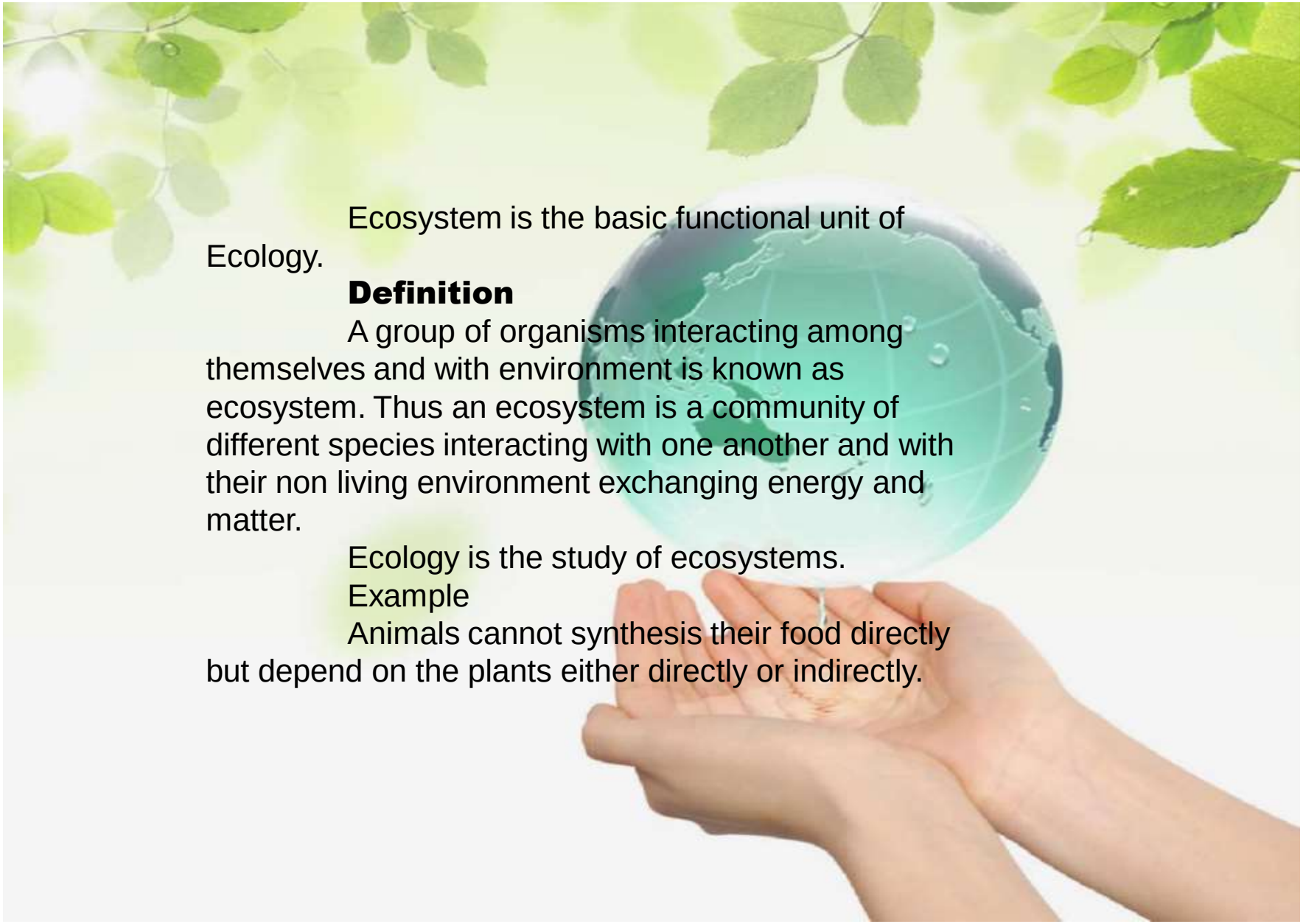
The term Ecosystem was first proposed by A.G. Tansley in 1935

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.

