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**SAIRAM**  
DIGITAL RESOURCES

YEAR  
**II**

SEM  
**IV**

**GE8291**

**ENVIRONMENTAL SCIENCE AND ENGINEERING**



## UNIT NO 1

### ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

- Definition, scope and importance of environment – need for public awareness
- Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers

## SCIENCE & HUMANITIES



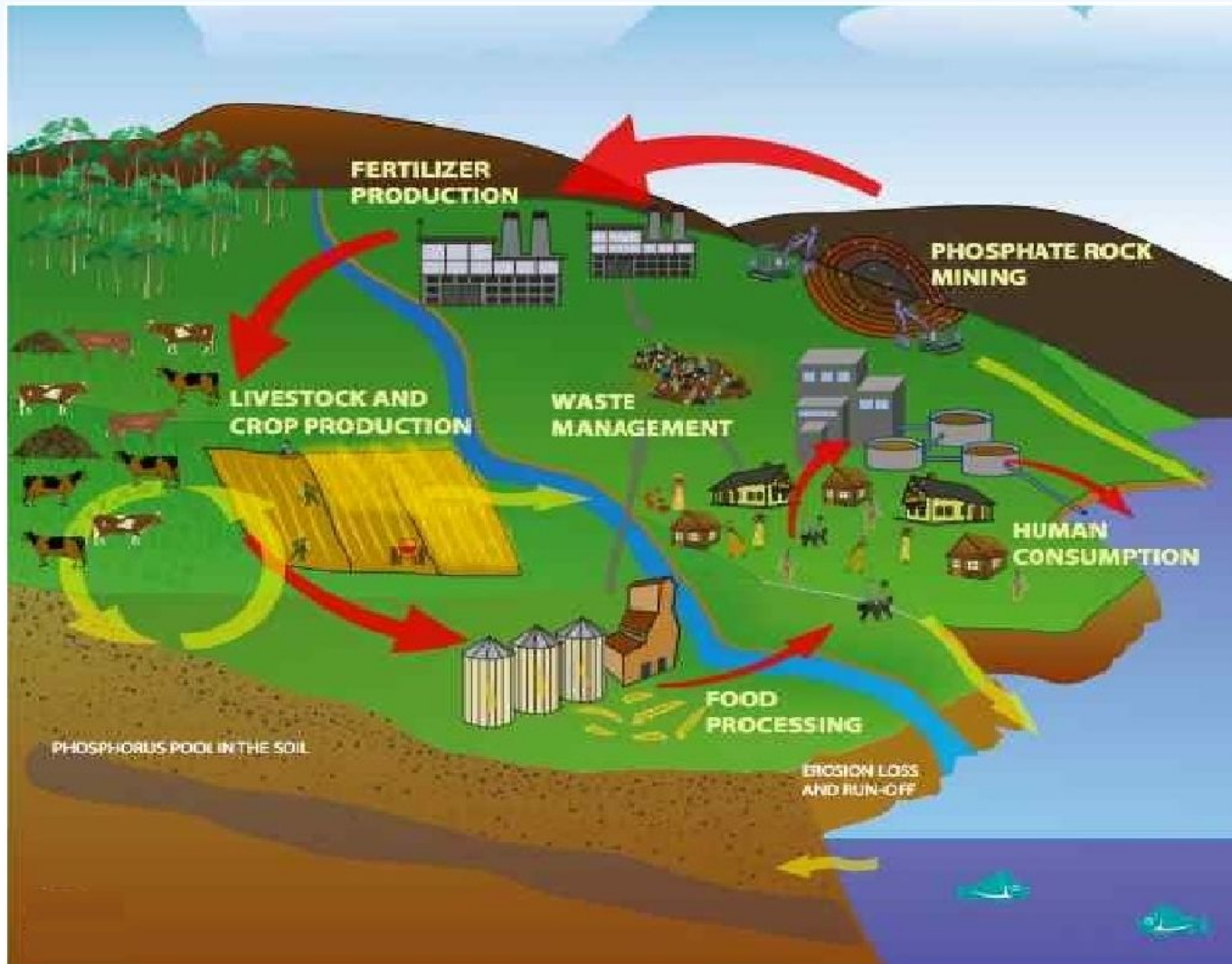


### 1.1.1 Introduction

- ❖ The word environment is derived from the French word “Environ” meaning “Surroundings”. Each and everything around us is called as environment.
- ❖ Every organisms is surrounded by materials and forces which constitute its environment ,from which it must derive its needs.
- ❖ Environment creates favourable conditions for the existence and development of living organisms

#### EXAMPLE.

Cow eats plants for its survival .





### 1.1.2 Definitions

#### ❖ Environment

Environment is defined as, "the sum of total of all the living and nonliving things around us influencing one another".

#### ❖ Environmental Science

Environmental science is the study of the environment, its biotic and abiotic components and their interrelationship.

#### ❖ Environmental Engineering

Environmental engineering is the application of engineering principles to the protection and enhancement of the quality of the environment and to the enhancement and protection of public health and welfare.

### 1.1.3 Types of Environment

Environment can be divided into two categories

1. Natural environment

2. Man made environment

- Natural Environment



- Man-Made Environment



## 1.Natural Environment

Natural environment is characterized by natural components.All the biotic (living) and Abiotic components(non-living) are created through a natural process.

### Example

Soil,water,trees,air,radiations..etc.

## 2.Man-made Environment

Man is the powerful environment agent.He modifies the environment using modern technologies,according to his needs to a great extent.Thus the man-made environment is created by man.

