INTRODUCTION TO ENVIRONMENTAL STUDIES

- **Definition, Scope and importance of Environmental Studies**
- **Multidisciplinary nature of environmental studies**
- **Component of Environment: Atmosphere, Hydrosphere, Lithosphere, Biosphere**
- **Biogeochemical cycles: Carbon cycle and Nitrogen cycle**
- **Concept of sustainability and sustainable development.**
- **Definition and Structure of ecosystem – Abiotic and Biotic components (Producers, Consumers and Decomposers)**
- **Functions of Ecosystem: Energy flow in an ecosystem, Food chains, Food webs with examples**
- **Classification -Renewable & Non-renewable Resources and types**

ENVIRONMENT

- The word 'environment' is derived from the French word 'environ' which means to encircle or surround.
- In simple words 'environment' is the surrounding of an organism, which includes air, water, land and its resources, flora and fauna and their interrelationships.
- Surrounding external conditions influencing development or growth of people, animal or plants; living or working conditions etc.

ENVIRONMENTAL STUDIES

- Environment means the surrounding things and conditions affectingthe plants and animals.
- **Environment**: is defined as sum total of all conditions that surround a particular organism at a particular point of time in space.
- Environment: is defined as "all the physical, chemical, biological factors external to the organisms, that governs the growth and development.
- Environment: is defined as "the aggregate of all external conditions and influences affecting life and development of an organism"

Environment literally means Surrounding in which we are living. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living component like animals, plants or non-living component like soil, air water.

Environmental Protection Act (1986) defined "Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living beings and property."

Meaning of Environmental Studies:

Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

SCOPE AND IMPORTANCE OF ENVIRONMENTAL STUDIES

The disciplines included in environmental education are Environmental sciences, Environmental engineering and Environmental management.

(a) Environmental Science:

It deals with the scientific study of environmental system (**air, water, soil and land**), the inherent or induced changes on organisms and the environmental damages incurred as a result of human interaction with the environment.

(b) Environmental Engineering:

It deals with the study of technical processes involved in the protection of environment from the potentially deleterious effects of human activity and improving the environmental quality for the health and well beings of humans.

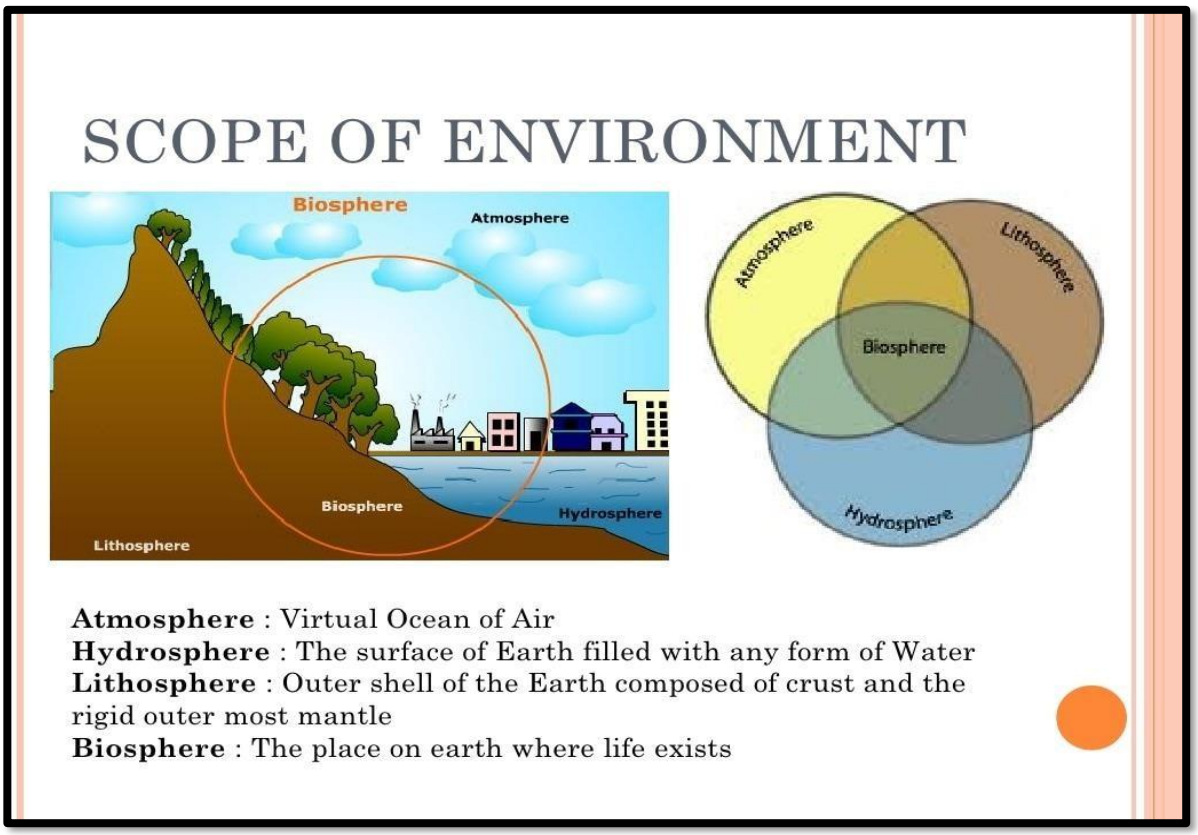
(c) Environmental Management:

It promotes due regard for physical, social and economic environment of the enterprise or projects. It encourages planned investment at the start of the production chain rather than forced investment in cleaning up at the end.

It generally covers the areas as environment and enterprise objectives, scope, and structure of the environment, interaction of nature, society and the enterprise, environment impact assessment, economics of pollution, prevention, environmental management standards etc.

SCOPE OF ENVIRONMENTAL STUDIES

- Everything around us forms our environment and our lives depend on keeping its important systems as intact as possible.
- It deals with many like conversation of natural resources, ecological aspects, pollution of the surrounding natural resources.
- Controlling the pollution
- Briefly, the environment has four realms i.e.
  1. Atmosphere(air)
  2. Hydrosphere(water)
  3. Lithosphere(land)
  4. Biosphere (all living species)



The importance of environmental studies are as follows:

1. To clarify modern environmental concept like how to conserve biodiversity.
2. To know the more sustainable way of living.
3. To use natural resources more efficiently.
4. To know the behavior of organism under natural conditions.
5. To know the interrelationship between organisms in populations and communities.
6. To aware and educate people regarding environmental issues and problems at local, national and international levels.