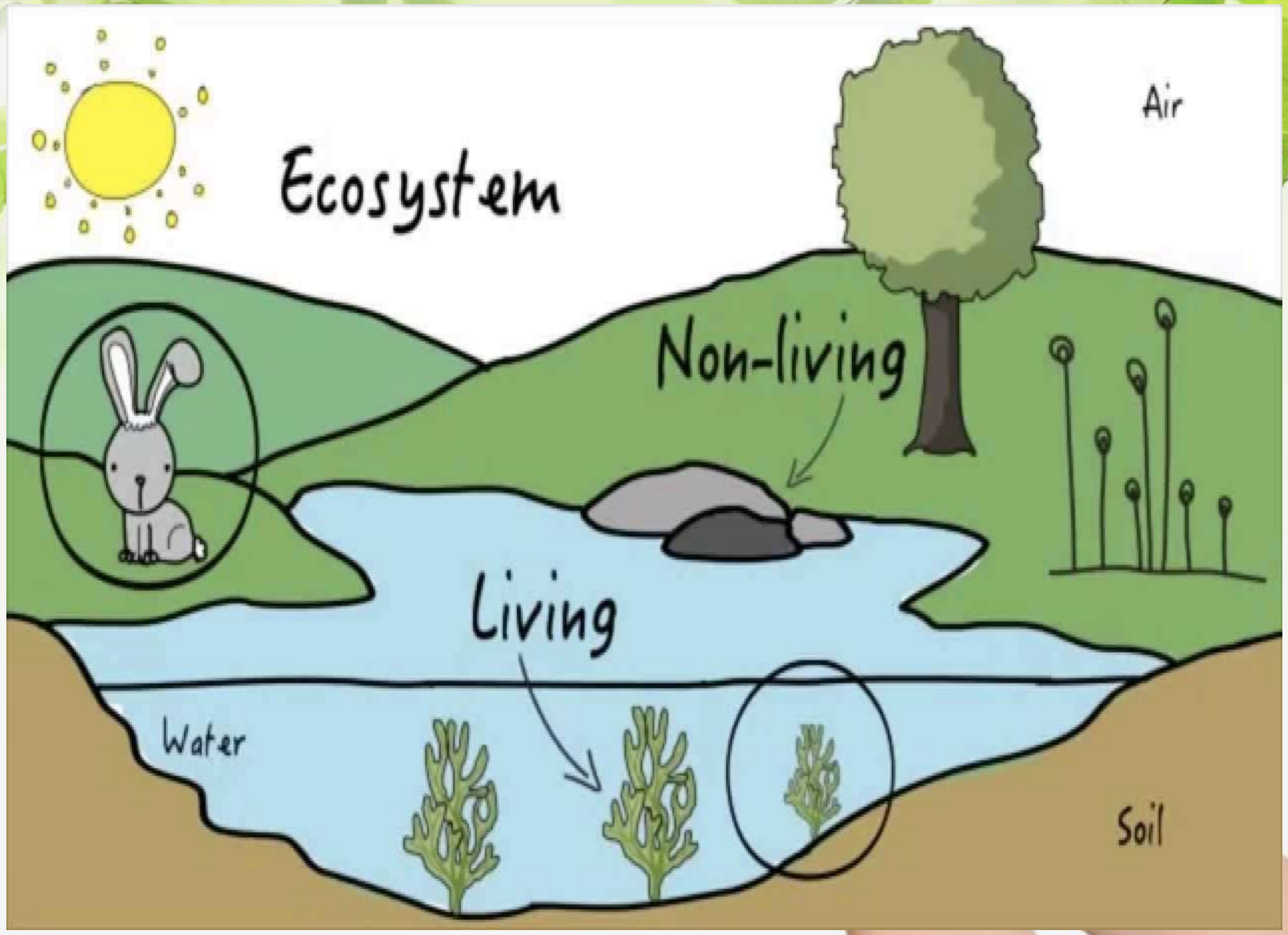
Definition

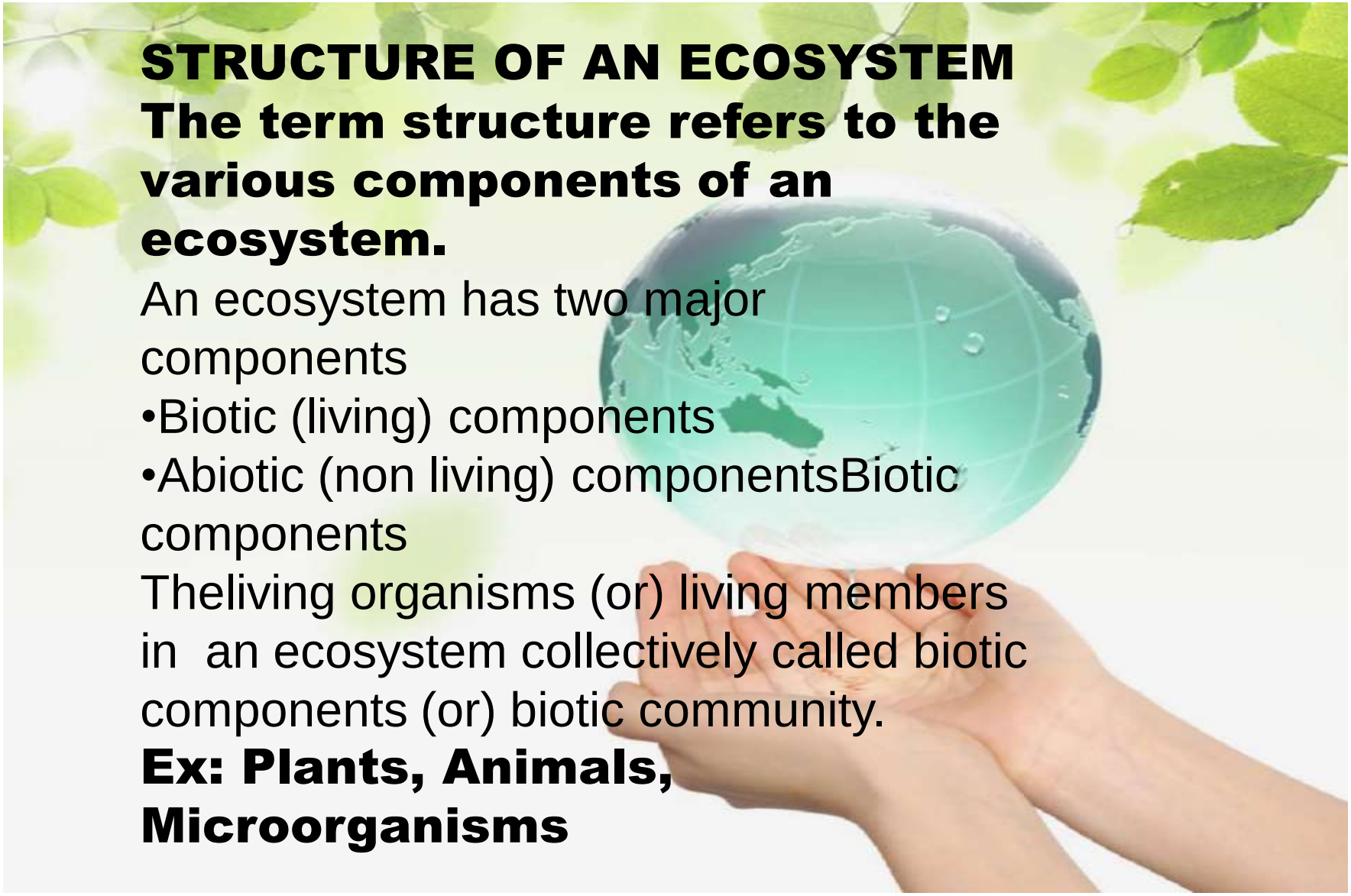
A group of organisms interacting among themselves and with environment is known as ecosystem. Thus an ecosystem is a community of different species interacting with one another and with their non living environment exchanging energy and matter.

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.

