

Concept of an Ecosystem:-

- The term 'ecosystem' was coined by A.G. Tansley an English Botanist, in 1953. An ecosystem is the structure and functional unit of ecology (nature) encompassing complex interaction between its biotic (living) and abiotic (non-living) components.

For example:- A pond is a good example of ecosystem. A pond, lake, desert, grassland, meadow forest etc are common examples of ecosystem.

- An ecosystem is a natural unit where living organism (plants, animals, microorganisms) interact with non-living components (air, water, soil, sunlight) in a particular area forming a balanced and self sustaining system.

In short:-

- ★ Ecosystem:- Biotic components + Abiotic components + their interaction.

Structure and function of an Ecosystem:-

The structure means the components that makeup the ecosystem and their arrangement.

It has two main part

1. Abiotic component (Non-living)
2. Biotic components (living)

ECOSYSTEM

Abiotic component

Climatic

- Rain
- light
- wind
- Temperature

Edaphic

Biotic component

Producers

Autotrophs

Consumers

Heterotrophs

Decomposers

Saprotrophs

Primary consumers

Secondary consumers

Tertiary consumers

Quaternary consumers

Herbivores

Primary carnivores

Large carnivores

Omnivores

Date _____
Page _____

Abiotic components

- (a) Climatic factors:- which include rain, temperature, light, wind, humidity etc.
- (b) Edaphic factors:- which include pH, soil topography, minerals etc.

★ The function of important factors in abiotic components are given below:-

- Soils are much more complex than simple sediments. Soils provide nutrients, water, a home, a structural growing medium for organisms.
- The atmosphere provides organisms found within ecosystem with carbon dioxide for photosynthesis and oxygen for respiration.
- Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism and the organisms' food for other forms of life.
- Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%.
- Water is the medium by which minerals, nutrients enter and are translocated in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reaction. Plants and animals receive their water from the earth's surface and soil. The original source of this water is precipitation from the atmosphere.

★ Biotic components:-

Biotic components refer to all living components in an ecosystem. Based on nutrition, biotic components can be categorised into autotrophs, autotrophs,

Date _____
Page _____

heterotrophs and saprotrophs (also decomposer)

→ Producers :-

Producers are usually green plants, which can synthesize their food themselves by making use of carbon-dioxide present in the air and the water in the presence of sunlight by involving chlorophyll, the green pigment present in the leaves through the process of photosynthesis. These are also known as photo autotrophs (auto-self, troph-food, photo-light)

→ There are some microorganisms also which can produce organic matter to some extent through oxidation of certain chemicals in the absence of sunlight. These are known as chemosynthesis organisms or chemo-autotrophs.

→ Consumers :-

All organisms which get their organic food by feeding on other organisms are called consumers. Consumers are further classified as

(1) Heterotrophs :-

They feed directly on producers and hence also known as primary consumers etc. rabbit etc.

(2) Carnivores :- They feed on other consumers. If they feed on herbivores they are called secondary consumers (eg frog) and if they feed on carnivores (snake, big fish, etc)

(3) Omnivores:- They feed on both plant and animals.
E.g. human, rat, fox, many birds.

(4) Detritivores:- They feed on the parts of dead organisms, wastes of living organisms, their cast-offs and particularly decomposed matters of e.g. beetles, termites, ants, crabs, earthworms etc.

• Decomposers:-

Decomposers derive their nutrient by breaking down the complex organic molecules to simpler organic compounds and ultimately into inorganic nutrients. Various bacteria and fungi are decomposers. The decomposers are known as saprotrophs.

★ The consumers are of four types mainly:-

a. Primary consumers or Herbivores

These are the animals which feed on plants or the producers. They are called her-bivores.
Ex - Rabbit, deer, goat, cattle etc.

b. Secondary consumers or primary consumers:-

The animals which feed on the herbivores are called the primary carnivores. Ex - cat, fox, snake etc.

c. Tertiary consumers or third order consumers

These are the large carnivores which feed on the secondary consumers. Ex - vulture.

d. Quaternary consumers or omnivores:-
These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Ex - lions, tigers

→ Function of Ecosystem:-

- Ecosystem are complex dynamic system. They perform certain functions. There are function of ecosystem.

(i) Productivity

(ii) Decomposition

(iii) Physical (energy flow)

(iv) Biological (food, chains, food web, ecological succession etc).

(v) Biogeochemical (nutrient cycling) process.

Food chain

→ It is a linear sequence of organisms where nutrients and energy are transferred from one organism to other. This occurs when one organism consumes another organism.