### Example

### TYPES OF ENVIRONMENT

**Natural Biotic & A biotic components**

E.g.: Soil, water ,air, tress, noise

**Man-Made**

**Most powerful environmental agent**

E.g:house,road,schools,railways

### COMPONENTS OF ENVIRONMENT

**A biotic /Non living /  
Physical**

**Sphere**

**Hydro**

**Litho**

**Atmo**

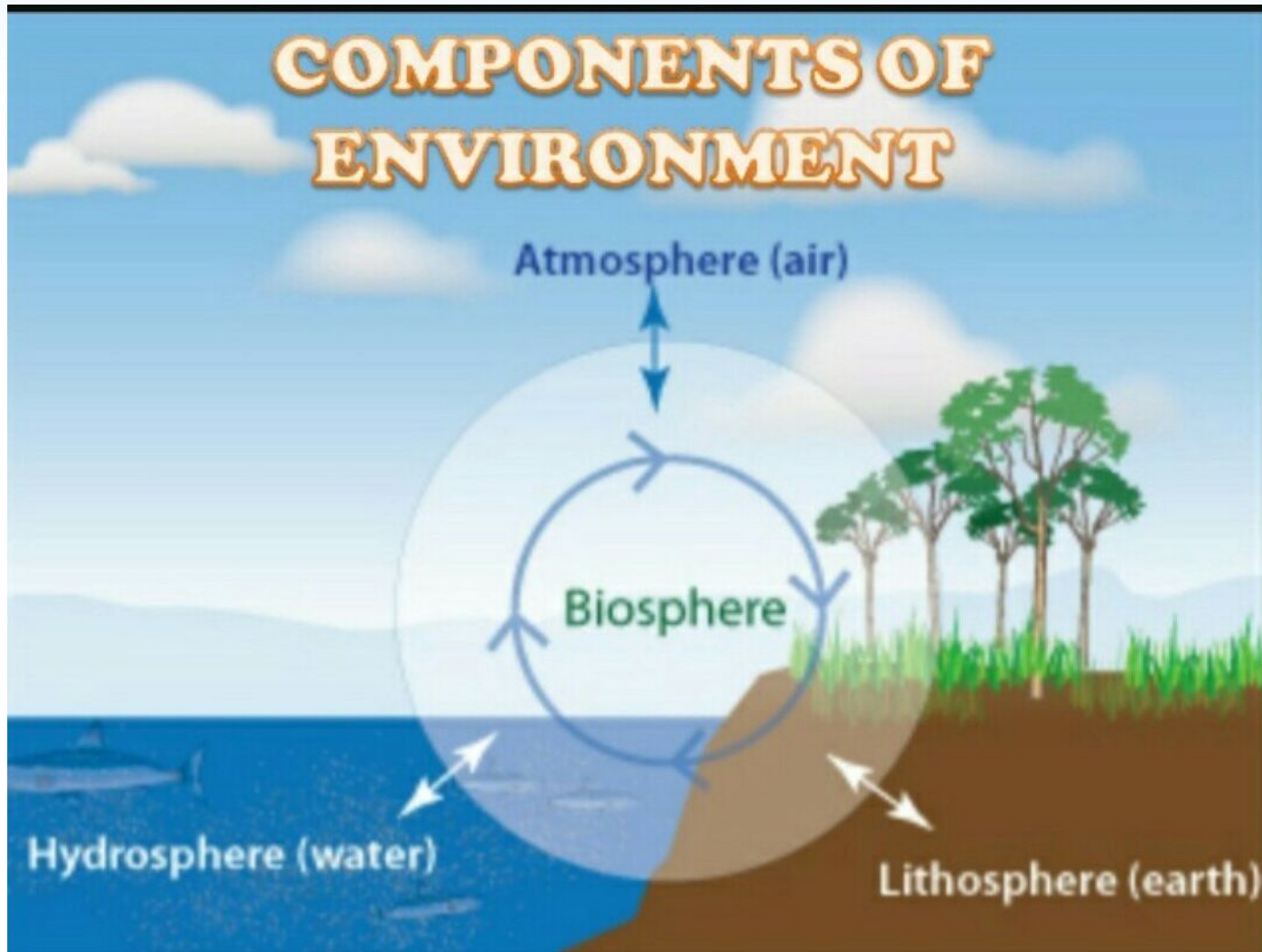
**Biotic / Living**

**Biosphere**

**Energy components**

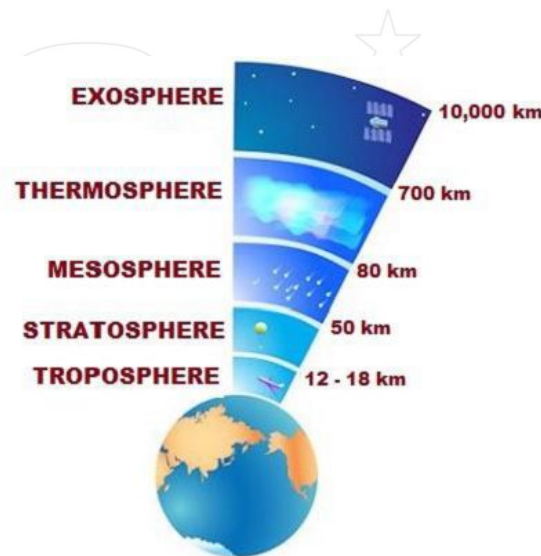
**Energy Flow**





The structure of the atmosphere is classified into the following layers

- Troposphere: 0 to 12 km
- Stratosphere: 12 to 50 km
- Mesosphere: 50 to 80 km
- Thermosphere: 80 to 700 km
- Exosphere: 700 to 10,000 km



## Troposphere

- Troposphere is the closest to the Earth's surface and contains water vapor (clouds), moisture, dust, etc.
- Most of the weather phenomena take place in Troposphere.
- Height of the Troposphere varies i.e. at the equator, it is measured about 18 km and at the poles, it is 12 km.
- Tropopause is the transitional zone that separates Troposphere and Stratosphere.