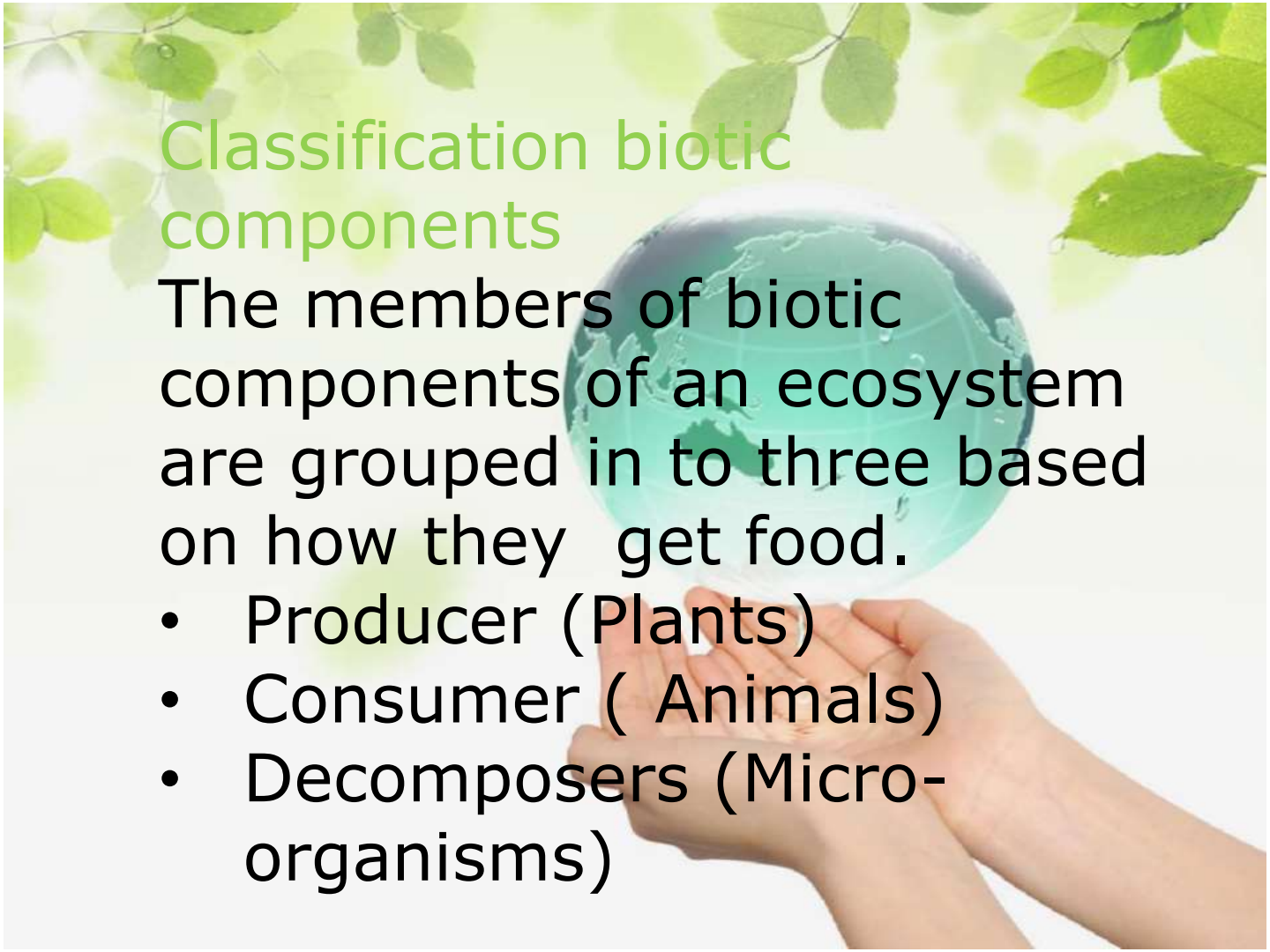
An ecosystem has two major components

•Biotic (living) components

•Abiotic (non living) componentsBiotic components

Theliving 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)

- **Producers (Autotrophs**)

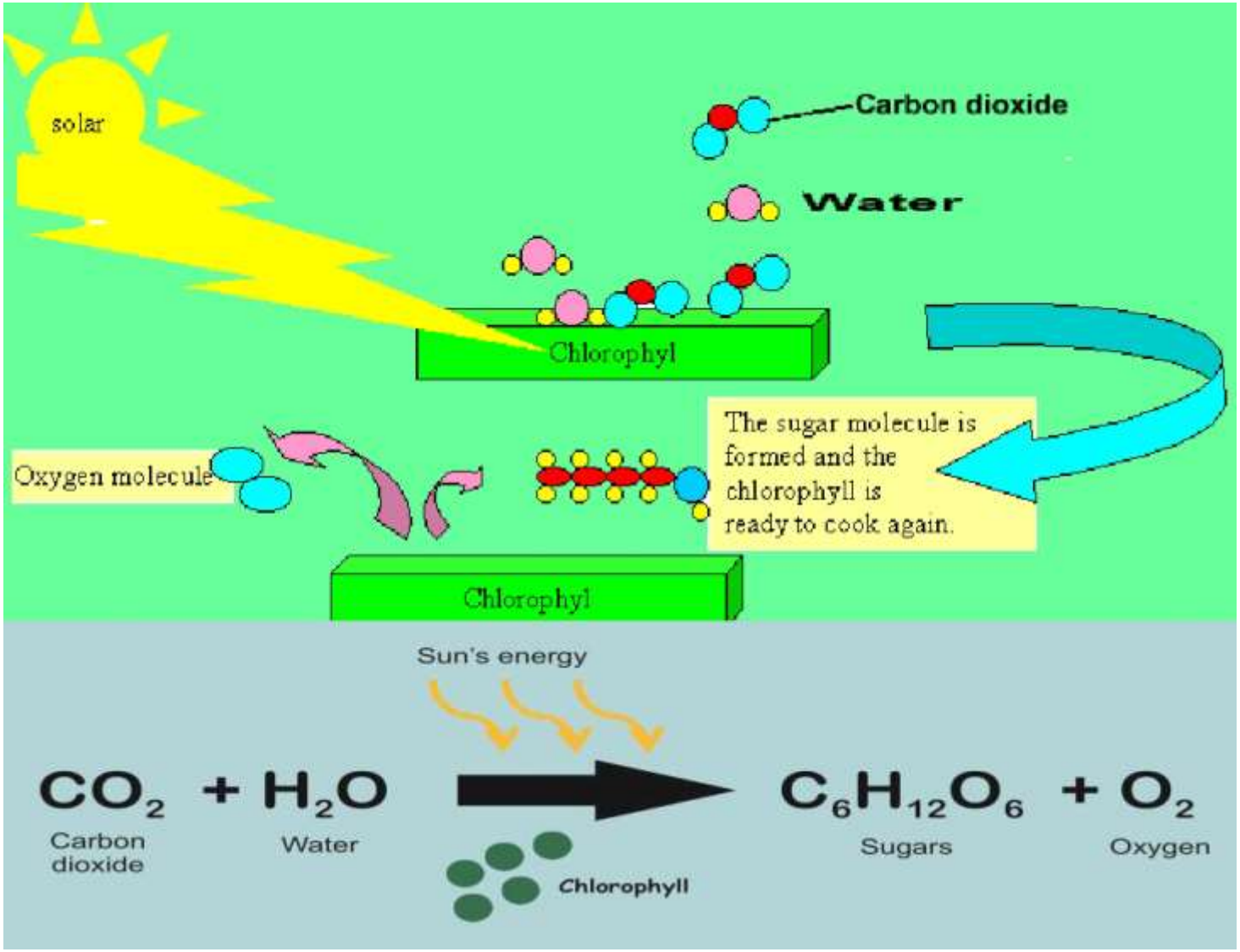
Producers synthesise their food themselves through photosynthesis
Ex: All green plants, trees.