→ A food chain begin with producers, progresses through various levels of consumers and ends with decomposers.

→ Each level in a food chain is known as trophic level.

Types of food chain

There are two types of food chain:-

1) Grazing foodchain

2) Detritus foodchain

Grazing food chain:-

- The grazing food chain starts with green plants passes through herbivores and the carnivores.
- In a grazing food chain energy in the lowest trophic level is acquired from photosynthesis.
- Majority of ecosystem in the environment follow these types of food chain.

Detritus food chain:-

- The detritus food chain begins from dead organic materials as the primary source of energy.
- As the primary source of energy, the dead organic materials are decomposed by micro-organisms like algae, fungi, and bacteria etc into simpler compounds i.e detritus which are then consumed by detritivores.
- The primary consumers i.e detritivores are the food source of smaller carnivores which are in turn consumed by larger carnivores.
Ex - dead leaves → earth worm → Birds

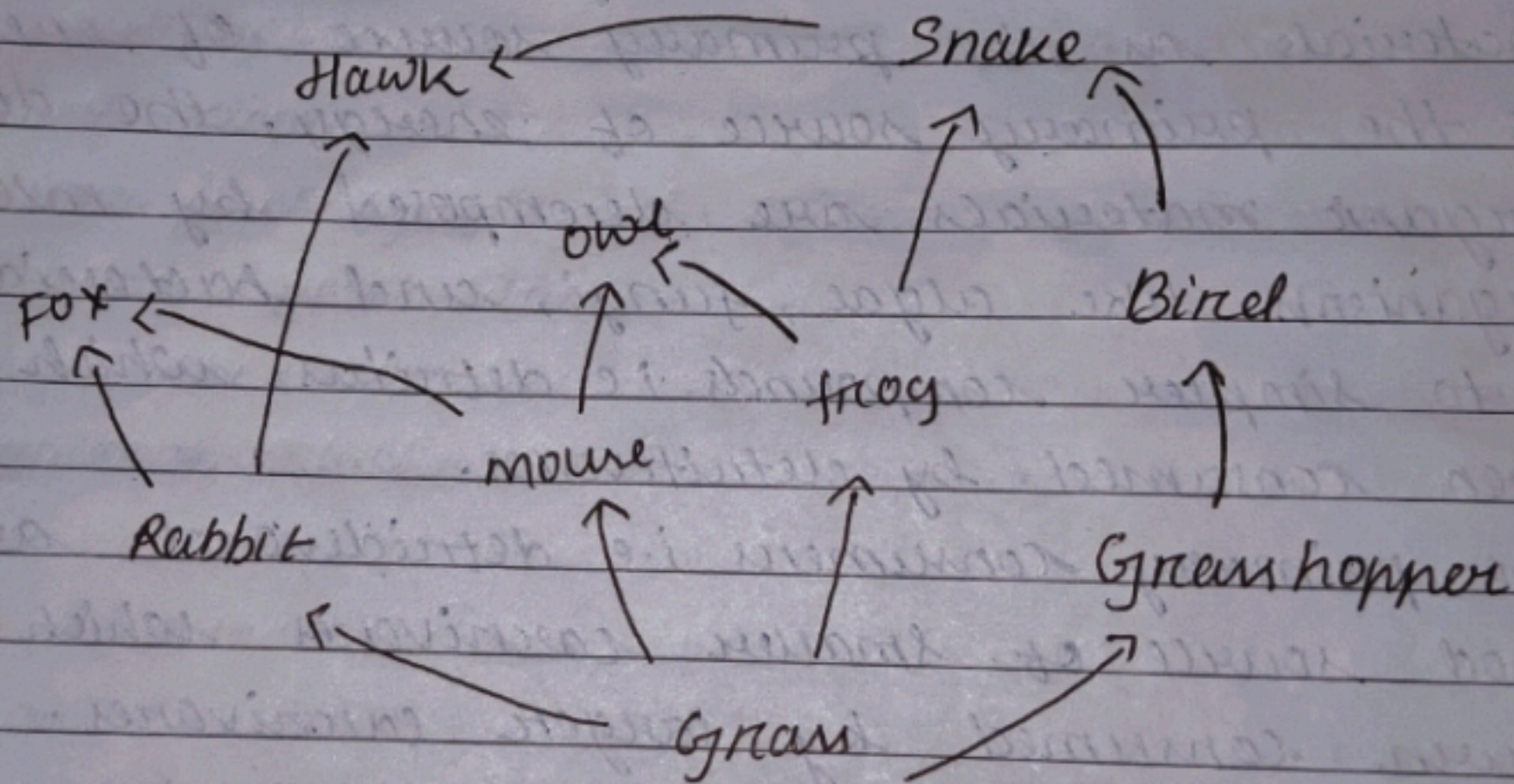
Characteristics of food chain:-

- A food chain involves transfer of energy between the living organisms of an ecosystem.
- In a food chain flow of energy is uni-directional.
- Usually there are three to four trophic levels in a food chain. In some cases there may be maximum of 5 trophic levels.