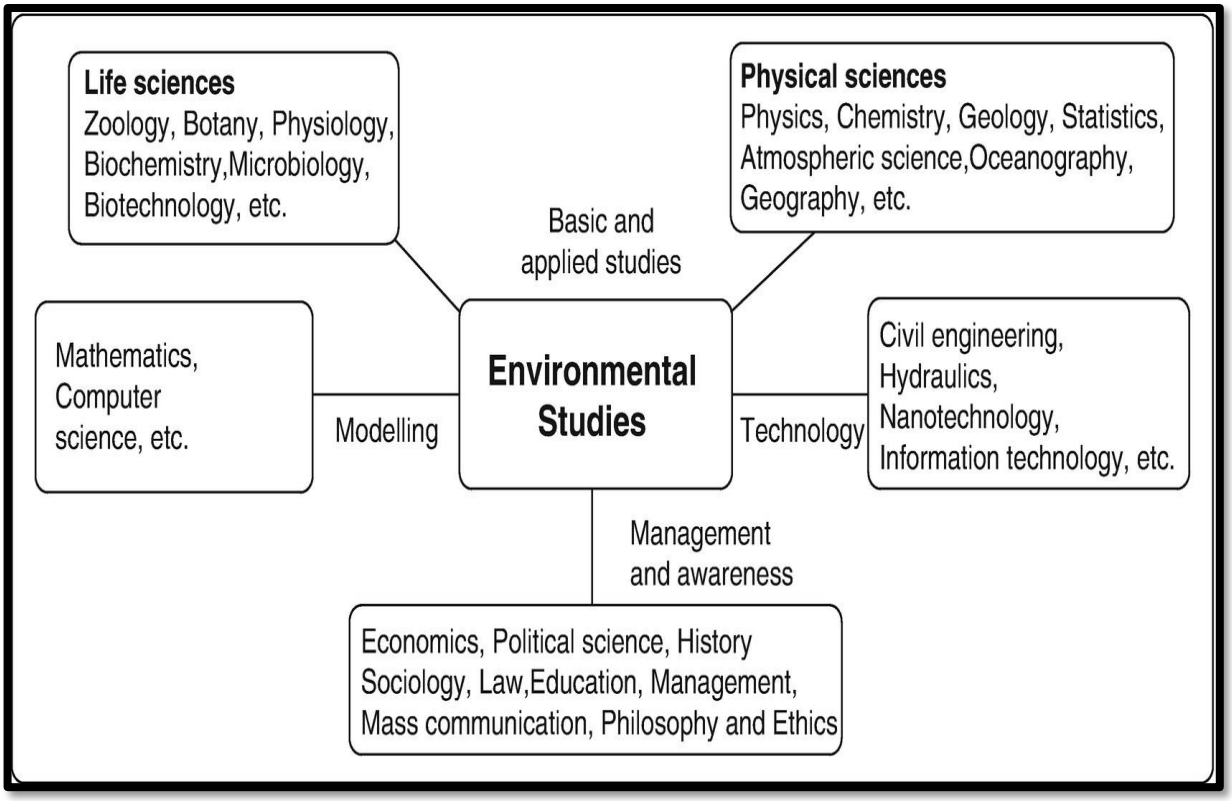
OBJECTIVE OF ENVIRONMENTAL STUDIES

- To increase awareness and sensitivity to the environment among the people.
- To increase the knowledge of the environment.
- To improve attitude towards the environment.
- To acquire skills for solving environmental problems.
- To increase participation and develop a sense of responsibility.

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Because, the environment is complex and actually made up of many different environments, including natural, constructed and cultural environments, environmental studies are the inter disciplinary examination of how biology, geology, politics policy studies, law, geology, religion engineering, chemistry and economics combine to inform the consideration of humanity's effects on the natural world.

It is essentially a multidisciplinary approach and its components include Biology, Geology, Chemistry, Physics, Engineering, Sociology, Health Sciences, Anthropology, Economics, Statistics and Philosophy. It is essentially a multidisciplinary approach.



MAJOR GLOBAL ENVIRONMENTAL PROBLEMS

- Global warming
- Ozone Layer Depletion
- Acid Rain
- Deforestation
- Loss of Biodiversity
- Water Pollution
- Desertification
- Waste disposal

- Rapid population growth
- Depletion of non-renewable energy sources
- Food and water shortage

There are several governmental & non-governmental organizations working towards environmental protection in our country. Few well known organizations are:

- **BSI** - Botanical Survey of India
- **ZSI** - Zoological Survey of India
- **BNHS** - Bombay Natural History Society
- **WWFI** - World Wide Fund for Nature India etc.

COMPONENT OF ENVIRONMENT:

The environment is defined as the whole physical and biological system surrounding man and other organisms along with various factors influencing them. The factors are soil, air, water, light, temperature etc. These are called Abiotic factors. Besides the abiotic factors, the environment is very much influenced by biotic factors which include all forms of life like plants, animals, microorganisms etc.

The four basic components of the non-living physical environment are:

1. Atmosphere
2. Hydrosphere
3. Lithosphere
4. Biosphere

The four major components of environment include **Lithosphere**, **Hydrosphere**, **Atmosphere** and **Biosphere**, corresponding to rocks, water, air and life respectively.

1. ATMOSPHERE

The gaseous envelope surrounding the earth is called Atmosphere. All living organisms on this earth depend on the atmosphere for their survival. It provides us the air we breathe and protect us from the harmful effects of the sun's ray. Without this blanket of protection, we would be baked alive by the heat of the sun during day and get frozen during night. So it is this mass of air that has made the temperature on the earth livable.

Composition of Atmosphere:

Atmosphere contains 78% nitrogen, 21% oxygen, 0.03% carbon dioxide and other gases like argon, hydrogen, helium, neon and ozone.

Importance of atmosphere:

- It protects the earth from the harmful radiation from the sun.
- It also serves as a store house for the water vapor which leads to precipitation over land and sea.
- The atmospheric elements determine the **weather** and **climate** of the place.

Weather:

Weather is this hour-to-hour, day to day condition of the atmosphere. A hot or humid weather may make one irritable. A pleasant, breezy weather may make one cheerful and even plan for an outing. Weather can change dramatically from day to day.

Climate:

The average weather condition of a place for a longer period of time represents the climate of a place.

Structure of atmosphere:

Depending on the various parameter like temperature, pressure, density of the atmosphere, it is divided into different layers. Density is the highest on the earth's surface and decreases rapidly upwards. Five layers are:

1. Troposphere 2. Stratosphere 3. Mesosphere 4. Thermosphere

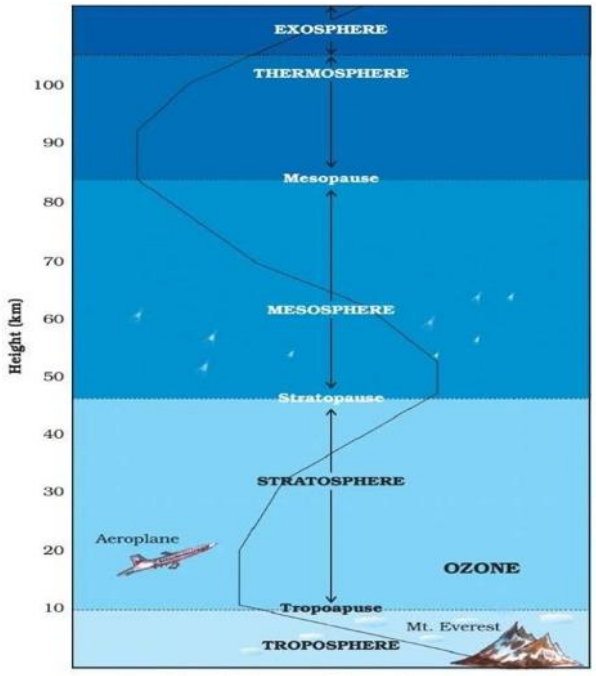


Fig. 4.2: Layers of Atmosphere

1. **Troposphere:**
   - Lower most layer of the atmosphere, where living organisms exist.
   - It extends up to 8km at poles and 18km at the equators which contains 70% of the atmospheric mass and extends up to 10-12 km distance.
   - Temperature decreases with altitude.
   - Density of this layer decreases with altitude.
   - The air we breathe exists here.
   - Almost all the weather phenomena like rainfall, fog and hailstorm occur in this layer, hence it is the most significant layer.
2. **Stratosphere:**
   - It lies beyond the troposphere, and the ozone separating the two layers is called tropopause.
   - It extends up to a height of 50km.
   - It possesses an ozone layer arranged at a height between 16 to 30kms.
   - Ozone layer absorbs, UV radiation waves and prevent them from reaching the earth.
   - Clouds are almost absent and very little dust or water vapor present in this layer.
3. **Mesosphere:**
   - It is the third layer over the stratosphere.
   - It extends up to the height of the 80 km.
   - Temperature decreases with the height, reaching up to the -100° C at the height of 80 km.
   - Meteorites burn up in this layer on entering from the space.
4. **Thermosphere:**
   - It is the fourth layer, located between 80 to 400km.
   - In thermosphere temperature rises very rapidly with increasing height.
   - Ionosphere is a part of this layer.
   - It is an electrically charged layer and enables wireless communication.
   - This layer helps in radio transmission. In fact, radio waves transmitted from the earth are reflected back to the earth by this layer.
5. **Exosphere:**
   - It is the uppermost layer of the atmosphere.
   - It extends up to the height of the 1600km.