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.

$6CO_2 + 6H_2O \text{ ----> } C_6H_{12}O_6 + 6O_2$

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

2. Consumers also called as Heterotrophs:

Classification of consumers

Consumers are further classified as 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):

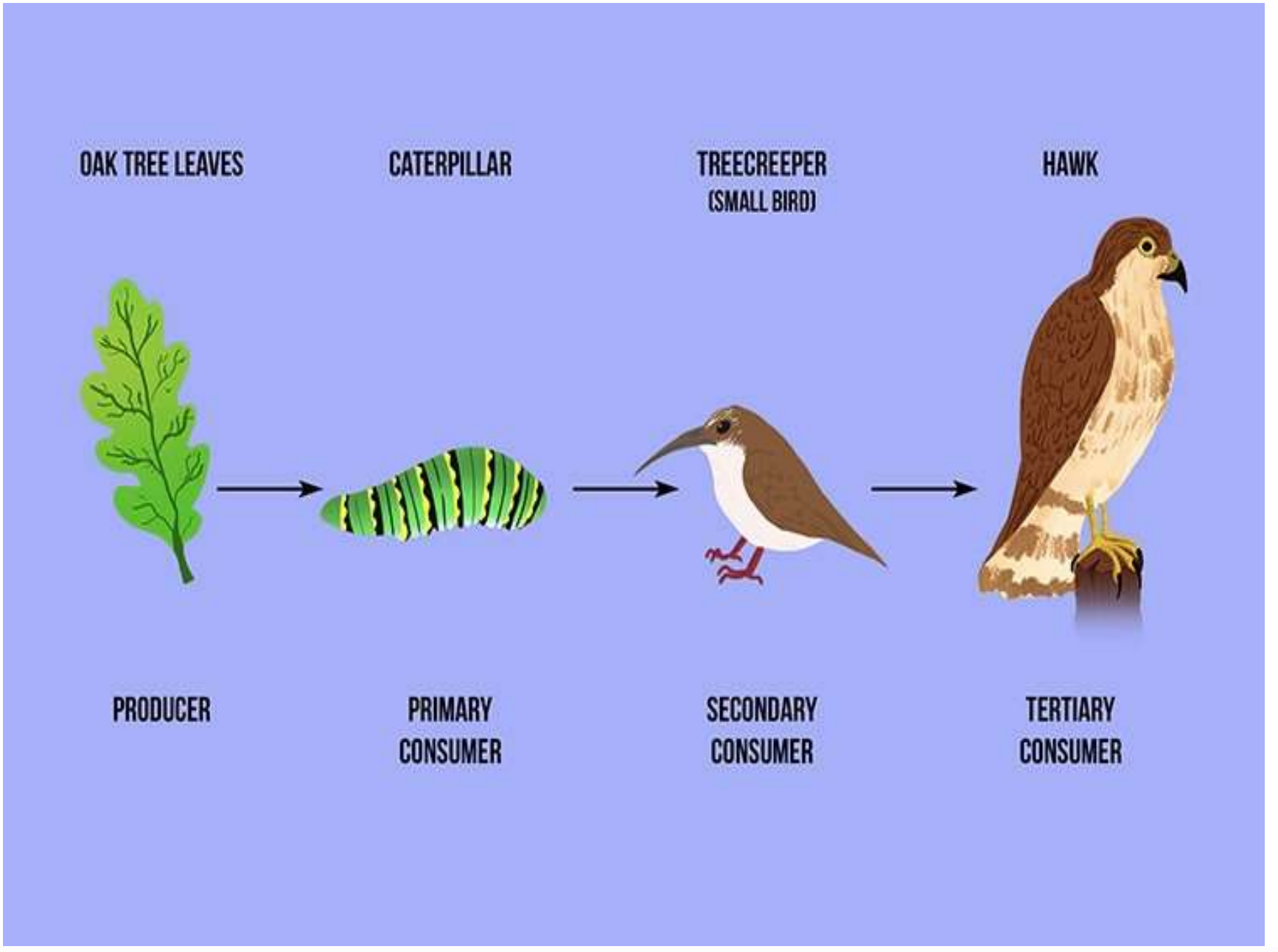
Secondary consumers are primary carnivores, they feed on primary consumers. They directly depend on the herbivores for their food.

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.

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.,

•**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.

Ex: Air, water, soil, sunlight, etc.,

•**Chemical Components:** They are the sources of essential nutrients.

•Organic substances : Protein, lipids, carbohydrates, etc.,

•Inorganic substances: All micro (Al, Co, Zu, Cu) and macro elements (C,H, O, P, N, P, 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

Running water ecosystems. Ex: Rivers, Streams…

Standing water ecosystems Ex: Pond, lake…

Marine ecosystem Ex: Seas and sea shores…

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

Ex: Croplands, gardens…

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.

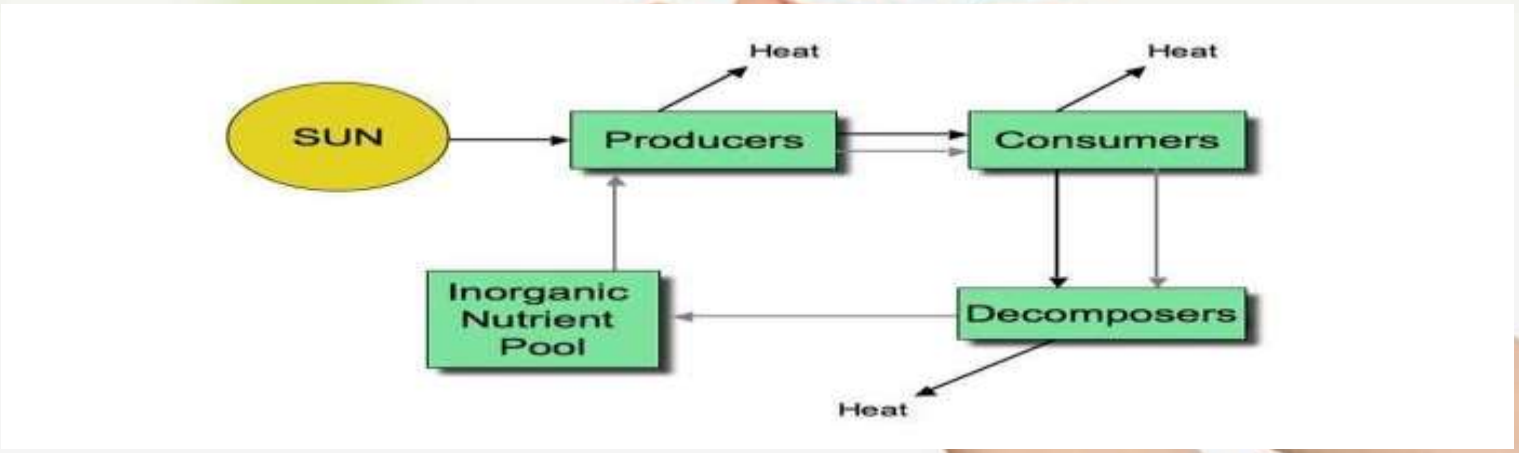
- **Primary function:** The primary function of all ecosystem is manufacture of starch (photosynthesis).
- **Secondary function:** The secondary function of all ecosystem is distribution energy in the form of food to all consumers.
- **Tertiary Function:** All living systems diet at a particular stage. 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