Food web

- Foodweb is a network of foodchain which are connected at various trophic level.
- In natural environment food chains don't operate in isolation because a single organism is consumed by many different consumers.
- Thus instead of straight line food chain, the relationship among organisms forms an inter-linking pattern called a food web.

Ex-



Food web

Characteristics of foodweb:-

- Each food web is formed by interlinking of food chains and is never straight line like a food chain.
- A food web provides alternative links of food availability.
- Availability of more alternatives in the food web makes the eco-system more stable.

Food chain

- It is a series of organisms is dependent on the next as source of food.
 - It consist of a linear path way showing the flow of energy.
 - It shows direct interaction bⁿ organisms in a linear manner.
 - It usually involves a shorter chain with fewer levels.
 - Removal of one organism as collapse the food chain.
 - It is less flexible
 - It is less stable.
- Ex - Grass → Rabbit → Fox

Food web

- It is a network of interconnected food chain.
 - It consist of multitude of network showing the flow of energy.
 - It shows complete interactions among various organisms.
 - It involves many levels of consumers.
 - Removal of one organism has less impact on the food web.
 - It is more flexible
 - It is more stable.
- Ex - Grass → Rabbit,
Grass → mouse,
mouse → snake,
Rabbit → fox.

Types of ecosystem

Ecosystem are of two types :-

- i) Natural ecosystem
- ii) Artificial ecosystem

Natural ecosystem

→ Natural ecosystem exist and operate in nature by themselves without any human support and interference.

Ex - ocean, lake, pond, forest

→ Natural ecosystem are divided into two types:-

i) Aquatic ecosystem

ii) Terrestrial ecosystem

Aquatic ecosystem

→ Organisms which survive in water are called aquatic organisms. These organisms are dependent on water for their food shelter, reproduction, and all other life activities.

→ An aquatic ecosystem includes a group of interacting organisms which are dependent on each other and their watery environment for nutrient and shelter. Aquatic ecosystems are further divided into two types:-

i) Fresh water

ii) Marine

Fresh water

→ Fresh water ecosystems includes lakes, ponds, rivers, streams etc. This covers only 0.8% of earth surface.

→ Fresh water ecosystems are again divided into two types.

i) lentic ecosystem

ii) lotic ecosystem

Lentic ecosystem

→ Lentic ecosystem refers to all standing water bodies.

Ex - lakes, ponds.

→ The word lentic is derived from Latin word lentus which means slow or motionless. These ecosystems are homes for many organisms like algae, snails, amphibians like frog, reptiles like alligators and other water snakes including both rooted and floating leaved plants.

Lotic ecosystem

→ Lotic ecosystems mainly refer to flowing water bodies which moves in a uni-directional way like rivers, streams etc.

→ The word lotic is derived from Latin words lotus which means washing.

→ These ecosystems are homes for numerous species of insects like beetles, mayflies, stoneflies and several species of fishes like eels. Apart from these aquatic species these ecosystems also include various mammals like river dolphins, manatees, otters.

Marine ecosystem

→ The term marine ecosystem encompasses the salty water of the earth and is also known as salt water ecosystem. Ex - Seas, oceans.

→ The marine ecosystems have alone salt contained and greater bio-diversity in comparison to the fresh water ecosystem. As the marine ecosystem is more concentrated with salts it makes difficult

for freshwater organisms to live in it. Similarly, the marine animals cannot survive in fresh waters.

Marine ecosystems are further divided into two types.

i) Ocean

ii) Coastal

→ Our planet earth is gifted with five major oceans :-

i) Indian Ocean

ii) Arctic Ocean

iii) Antarctic Ocean

iv) Atlantic Ocean

v) Pacific Ocean

→ Among these Pacific and Atlantic oceans are the largest and deepest.