- It gradually merges with the outer space.
- This layer has very thin air. Light gases like helium and hydrogen float into the space from here.

2. HYDROSPHERE

It includes all types of water resources such as oceans, seas, rivers, lakes, streams, reservoirs, glaciers and ground waters. The distribution of earth's water supply.

- Very important part of the earth's surface, about 70% of total area is covered with water.
- Oceans constitute 97% of all water available on the earth and fresh water forms the rest 3%.
- Water exists in liquid, solid and gaseous (water vapor) form.

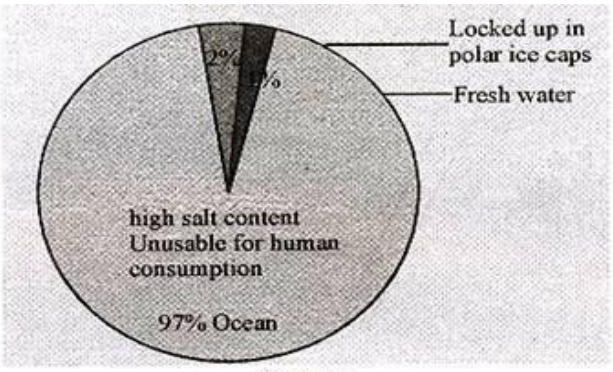


Figure 1.1

As can be seen, only 1 % of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.

The extent of the use of available fresh water for various purposes is shown in the following figure -1.2.

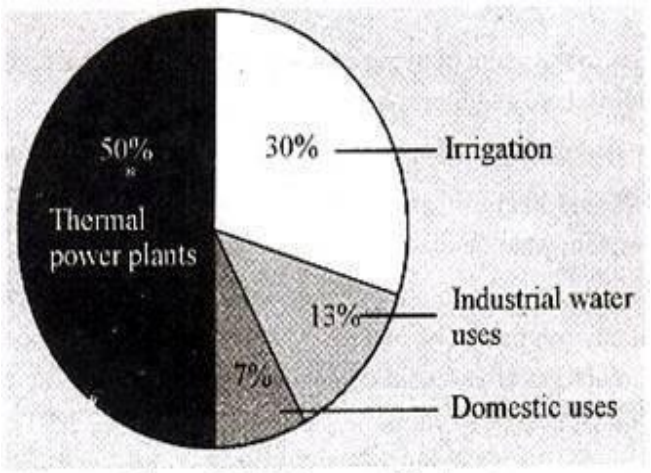


Figure 1.2. Major use of fresh water

IMPORTANCE OF HYDROSPHERE

- Water, the universal solvent is used for metabolism, growth, and reproduction by living organisms.
- Water is useful to organisms as a medium of living.
- Oceans are an important natural resource.
- They are also source of many products of our use.
- They regulate the climate of a region.
- Oceans are a food resource, source of petroleum, gas and energy.
- Oceans also play an important role in trade and transportation.
- Water is used for agriculture as well as industries.

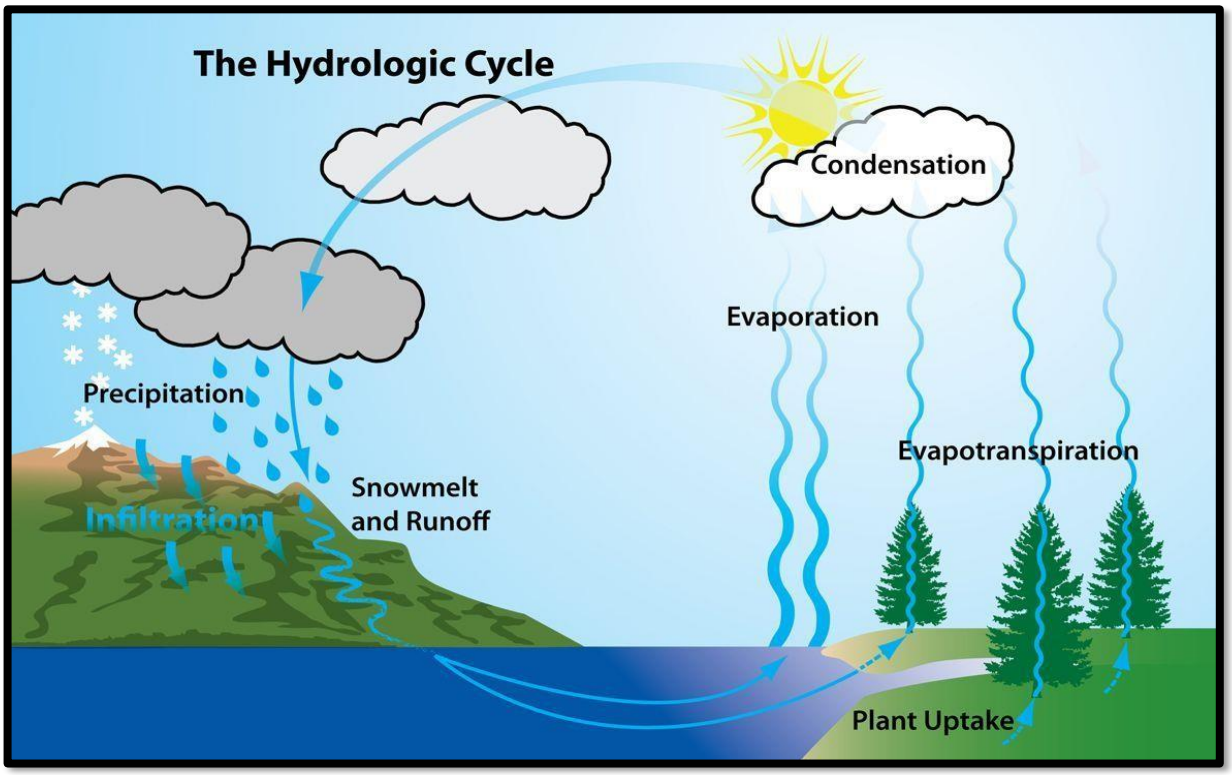
HYDROLOGICAL CYCLE/ WATER CYCLE

The continuous exchange of water between the oceans, atmosphere and the biosphere through evaporation (including transpiration), condensation and precipitation is known as hydrological cycle.

What is the Water Cycle?

The water cycle is an important Biogeochemical Cycle involved in the flow or circulation of water through different levels of the ecosystem. The water cycle is defined as a natural process of constantly recycling the water in the atmosphere. It is also known as the hydrological cycle or the hydrologic cycle.

During the process of the water cycle between the earth and the atmosphere, water changes into three states of matter – solid, liquid and gas.



Stages of Water Cycle

Evaporation

This is the initial stage of the water cycle.

The process by which water from its liquid state changes to vapor, a gaseous state, is termed as evaporation.

Condensation

When the evaporated water vapor loses its thermal energy, it becomes liquid through the process of condensation. Formation of clouds are examples of condensation.

Precipitation

Rain, snow, sleet, or hail are all examples of Precipitation. After the condensation, atmospheric water vapor forms sufficiently large water droplets and falls back to the earth with the help of gravity.

Deposition or Collection

This is the final stage of the water cycle. Deposition occurs when evaporated water vapor falls back to earth as precipitation. This water may fall back into the different water bodies, including oceans, rivers, ponds, lakes and even end up on the land, which in turn becomes a

part of the groundwater.