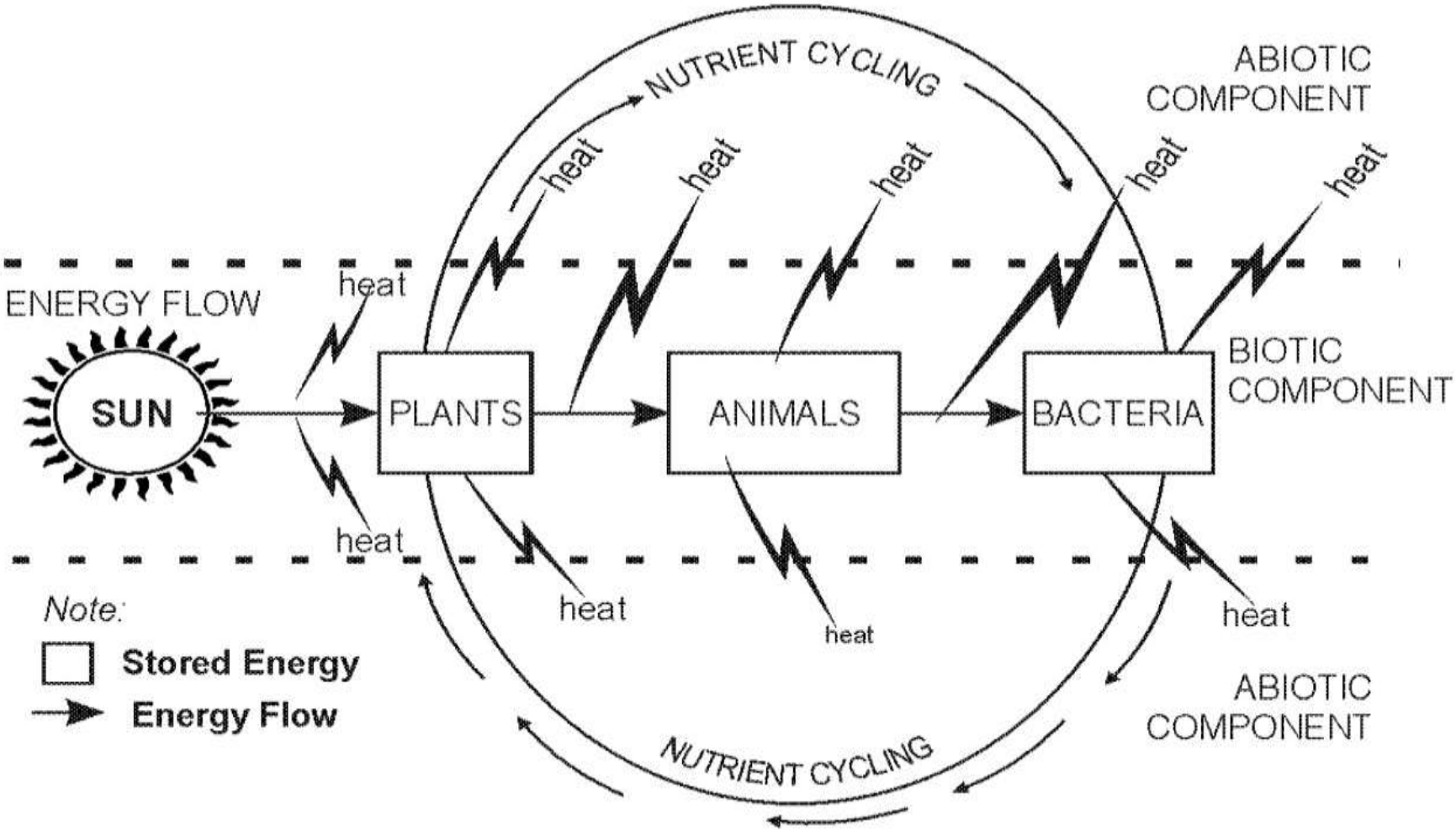
Energy is the most essential requirement for all living organisms.
Solar energy is the only source to our planet earth.
Solar energy is transformed to chemical energy in photosynthesis by the plants (Primary producers).
Some amount of chemical energy is used by the plants for their growth and the remaining 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.



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.,



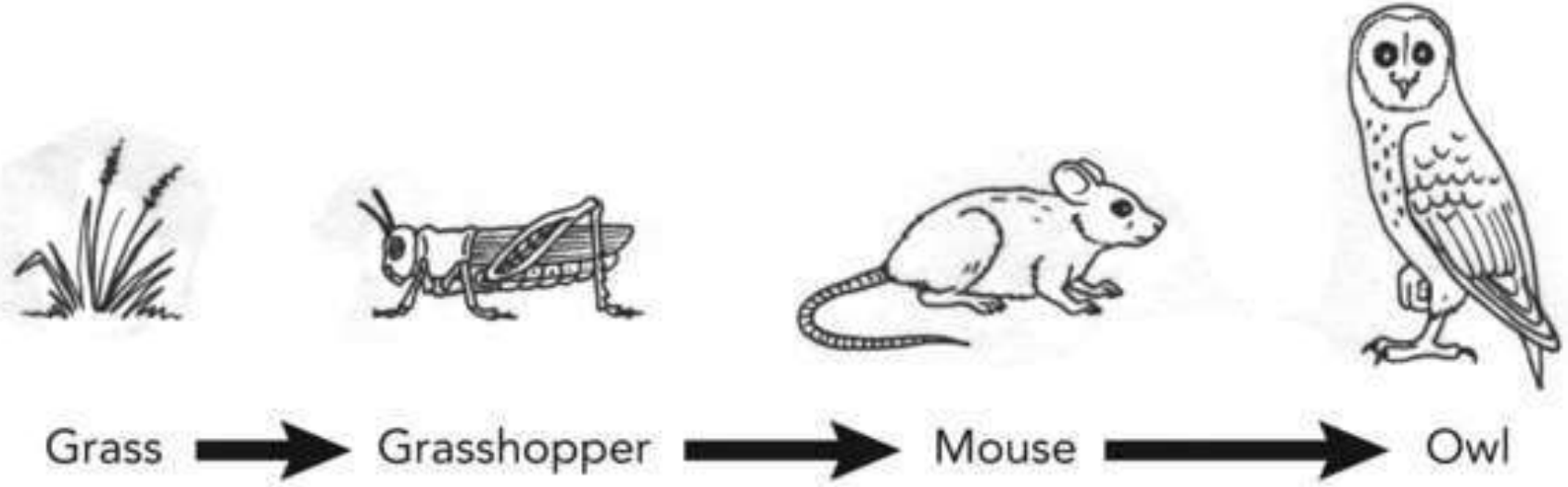
Flow of energy and nutrient cycling from abiotic to biotic and vice versa.