## Stratosphere

- Stratosphere is the second-lowest layer of the Earth's Atmosphere that goes up to 50 km.
- Stratosphere contains Ozone (O<sub>3</sub>) Layer that absorbs the ultraviolet rays (coming through the Sun rays) and protects life on the Earth.
- As the ultraviolet radiation absorbs in Stratosphere, therefore the temperature rises with increasing altitude.
- The Stratopause is the transitional zone that separates Stratosphere and Mesosphere.

## Mesosphere

- Mesosphere, present above the Stratosphere, extends up to (from 50 km to) 80 km.
- Temperature in the Mesosphere decreases with increasing altitude.
- Mesopause is the transitional zone that separates Mesosphere and Thermosphere.

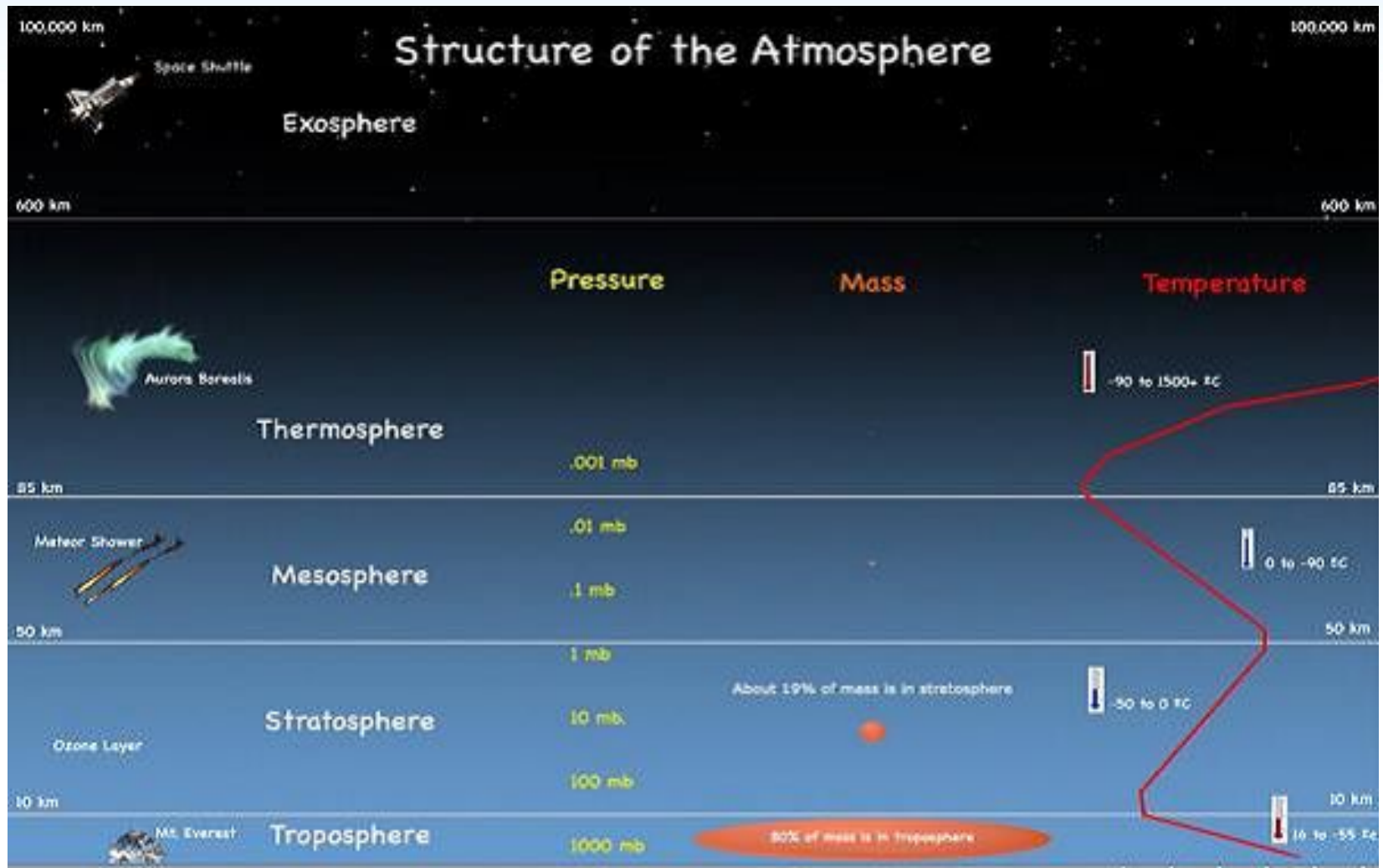
## Thermosphere

- Above the Mesosphere, Thermosphere is the second-highest layer that starts at the altitude of 80 km and extends up to (roughly) 700 km (however, it varies between 500 and 1000 km).
- The lower part of the Thermosphere (roughly between 80 km and 550 km) contains ions and known as Ionosphere.
- The temperature of the Thermosphere rises with increasing altitude.
- Thermopause is the transitional zone that separates Thermosphere and Exosphere.



## Exosphere

- Exosphere is the highest or outermost layer of the Earth's atmosphere that extends (starting from 700 km altitude) up to 10,000 km where it ultimately merges into the solar wind.
- Major constituents of the Exosphere are helium, hydrogen, nitrogen, oxygen, and carbon dioxide.
- The phenomena of Aurora Borealis and Aurora Australis can be seen in the lower part of the Exosphere (merged with upper part of the Thermosphere).



### 1.1.4 Scope of environmental studies

Environmental studies discipline has multiple and multilevel scopes. This study is important and necessary not only for children but also for everyone. The scopes are summarized as follows:

1. The study creates awareness among the people to know about various renewable and nonrenewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.
2. It provides the knowledge about ecological systems and cause and effect relationships.
3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganisms in the environment.
4. The study enables one to understand the causes and consequences due to natural and main induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.