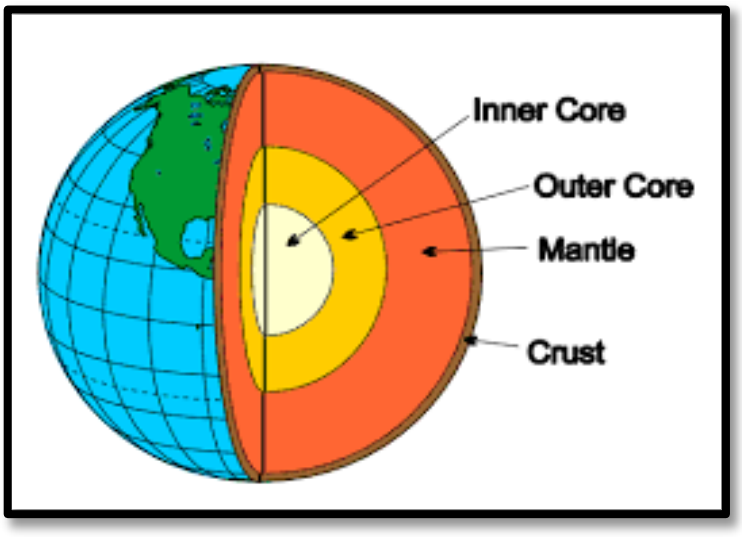
Overall, the water cycle process describes how water is balanced in the atmosphere. It also plays an important role in ensuring the availability of water for all living organisms and also it has a great impact on our environment.

3. LITHOSPHERE

- Lithosphere refers to the layers of rock material on the earth's surface, both on the continents and ocean floors. It is the uppermost layer of the earth crust, which is made up of soil, minerals, rocks and other organic and inorganic matter.
- There are three major landforms i.e. mountains, plateaus and plains.
- An uplifted portion of the earth's surface is called a hill or a mountain.

Structure of Earth:

The structure of the earth is divided into three major components: **the crust, the mantle, and the core.** Each layer has a unique chemical composition, physical state, and can impact life on Earth's surface. Movement in the mantle caused by variations in heat from the core, cause the plates to shift, which can cause earthquakes and volcanic eruptions. These natural hazards then change our landscape, and in some cases, threaten lives and property.



IMPORTANCE OF LITHOSPHERE

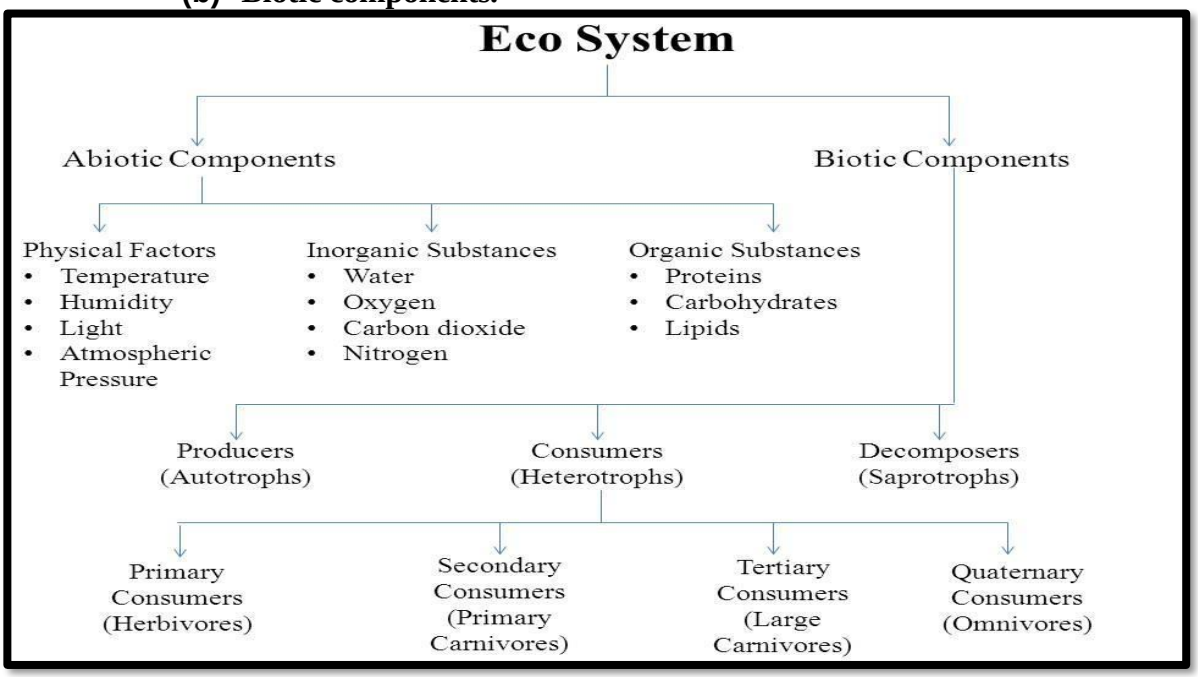
- Soil is medium of living for plants & animals.
- Plants obtain water & minerals from soil.
- The forest, grasslands and deserts over the earth are distributed on the basis of

the kinds of the soil.

- It is the source of minerals like silicate, copper, lead, gold, carbonate etc.
- It is also a source of fuels as coal and oil.
- Various landforms (mountains, plateaus, valleys, plains) are an important factor that determines the climate of an area.

4. BIOSPHERE

- It is the part of the earth in which all life forms exist. The organisms comprising the biosphere are mostly found in the relatively narrow zones of contact(interface) between the atmosphere, lithosphere and hydrosphere.
- Life is possible only in this layer.
- Plants and animals live on land, sea/water, and sea shores. Whereas they live, they interact with the non-living components of other three realms to form complex ecosystems.
- Thus, ecosystem comprises of the living(biotic) and non-living(abiotic) components.
- The two major components of the ecosystem:
  - **(a) Abiotic components**
  - **(b) Biotic components.**



IMPORTANCE OF BIOSPHERE

- Plants and animals provide food required for human metabolism.
- Provide food for all forms of life and form food chains in nature.

- Useful as a source of energy (biomass, fuel wood, organic matter etc.)
- Provide timber & other construction material.
- Forest resource is a source of food, medicines, honey, lac leather etc.)
- Forest regulates climate & rainfall.
- Forest purifies air.
- Forest prevents soil erosion.
- Forest provides habitat for plants, animals and microorganisms.

BIOGEOCHEMICAL CYCLES

"Biogeochemical cycles mainly refer to the movement of nutrients and other elements between biotic and abiotic factors."

The term biogeochemical is derived from "bio" meaning biosphere, "geo" meaning the geological components and "chemical" meaning the elements that move through a cycle.
The matter on Earth is conserved and present in the form of atoms. Since matter can neither be created nor destroyed, it is recycled in the earth's system in various forms.
The cycle starts by absorbing the chemical elements by the organisms and is returned to the air, water and soil through decomposition.
These cycles are largely energized by solar insolation.

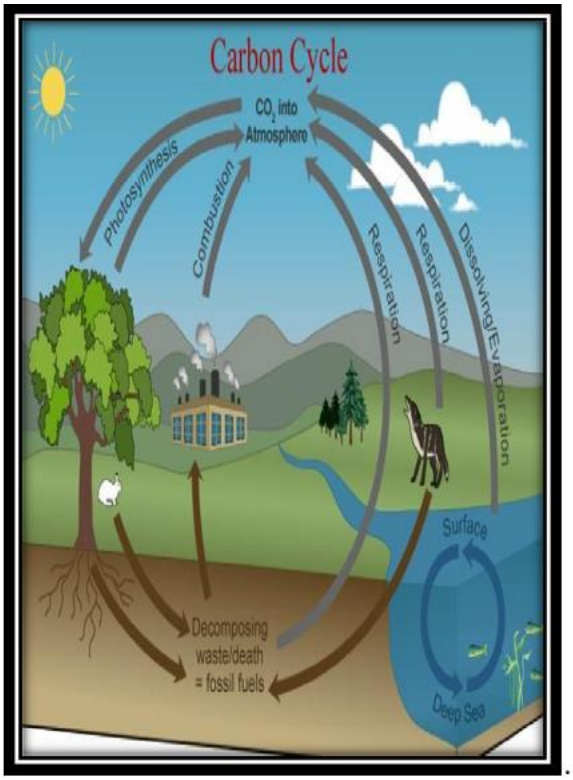
These biogeochemical cycles are:

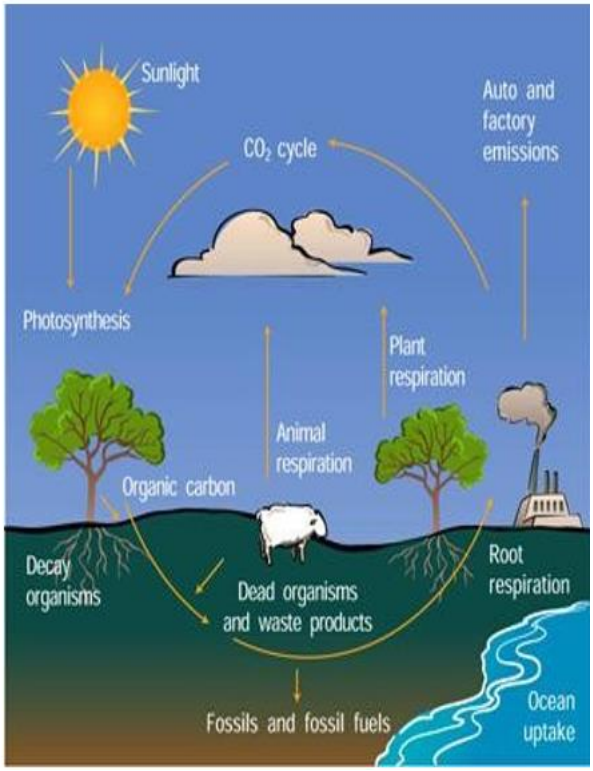
1. **Water cycle**
2. **Carbon cycle**
3. **Nitrogen cycle**
4. **Oxygen cycle**

1. CARBON CYCLE

The carbon found in organic compounds id indicated in both the abiotic and biotic parts of the ecosystem. Carbon is a building block of both plant and animal tissues. In the atmosphere, carbon occurs as carbon dioxide (CO_2). In the presence of sunlight, plants take up carbon dioxide from the atmosphere through their leaves. The plants combine carbon dioxide with water, which is absorbed by their roots from the soil. In the presence of sunlight, they are able to form carbohydrates that contain carbon. This process is known **photosynthesis**.
HERBIVORES feed on plant materials, which is used by them for energy and for their growth. Both plants and animals release carbon dioxide during respiration. When plants and

animals die, they return their carbon to the soil. These processes complete the carbon cycle.

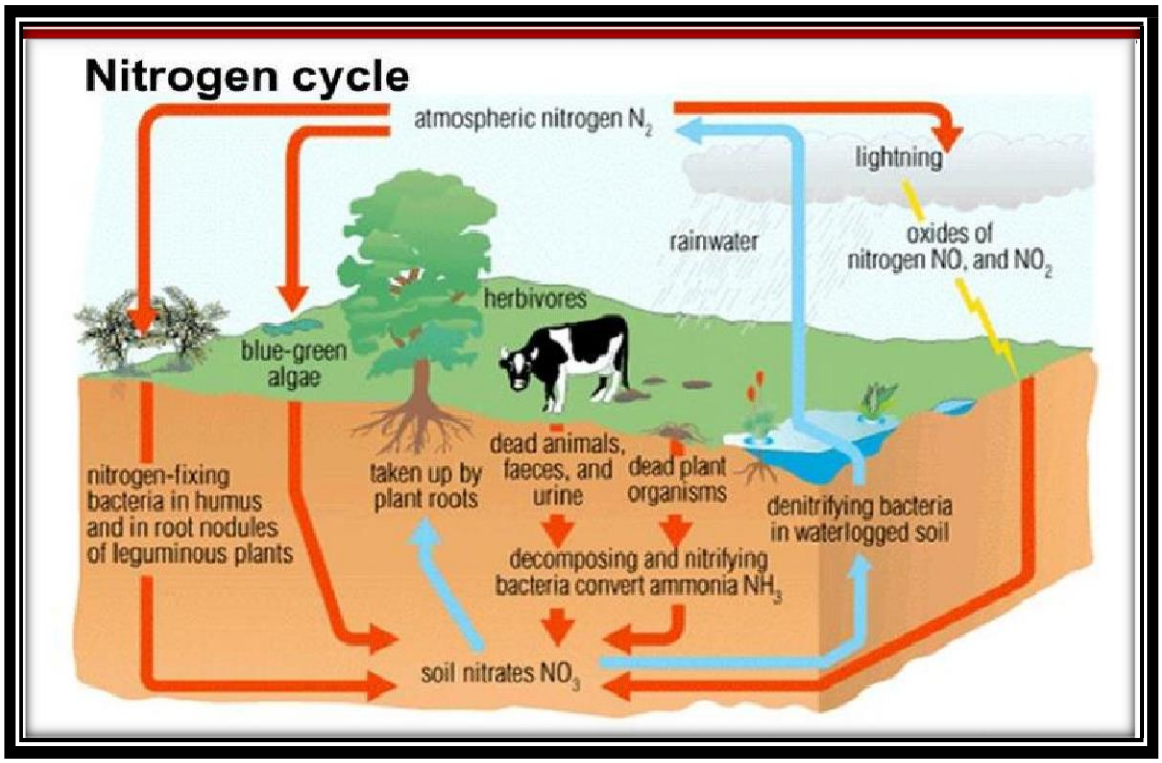




- Carbon enters into the living world in the form of carbon dioxide through the process of photosynthesis as carbohydrates.
- These organic compounds (food) are then passed from the producers to the consumers (herbivores & carnivores)
- This carbon finally returned back to the surrounding medium by the process of respiration or decomposition of dead bodies of plant and animals by decomposers.
- Carbon is also recycled during burning of fossil fuels.

2. NITROGEN CYCLE

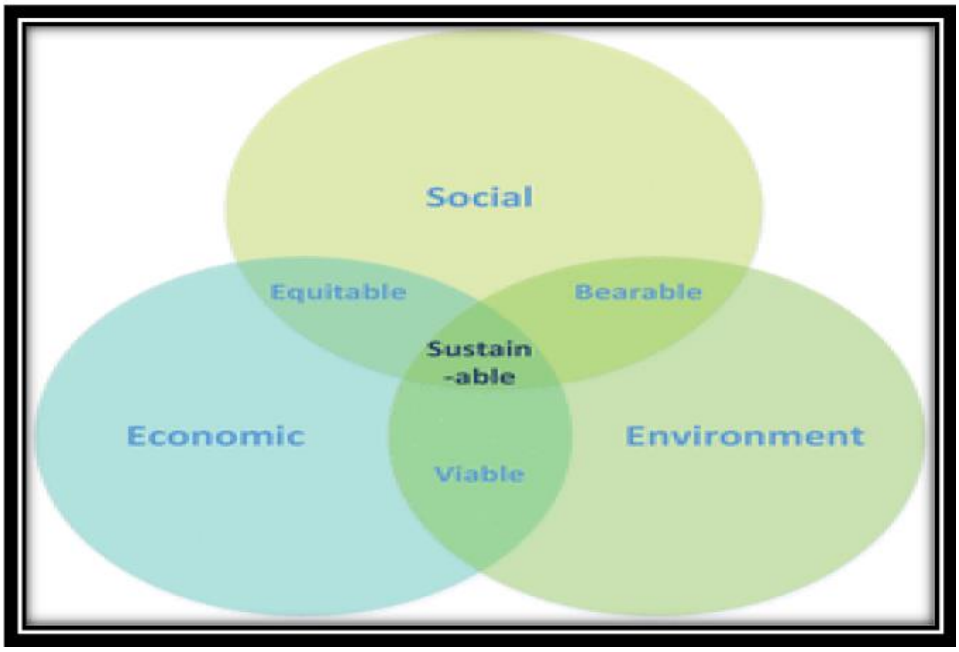
Carnivores feed on herbivores that, in turn, feed on plants. When animals defecate, this waste material is broken down by worms and insects, mostly battles and ants. These small "**soil animals**" break the waste materials into smaller bits on which microscopic bacteria and fungi.