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



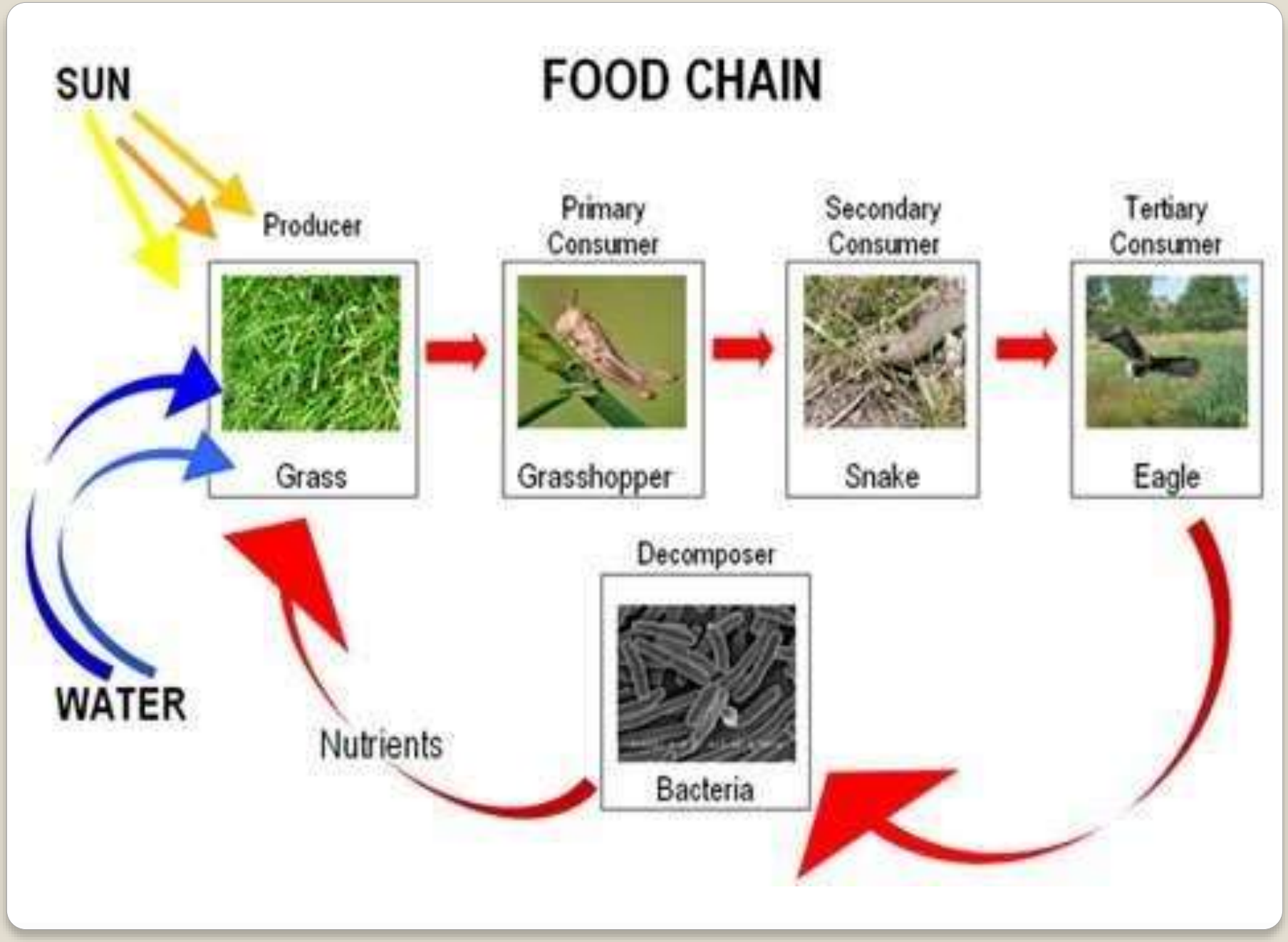
TropicLevels (T1,T2, T3, T4, T5) (or) Feeding levels

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.