→ Creatures of these ecosystems include sharks, small and large ocean fishes, turtles, blue whale, reptiles, marine mammals, and many species of ocean plants.

Coastal ecosystem

→ comprises of open systems of land and waters which are joined together to form the coastal ecosystem.

→ A wide variety of species of aquatic plants and algae are found at the bottom of the coastal ecosystem.

→ The fauna of these ecosystem mainly consists of crabs, fishes, insects, clibstones, snails etc.

Terrestrial ecosystem

- Terrestrial ecosystem is a natural and exclusively land based ecosystem.
- It comprises a community of organisms and their environment that occurs on the land masses of earth surface.
- Terrestrial ecosystems by the predominant presence of soil rather than water at the surface.
- There are different types of terrestrial ecosystem distributed around various geological zones. There are as follows:-
- Forest Ecosystem
- Grassland Ecosystem
- Tundra Ecosystem
- Desert Ecosystem

Forest Ecosystem

A forest ecosystem consists of various types of microorganisms, plants and animals and all these components live in coordination with each other. Forests help in maintaining the temperature of the earth and plays a major role in carbon sink. They are of great importance in maintaining the ecological balance.

Grassland Ecosystem

The grassland ecosystem is dominated by grasses and herbs. It occupies about 19% of the earth surface and usually occurs in the interior parts of the continent. Some of the examples of grassland ecosystems are Temperate grasslands and savanna grasslands.

Date _____
Page _____

Tundra Ecosystem

Tundra is known for large stretches of bare ground and soil. Tundra ecosystems are devoid of trees and is also known as for patchy mantle of low vegetation such as mosses, lichens, herbs and small shrubs. These ecosystems are found in cold climates or where rainfall is scarce. There are covered with snow for most of the year. The Arctic on mountains tops are the examples of tundra types ecosystem.

Desert Ecosystem

Deserts are found throughout the world and covers about 14.1% of the earth surface. These ecosystems are usually covered with cloudless sky and therefore, the sun radiation heats up the desert quickly, resulting in the highest air temperature on the earth. In contrast, nights are very cold as the temperature goes down fast due to loss of heat into the atmosphere through radiation. There are the regions with very little rainfall and thus produces sparse perennial vegetation of widely spaced shrubs.

Biogeochemical cycles

The living organisms require various chemical elements and their salts for supporting life.

The six major essentially required elements are carbon, hydrogen, oxygen, nitrogen, phosphorus & sulphur. These chemical elements tends to organisms in the biosphere in characteristic

from the physical environment to the organisms & back to the environment. These circular paths are known as Biogeochemical cycles. Thus biogeochemical cycles are the natural pathways by which essential elements of living matter are circulated. Such a cycle is so named because it involves living organisms, soil & earth's crust, and the chemical element in circulation. Some major bio-geochemical cycles are:-