5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.
6. The study enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.
7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.
8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.
9. It teaches the citizens the need for sustainable utilization of resources as these resources are inherited from our ancestors to the younger generating without deteriorating their quality.
10. The study enables theoretical knowledge into practice and the multiple uses of environment.

### 1.1.5 Importance of environmental study

Environmental study is based upon a comprehensive view of various environmental systems. It aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems. The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere .

- ❖ Environmental studies take a multidisciplinary approach to the study of human interactions with the natural environment. It integrates different approaches of the humanities , social sciences, biological sciences and physical sciences and applies these approaches to investigate environmental concerns.
- ❖ Environmental study is a key instrument for bringing about the changes in the knowledge, values, behaviors and lifestyles required to achieve sustainability and stability within and among countries.
- ❖ The study motivates students to get involved in community action, and to participate in various environmental and management projects.



- ❖ The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- ❖ It is a high time to reorient educational systems and curricula towards these needs.
- ❖ Through environmental studies, people can gain the knowledge of different types of environment and the effects of different environmental hazards.
- ❖ Environmental studies develop a concern and respect for the environment.
- ❖ Environmental studies inform the people about their effective role in protecting the environment by demanding changes in laws and enforcement systems.

### 1.1.6 Need for Public Awareness

- ❖ Due to many discoveries and inventions from 16th century onwards, man has overexploited the natural resource which leads to many environmental problems.
- ❖ lack of awareness and less number of people participation leads to poor pollution management.
- ❖ Hence ,it is necessary to create awareness to the public about environmental problems and to protect the environment through implementing proper regulations.
- ❖ In order to protect the environment from the pollution,Supreme Court has initiated the environmental awareness to the public through government and non-government agencies.

### 1.1.7 Importance of Public participation

Without public participation ,environmental pollution cannot be controlled by laws.The public participation is useful for controlling the pollution.

#### Types of Public Participation

The various forms of public participation to protect the environment from pollution are as follows:

- i)Pressure Group:**The public pressure group is formed to influence the government on one hand and the industries on the other hand.
- ii)Watch dog:**The public can acts as “watch dog”to protect the environment from the pollution.
- iii)Advisory Council:**The advisory council to be formed by the public to keep the environment suitable for living.

**iv)Implementing the Environmental laws:**

The public can be utilized to enforce the environmental laws.If there is an any violation ,the member of public should conduct public interest litigation.

## Environmental Awareness



### **1.1. 8 CONCEPT OF ECOLOGY AND ECOSYSTEM**

- ★ The term Ecology was coined by Earnst Haeckel in 1869. It is derived from the Greek words Oikos- home + logos- study.
- ★ So ecology deals with the study of organisms in their natural home interacting with their surroundings.
- ★ An ecosystem is a group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter.
- ★ Now ecology is often defined as "the study of ecosystems".
- ★ The ecosystem is a unit or a system which is composed of a number of subunits that are all directly or indirectly linked with each other.
- ★ They may be freely exchanging energy and matter from outside—an open ecosystem or may be isolated from outside—a closed ecosystem.



## ECOLOGY

- ★ All living organisms, whether plant or animal or human being is surrounded by the environment, from which it derives its needs for its survival.
- ★ Each living component interacts with non-living components for their basic requirements from different ecosystems.

## DEFINITION

- ★ Ecology is the study of interaction among organisms or group of organisms with their environment.
- ★ Ecology is the study of ecosystem.

## ECOSYSTEM

### Ecosystem

Ecosystem is the basic functional unit of ecology. The term ecosystem is derived from a Greek word meaning study of home.