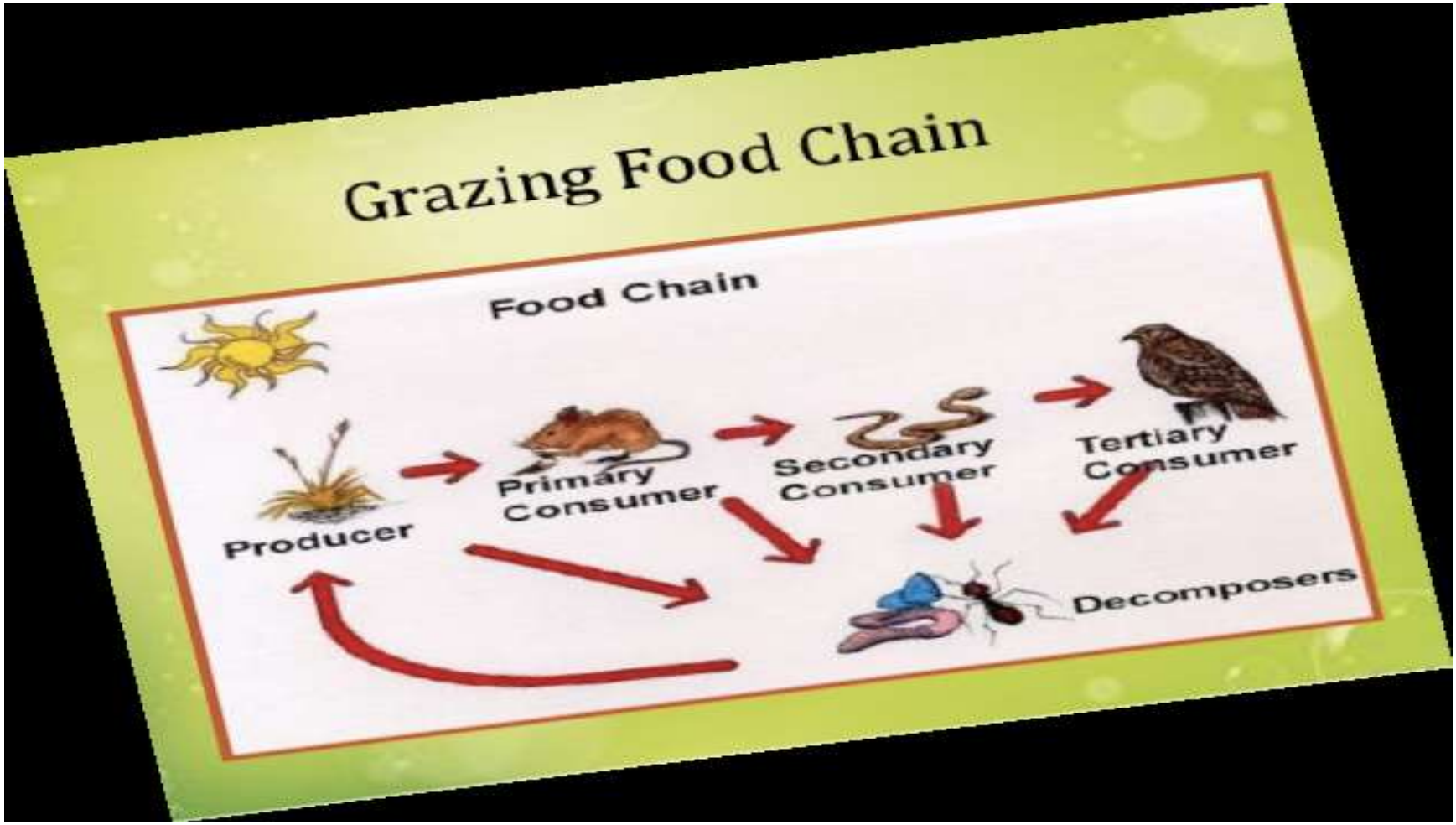

FOOD CHAIN
SUN
Producer
Primary Consumer
Secondary Consumer
Tertiary Consumer
Grass
Grasshopper
Snake
Eagle
Decomposer
Bacteria
WATER
Nutrients

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.

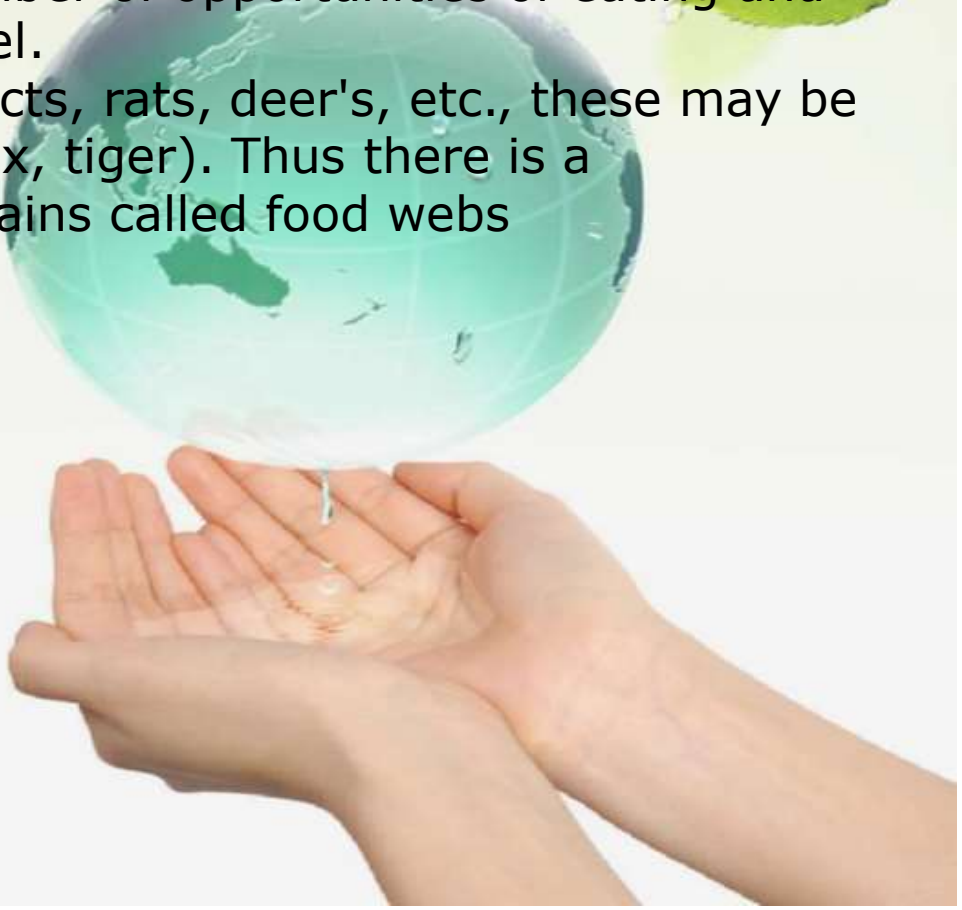
The following diagram shows that grazing food chain and detritus food chain are interconnected to each other but are not isolated.