- Nitrogen is present in the atmosphere in it elemental form and as such it cannot be utilized by living organism.
- This elemental form of nitrogen is converted into combined state with element like H, C, O by certain bacteria so that it can be readily used by plants.
- Nitrogen is continuously entering into the air by the action of microorganism like denitrifying bacteria and finally returned back to the cycle through action of lightening and electrification.

CONCEPT OF SUSTAINABILITY

The way in which sustainability is used nowadays is based on the English term "sustainability," which is an expression of the possibility of a certain matter to be supported. Sustainability is seen as a paradigm for thinking about the future in which environmental, societal, and economic considerations are balanced in the pursuit of an improved quality of life. The ideals and principles behind it lays on broad concepts such as intergenerational equity, gender equity, social tolerance, poverty alleviation, environmental preservation and restoration, natural resource conservation, and building just and peaceful societies. So to achieve true sustainability we need to balance economic, social and environmental sustainability factors in equal harmony. These may be defined as:

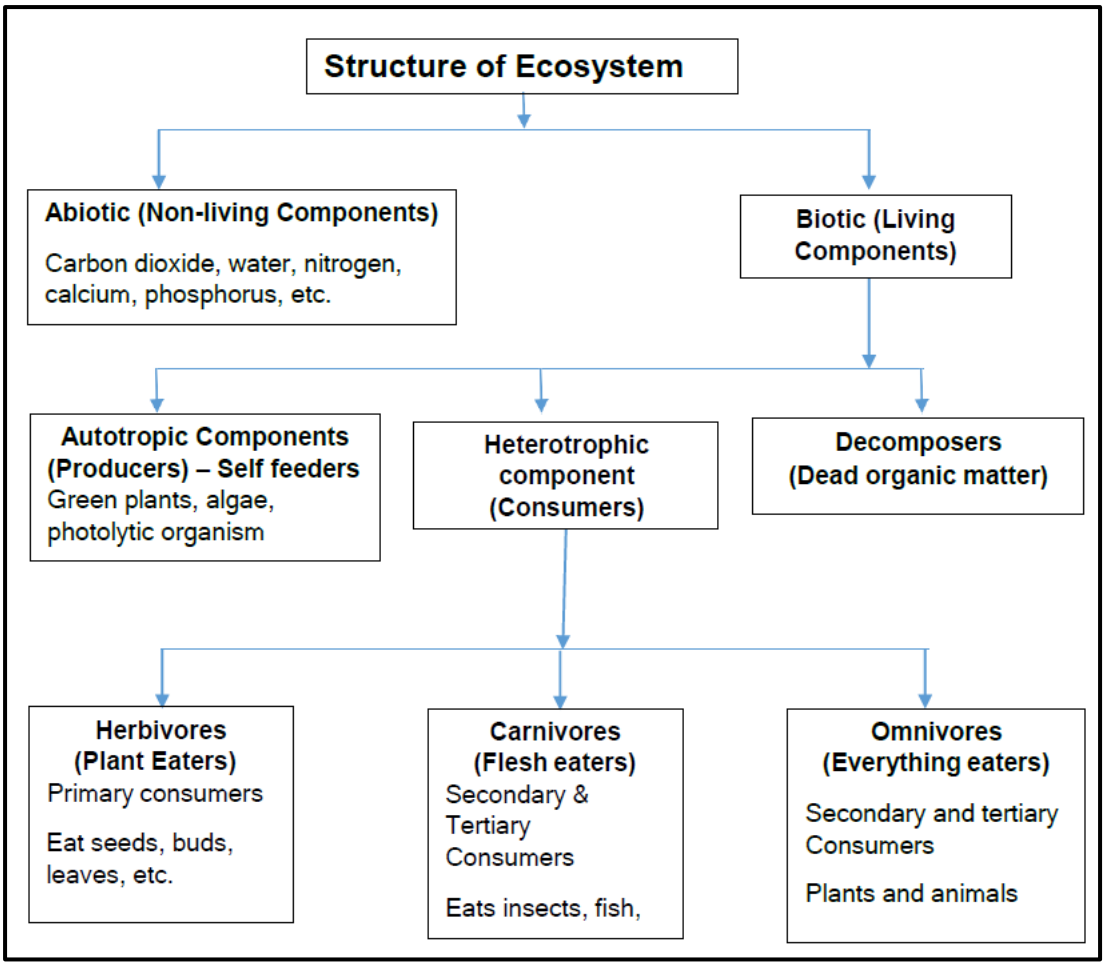


DEFINITION AND STRUCTURE OF ECOSYSTEM – ABIOTIC AND BIOTIC COMPONENTS (PRODUCERS, CONSUMERS AND DECOMPOSERS)

An „ecosystem" is a region with a specific and recognizable landscape form, such as a forest, grassland, desert, wetland or costal area. The nature of ecosystem is based on its geographical features like hills, mountains, plains, rivers, lakes, coastal areas or island. It is also controlled by climatic conditions the amount of sunlight, the temperature and the rainfall in the region. The geographical, climatic and soil characteristics form its non-living or abiotic component. These features create conditions that support a community of plants and animals that evolution has produced to live in these specific conditions. The living part of the ecosystem is referred to as its biotic component.

Ecosystem was defined in its presently accepted form by Eugene Odum as, "an unit that includes all the organisms, i.e., the community in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles, i.e., exchange of materials between living and non-living, within the system".

The living community of plants and animals in any area together with the non- living components of the environment – such as soil, air and water – constitute the ecosystem.



Abiotic Components:

Basic inorganic compounds of an organism, habitat or an area like carbon dioxide, water, nitrogen, calcium, phosphorus, etc. that are involved in the material cycles are collectively called as abiotic component. The amount of these inorganic substances present at any given time, in an ecosystem is called as the standing state or standing quality of an ecosystem.

Whereas, organic components e.g., proteins, amino acids, carbohydrates and lipids that are synthesized by the biotic counterpart of an ecosystem make the biochemical structure of the ecosystem. The physical environment, viz. climatic and weather conditions are also included in the abiotic structure of the ecosystem.

Biotic Components:

From the trophic (nutritional) point of view, an ecosystem has autotrophic (self-nourishing) and a heterotrophic (other nourishing) component:

(a) Autotrophic component (Producers):

This component is mainly constituted by the green plants, algae and all photosynthetic organisms. Chemosynthetic bacteria, photosynthetic bacteria, algae, grasses, mosses, shrubs,

herbs and trees manufacture food from simple inorganic substances by fixing energy and are therefore called as producers.

(b) Heterotrophic component (Consumers):

The members of this component cannot make their own food. They consume the matter built by the producers and are therefore called as consumers. They may be herbivores, carnivores or omnivores. Herbivores are called as primary consumers whereas carnivores and omnivores are called as secondary consumers. Collectively we can call them as macro-consumers.