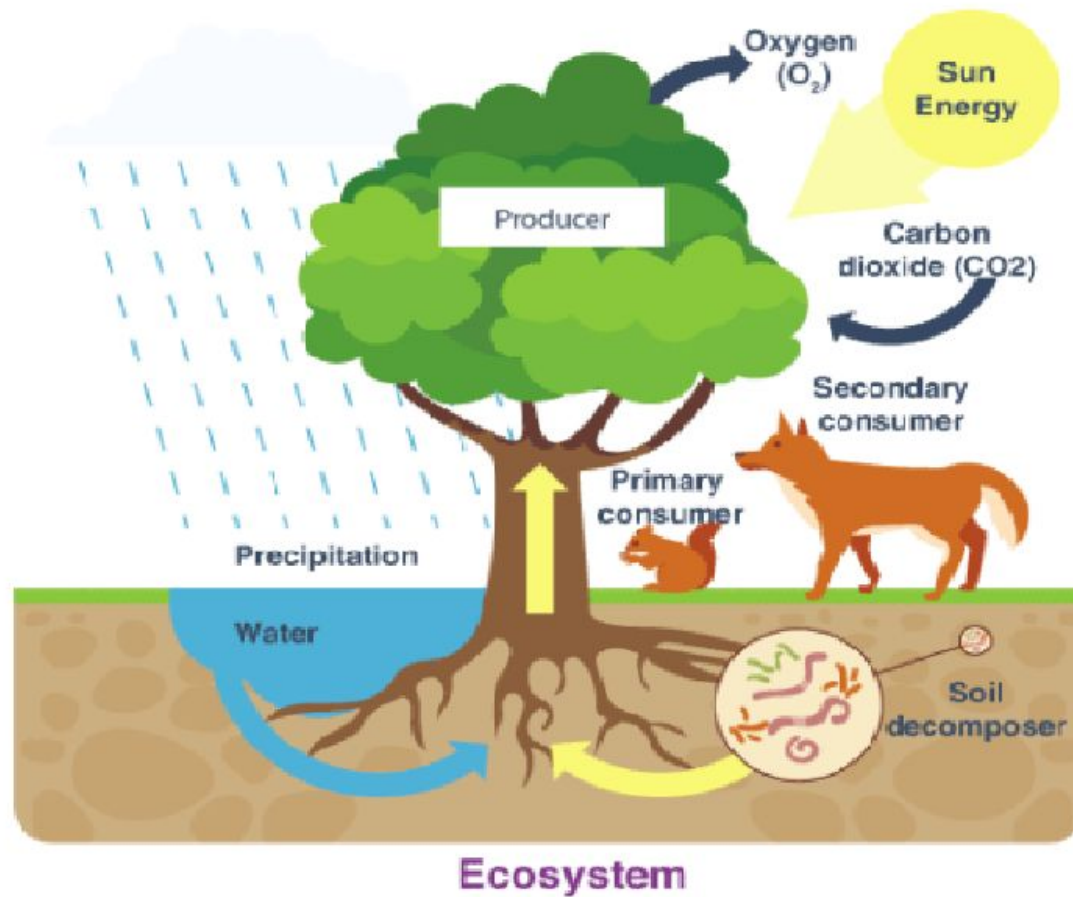
### DEFINITION

*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.*

### Examples

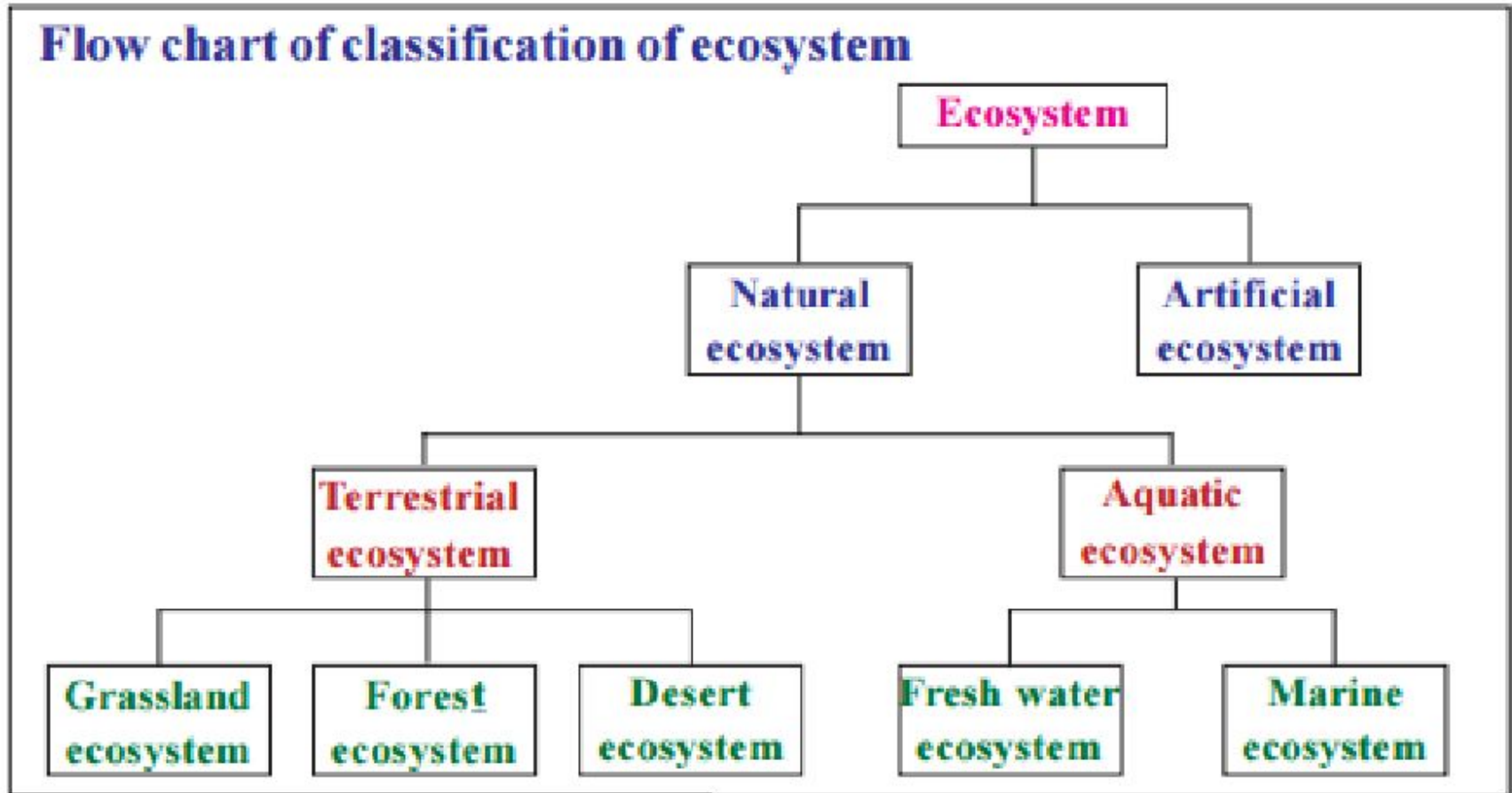
*Animals cannot synthesis their food directly but depend on the plants either directly or indirectly.*



### **Biome (Small Ecosystem)**

- A kind of organisms which can live in a particular ecosystem depends on their physical and metabolic adaptations to the environment of that place.
- On earth there are many sets of ecosystems which are exposed to same climatic conditions and having dominant species with similar life cycle, climatic adoptions and physical structure. This set of ecosystem is called a biome.  
  
Thus, the biome is a small ecosystem within an ecosystem.

### 1.1.9 TYPE OF ECOSYSTEM





### 1.1.9 TYPE OF ECOSYSTEM

#### 1.Natural ecosystem

Natural ecosystems operate themselves under natural conditions. Based on habitat types, it can be further classified into two types.