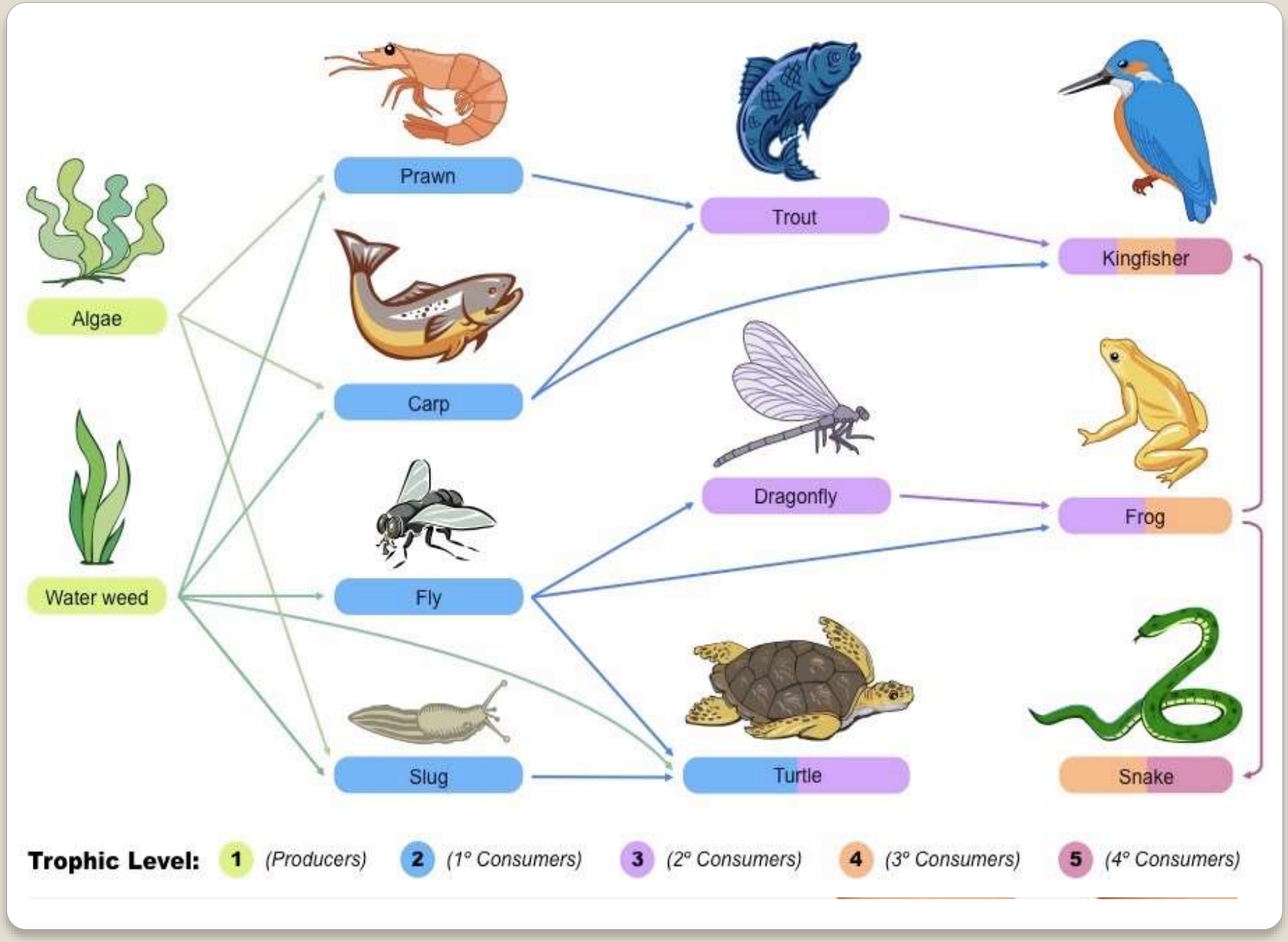
FOOD WEB • The interlocking pattern of various food chains in an ecosystem is known as food web.

• 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.

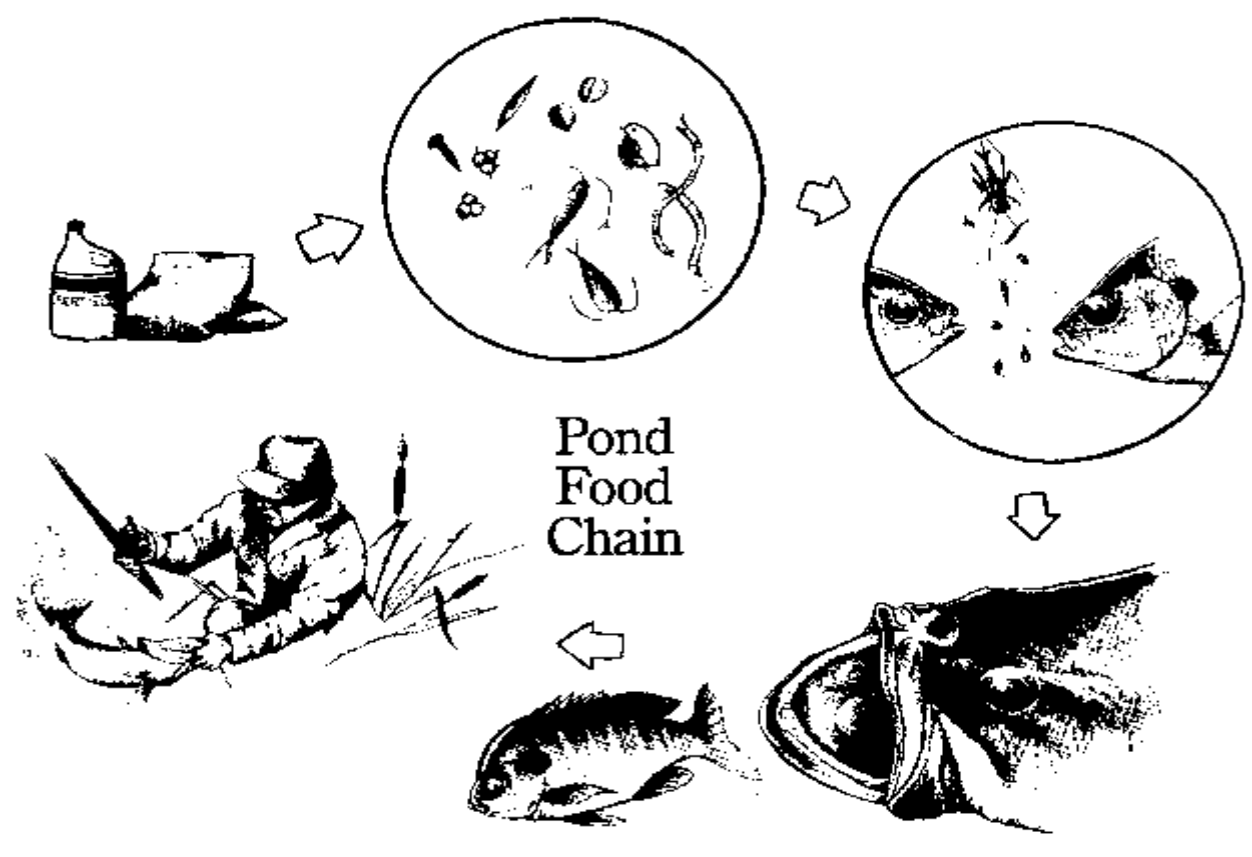
• Grass may be eaten by insects, rats, deer's, etc., these may be eaten by carnivores (snake, fox, tiger). Thus there is a interlocking of various food chains called food webs




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


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.



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.**

Thank you