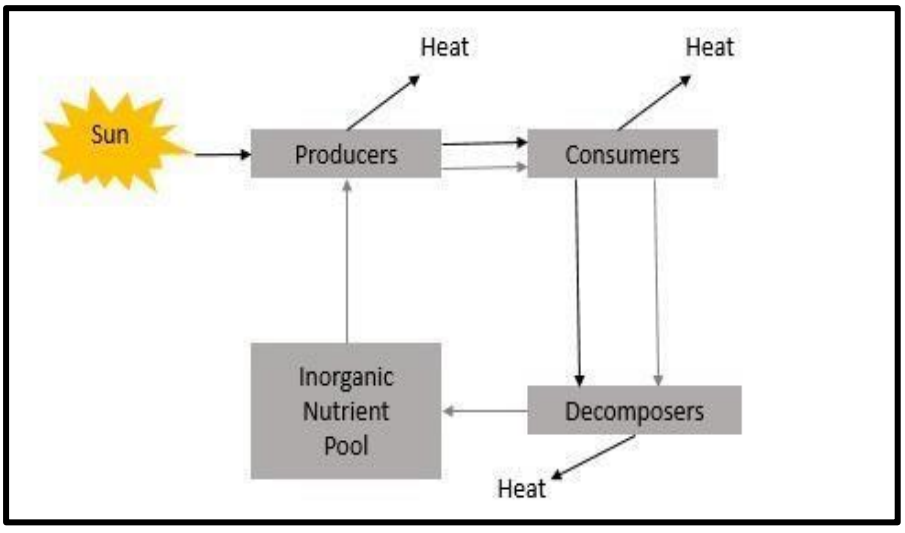
(c) Decomposers:

Heterotrophic organism chiefly bacteria and fungi that breakdown the complex compounds of dead protoplasm, absorb some of the products and release simple substances usable by the producers are called as decomposers or reducers. Collectively we call them as micro consumers.

FUNCTIONS OF ECOSYSTEM: ENERGY FLOW IN AN ECOSYSTEM, FOOD CHAINS, FOOD WEBS WITH EXAMPLES

ENERGY FLOW IN AN ECOSYSTEM

Energy moves life. The cycle of energy is based on the flow of energy through different trophic levels in an ecosystem. Our ecosystem is maintained by the cycling energy and nutrients obtained from different external sources. At the first trophic level, primary producers use solar energy to produce organic material through photosynthesis.



The herbivores at the second trophic level, use the plants as food which gives them energy. A large part of this energy is used up for the metabolic functions of these animals such as

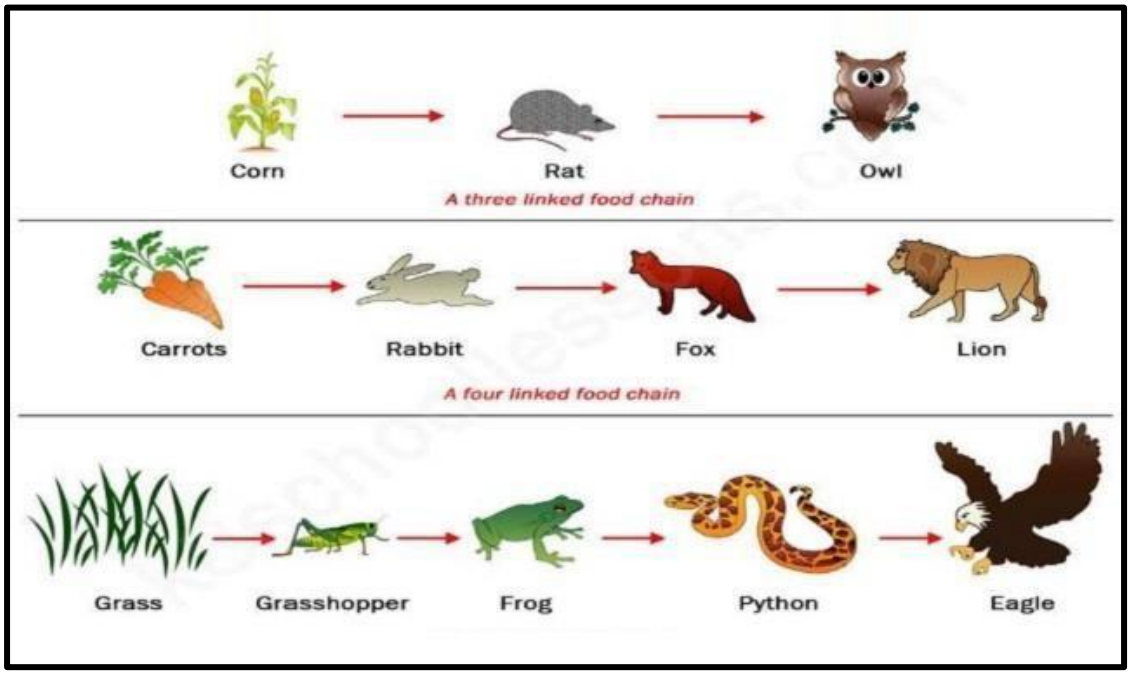
breathing, digesting food, supporting growth of tissues, maintaining blood circulation and body temperature.

The carnivores at the next trophic level, feed on the herbivores and derive energy for their sustenance and growth. If large predators are present, they represent still higher trophic level and they feed on carnivores to get energy. Thus, the different plants and animal species are linked to one another through food chains.

Decomposers which include bacteria, fungi, worms, and insects break down wastes and dead organisms, and return the nutrients to the soil, which is then taken up by the producers. Energy is not recycled during decomposition, but it is released.

FOOD CHAINS

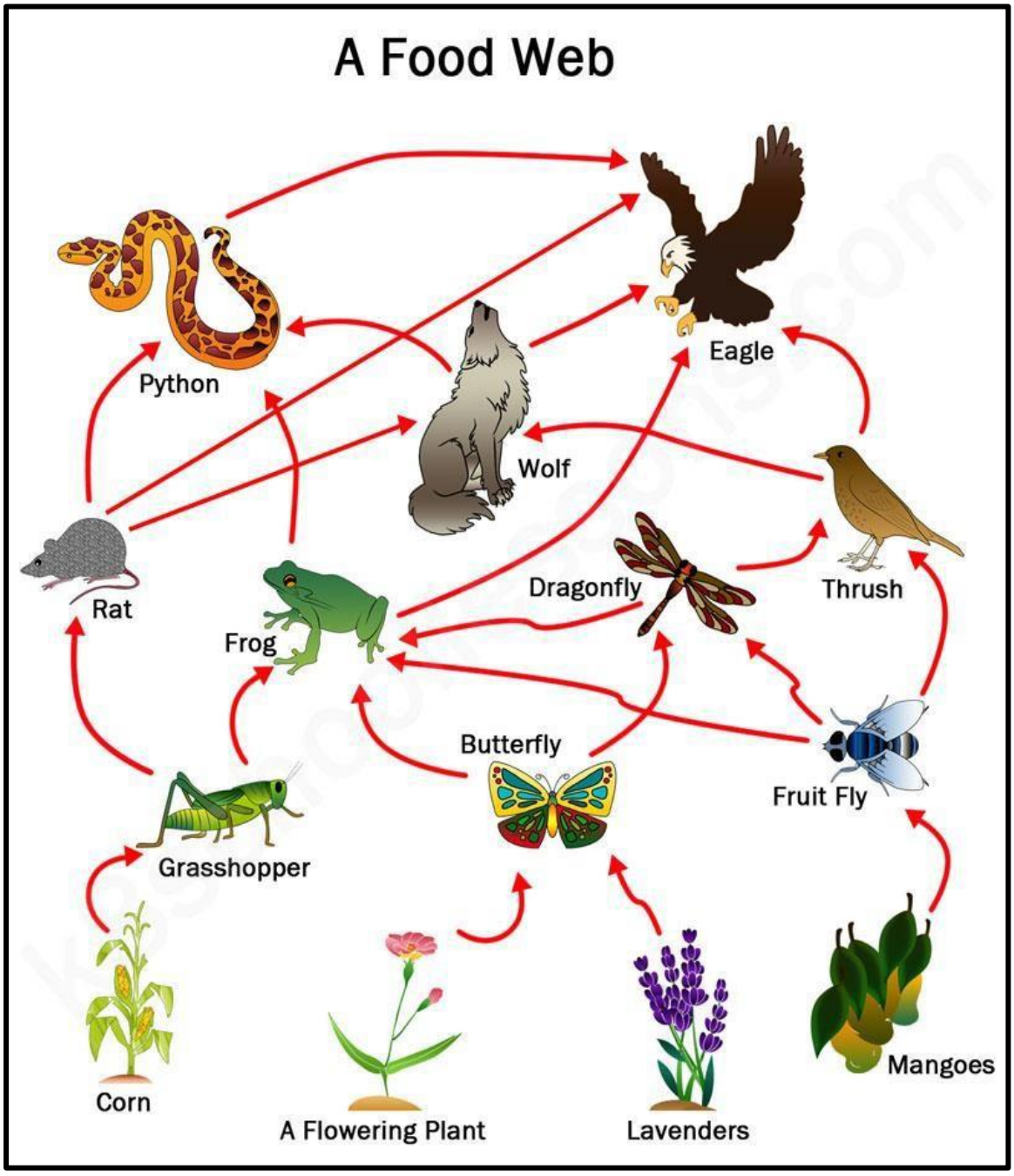
All ecosystems are made up of food chains that begin with energy – i.e., sunlight extracted from the physical environment and converted into organic matter by plants. Herbivores (Plant eating animals) synthesize a portion of the plant material in their bodies. The flesh of the herbivore provides nutrition and energy to the carnivore (flesh eating animals). Thus, energy is passed on from one organism to another step by step, thus establishing a link. These links together form a food chain.