##### (i). Terrestrial ecosystem

This ecosystem is related to land and types of vegetation.

#### EXAMPLES

Grassland ecosystem, forest ecosystem, desert ecosystem, etc.,

##### (ii). Aquatic ecosystem

This ecosystem is related to water, it is further sub classified into two types based on salt content.

**(i) Fresh water ecosystem.**

**(a) Running water ecosystems.**

**EXAMPLES**

Rivers, streams.

**(b) Standing water ecosystems.**

**EXAMPLES**

Pond, lake.

**(ii) Marine ecosystem.**

**EXAMPLES**

Seas and sea shores.

## 2.Man-made (or) Artificial ecosystems

Artificial ecosystem is operated (or) maintained by man himself.

### Examples

Croplands, gardens.

## TYPES OF ECOSYSTEMS

### ARTIFICIAL Ecosystems

These ecosystems **ARE** **designed** and **managed** by humans.

e.g. park, farm, schoolyard,  
Marine Land, zoo,  
backyard, aquarium



### NATURAL Ecosystems

These ecosystems **ARE NOT** **designed** and **managed** by humans.

e.g. field, meadow, stream,  
primary growth forest



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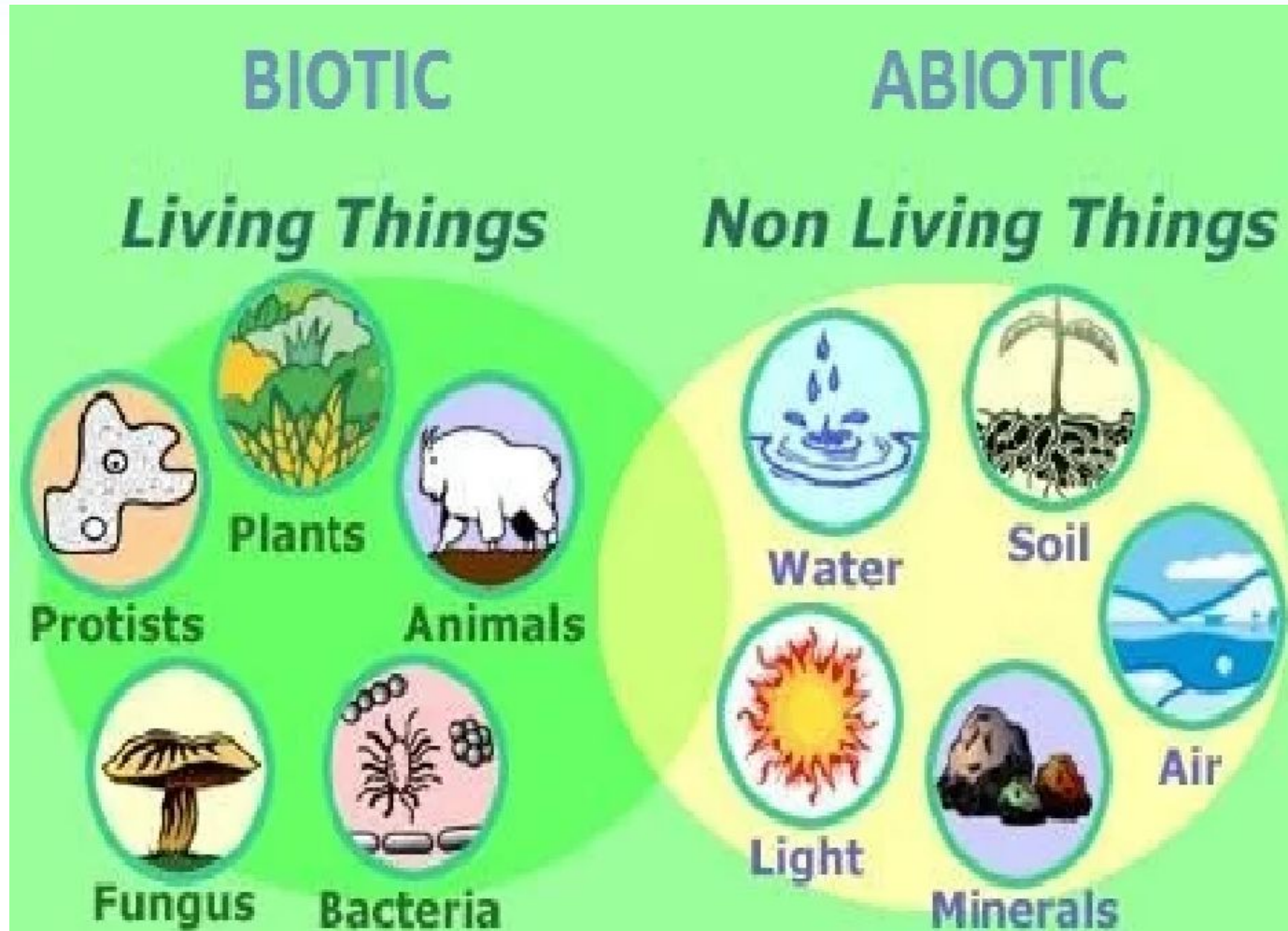
### 1.1.10 STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM

The term structure refers to various components. So the structure of an ecosystem explains the Relationship between abiotic (non-living) and biotic (living) components.

An ecosystem has two major components

1. Abiotic (non-living) components.
2. Biotic (living) components.

### 1.1.10 STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM





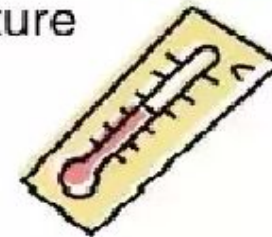
## 1.1.10 STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM

### Biotic vs. Abiotic Factors

- Living
- Examples
  - Plants
  - Animals
  - Fungi
  - Bacteria



- Non-Living
- Examples
  - Water
  - Sunlight
  - Soil
  - Air
  - Temperature





## Abiotic (non-living) components

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

### Examples

Climate, soil, water, air, energy, nutrients, etc.,

**1. Physical components:** It includes the energy, climate, raw materials and living space that the biological community needs. It is useful for the growth and maintenance of its member.

### Examples

Air, Water, Soil, Sunlight..etc.

**2.Chemical Components:** It is the sources of essential nutrients.

### Examples

(i) Organic Substances: Proteins, lipids, carbohydrates..etc.

ii) Inorganic substances: All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, P, K) and few other elements.

### Biotic components

- ❖ Living organisms (or) living members in an ecosystem collectively form its community called biotic components (or) biotic community.
- ❖ The living components are made of many different species. These species are distinguished on the basis of their nutritional (feeding) relationship. It includes

**1. Autotrophic components:** The members of autotrophic components are producers, which are autotrophs (self-nourishing organisms). They derive energy from sunlight and make organic compounds from inorganic substances.

### Examples

Green plants, algae, bacteria, etc.,

**2. Heterotrophic components:** The members of heterotrophic components are consumers and decomposers, which are heterotrophs (dependent on others for food).

They consume the autotrophs (producers). The heterotrophs are

**(a) Macro consumers:** These are herbivores, omnivores (or) carnivores.

**(b) Saprotrophs (micro consumers):** These are decomposers (bacteria, fungi, etc).

### Classification of biotic components

The members of biotic components of an ecosystem are grouped into three groups based on how do they get their food.

1. Producers (Plants).
2. Consumer (Animals).
3. Decomposers (Micro-organisms).

**1. Producers (Autotrophs):** Producers synthesize their food themselves through photosynthesis.

#### Examples

green plants, trees.