FOOD WEBS

Food chain represents an isolated relationship between the producers and consumers. In reality or in the environment all elements are inter-related and inter-dependent and hence we find that the elements of different food chains are inter-related and inter-dependent on the elements of

other food chains. Such a set of integrated food chains or the combination of different food chains is called as food web.



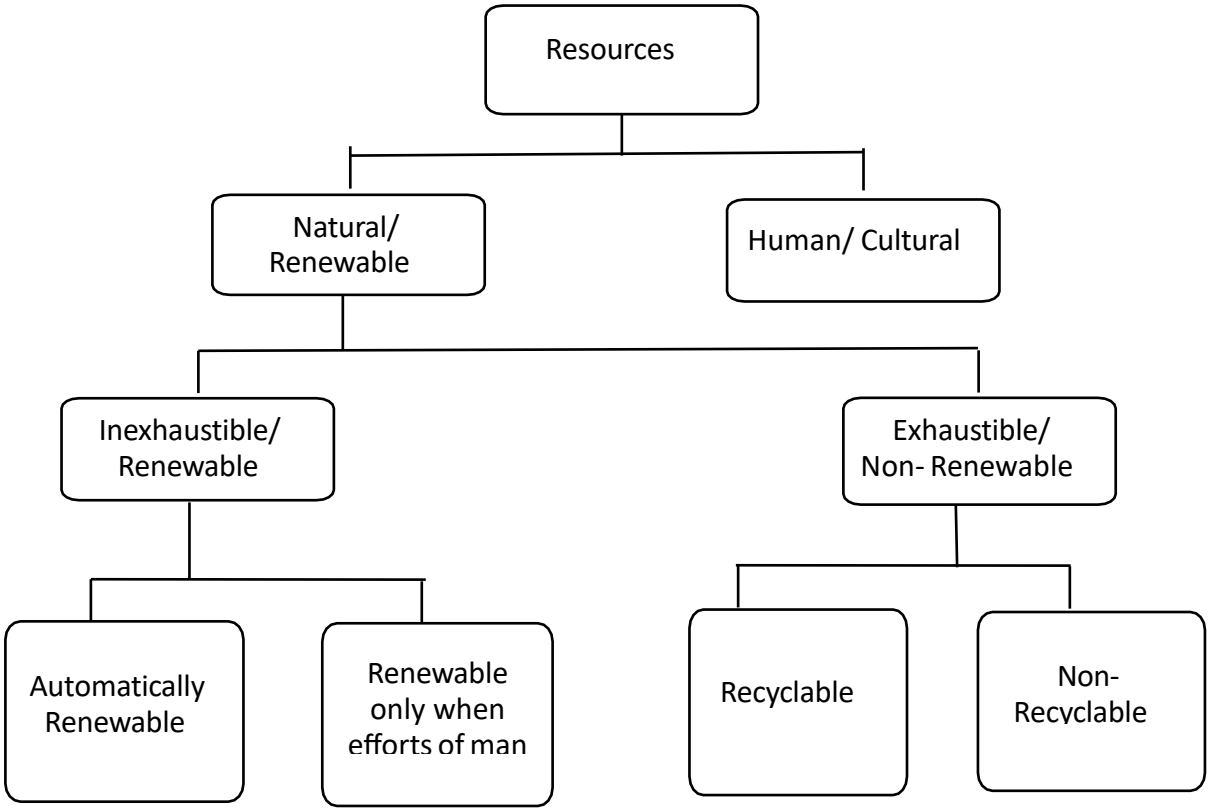
CLASSIFICATION RENEWABLE & NON-RENEWABLE RESOURCES AND TYPES

MEANING OF RESOURCES

A resource is means of supplying what is needed. Resources refer to the interaction between man and nature. So, in simple words a resource has been defined as mean of attaining given ends.

According to Cosmo Dictionary of Geography resource is A feature of the environment that is value to man in one form or another.

CLASSIFICATION



(A) Natural/ physical resources

The resources which are made available by nature are called as natural or physical resources. The natural resources are sunlight, water, air, minerals, soil, etc. the natural resources are inexhaustible and exhaustible.

1. **Inexhaustible/ flow resources:** The resources those get regenerated by reproduction or by physical, mechanical or chemical processes are known as inexhaustible resources or flow resources. E.g. sunlight, air, water, forest, etc.
   i. **Automatically Renewable:** It get recharged by various bio-geochemically processes of nature.
   ii. **Renewable with efforts of man:** Some of the resources get regenerated by efforts of man.
2. **Exhaustible/ fund resources:** many of the natural resources are limited. Once they are used reproduction is not possible, such resources are known as exhaustible/ fund resources. E.g. natural oil, iron, bauxite, etc.

i. **Recyclable:** Those resources whose reproduction is not possible, but the product can be recycled again and again. E.g. iron ore reproduction is not possible for man but produced iron and steel can be reused again and again.

ii. **Non-recyclable:** they are of one single use. Once they are used in production process they produce heat, ash or smoke. E.g. resources like coal, natural oil, natural gas, uranium, Sulphur, etc.

(B) Human/ cultural resources

Man plays a unique role in the overall scheme of resource development. He is both the producer as well as the consumer of the resources. As a resource producer he contributes his labor, mental and physical ability.

The larger the population and the better its quality, the greater would be the rate of economic growth. There would be many more workers, managers, technicians, risk takers, savers and investors. It is this sense that population is considered as resources, an asset and is called the manpower of a nation.

The term Human Resources is generally taken to mean the population of a country. But, strictly speaking, mere population cannot be considered human resources.

Renewable Resources	**Non- renewable Resources**
The Renewable resources are present in the atmosphere of the earth.	The Non-Renewable resources are typically found in the underground layers of the earth
The Renewable resources are replaced by nature itself in a very short period.	The Non-Renewable resources cannot be replaced by nature during the time of human life period.
The Renewable energy resources are plenty available and ample in nature.	The Non-Renewable resources are scarce resources and not available in an ample manner in nature.
The Renewable resources are obtained free of cost or at very less cost in nature.	The Non-Renewable resources are very costly and not easily available.

The Renewable resources do not affect the environment of the earth and don't cause any climate changes in the atmosphere.	The Non-Renewable resources seriously affect the environment and cause climate changes in the environment.
The Renewable resources are called as 'Clean and Green' energy sources because they don't produce harm to the environment.	The Non-Renewable resources release 'Green House' gasses into the atmosphere which leads to global warming.
The use of Renewable resources promotes the balance in the nature and natural habitat of the earth.	The use of Non-Renewable resources disrupts the balance in nature which is due to digging the earth to take out coal, minerals, fuels, etc.