## Biotic Components of Ecosystems:

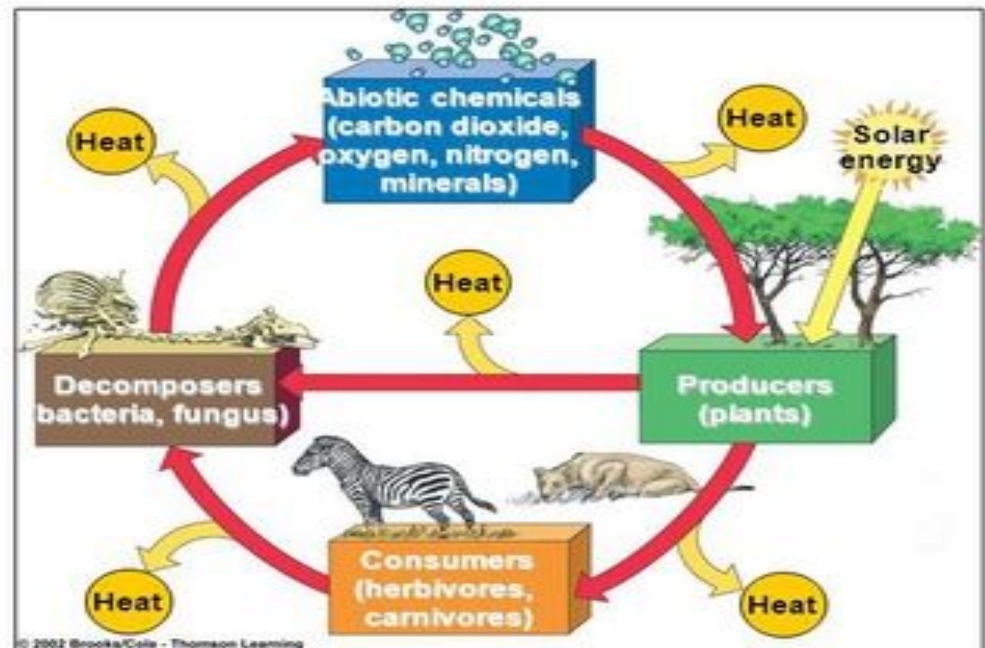
**Producers (autotrophs)**

-**photosynthesis**

**Consumers (heterotrophs)**

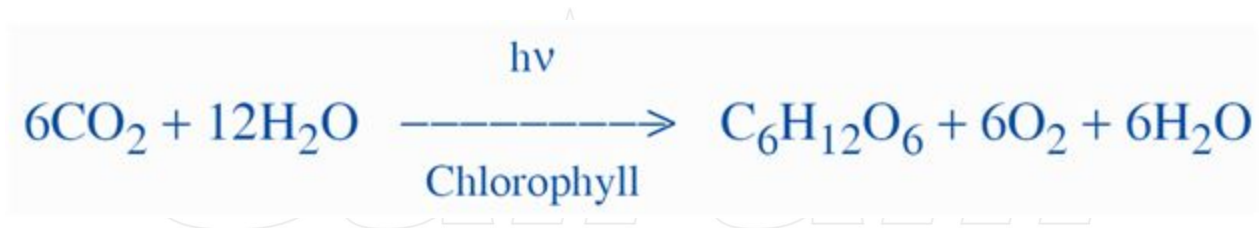
-**respiration**

**Decomposers**



## Photosynthesis

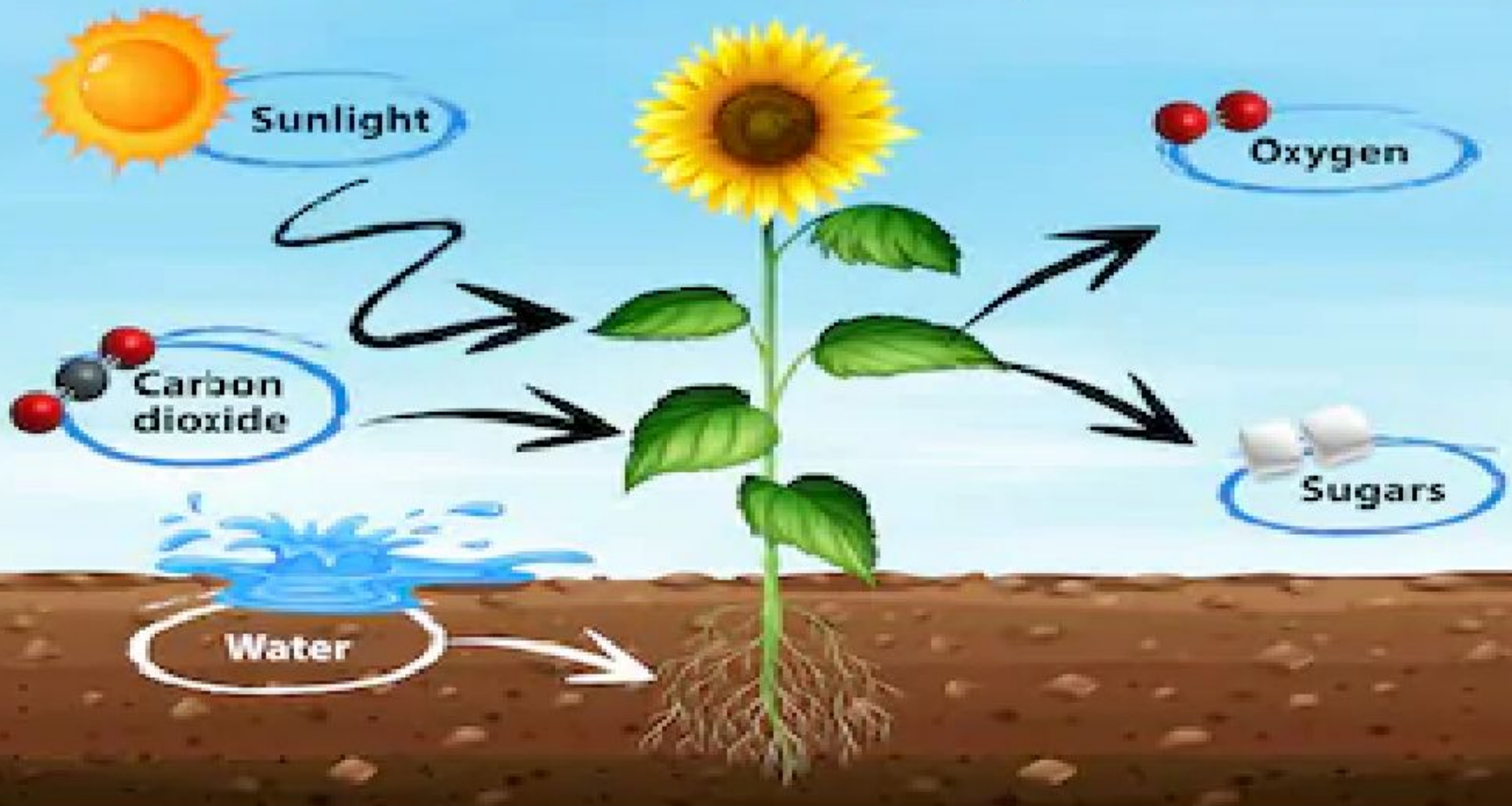
The green pigments, called chlorophyll, present in the leaves of plants, converts CO<sub>2</sub> and H<sub>2</sub>O in the presence of sunlight into carbohydrates.



This process is called photosynthesis.



# Process of Photosynthesis



**2. Consumers (heterotrophs):** Consumers are organisms, which cannot prepare their own food and depend directly or indirectly on the producers.

They cannot make organic compounds, but can transform one form of organic compounds into other form of organic compounds.

**(i) Plant eating species**

Insects, rabbit, goat, deer, cow, etc.,

**ii) Animals eating species**

Fish, lions, tiger, etc.,

## Types of consumers

### i) Primary consumers (Herbivores) (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, horse, 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.

#### Examples

Frog, cat, snakes, foxes, etc.,

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

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

#### Examples

*Tigers, lions, etc.,*

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**3. Decomposers:** Decomposers are those organisms which feed on dead organisms, plants and animals and decompose them into simpler compounds.

During the decomposition inorganic nutrients are released. These inorganic nutrients together with other organic substances are then utilized by the producers for the synthesis of their own food.

### Examples

Microorganisms like bacteria and fungi.

### Decomposers



Worm

Mushroom

Insects

Bacteria

- (i) **Herbivores:** Animals that eat only plants are called herbivores. (vegetarian)
- (ii) **Carnivores:** Animals that eat other animals are called carnivores. (non-vegetarian)
- (iii) **Omnivores:** Animals that eat both animals and plants. (Vegetarian and non-vegetarian)

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### 1.1.11 FUNCTIONS OF AN ECOSYSTEM

To understand clearly the nature of ecosystem, its functioning should be thoroughly understood.

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

**1.Primary function (or) primary production**

**2.Secondary function (or) secondary production**

**3. Tertiary Function**

### 1. Primary function (or) primary production:

Primary function of all ecosystems is manufacture of starch (photosynthesis).

### 2. Secondary function (or) secondary production:

Secondary function of all ecosystem is distributing energy in the form of food to all consumers (or) the energy stored by the consumer

### 3. Tertiary Function:

All living systems die at a particular stage. These dead systems are decomposed to initiate the third function of ecosystems namely “cycling”.

## 1.1 Video links

### 1.Components of ecosystem

<https://youtu.be/MWPj2lkekII>

### 2.Structure and function of an ecosystem

<https://youtu.be/KAuf-oBNvOU>

THANK YOU