1. Carbon cycle
2. Nitrogen cycle
3. Sulphur cycle
4. phosphorus cycle.

Carbon cycle

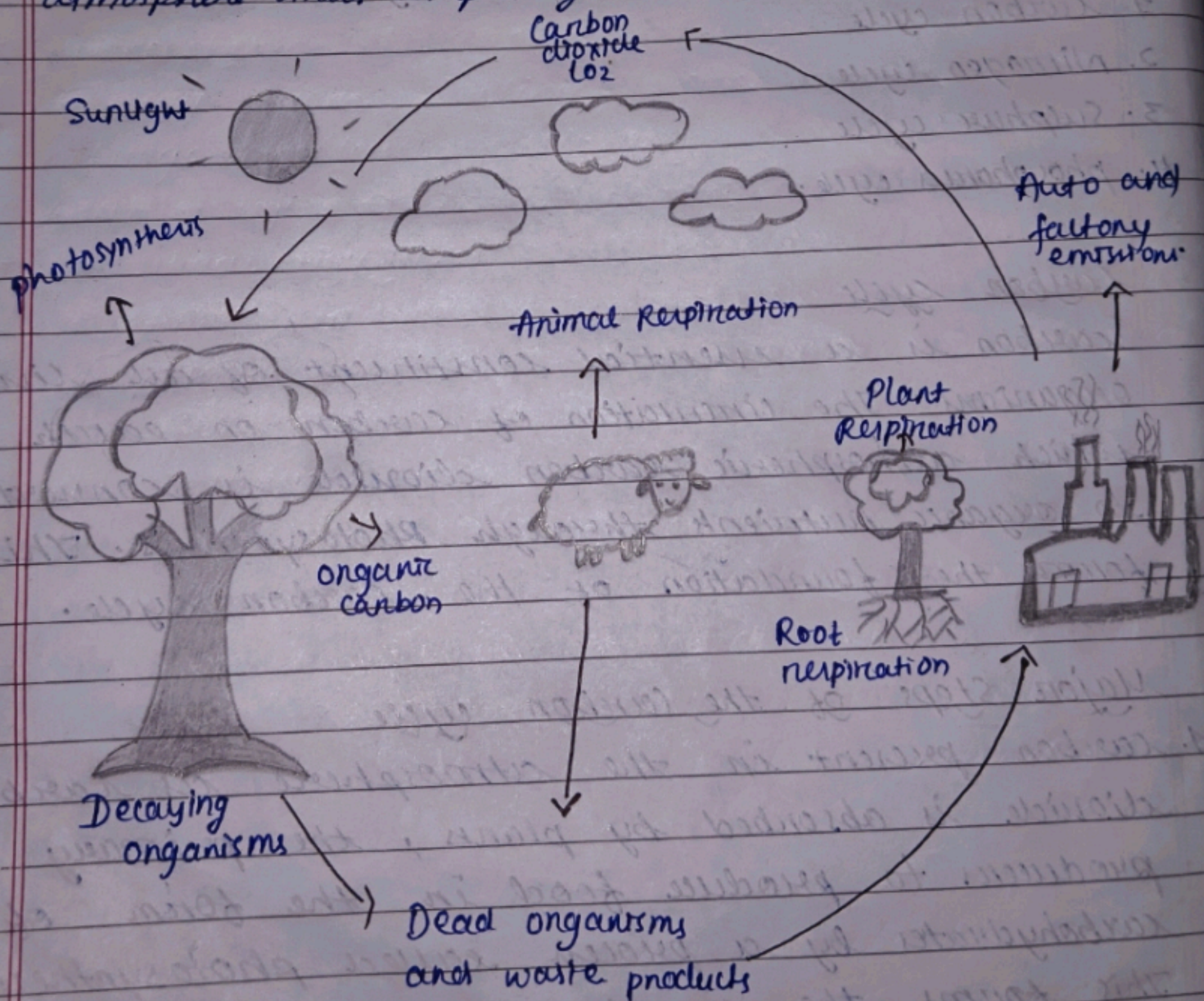
Carbon is an essential constituent of all living organisms. The circulation of carbon on earth in which atmospheric carbon dioxide is converted to organic nutrients through photosynthesis. This forms the foundation of the carbon cycle.

Major Steps of the carbon cycle

1. Carbon present in the atmosphere as carbon dioxide is absorbed by plants, the primary producers to produce food in the form of carbohydrates by a process called photosynthesis. This forms the foundation of the carbon cycle.
2. Plants are being eaten up by animals to meet their energy requirements and thus carbon gets accumulated into their bodies in the form of organic carbon.

3. Respiration by animals release carbon dioxide back to the atmosphere.

- 4) When the plants and animals die, the organic carbon is released back into the atmosphere as carbon dioxide gas through decomposition by the microorganisms.
- 5) The carbon that is left over in the body of the dead organisms that after decay become fossil fuels over many years, which on combustion releases the carbon stored in them back to the atmosphere thus completing the cycle.



CARBON CYCLE

Importance of carbon cycle

- carbon cycle is important to maintain the balance of carbon in nature.
- Since the rate of photosynthesis by the producers is determined by atmospheric carbon dioxide, the carbon cycle helps to sustain life on earth.
- If the carbon cycle is disturbed, it will result in serious consequences like climatic changes and global warming.

Nitrogen cycle

- Nitrogen is the most abundant elements in earth's atmosphere and approximately 78% of the atmosphere is oxygen but it is all-usable to the plants and animals unless it is converted into nitrogen compounds.
- The nitrogen cycle is a Biogeochemical process where nitrogen moves from the atmosphere to the soil and living organisms eventually returning to the atmosphere.

Different stages of nitrogen cycle

There are 5 stages of nitrogen cycle:

- i) Nitrogen fixation
- ii) Nitrification
- iii) Nitrogen assimilation
- iv) Ammonification

v) Denitrification

Nitrogen fixation (converting atmospheric nitrogen to ammonia)
The process of converting atmospheric nitrogen to biologically available nitrogen is called nitrogen fixation. It occurs by the following way.

→ Biological fixation

Most nitrogen fixation is performed by symbiotic bacteria on the roots of legumes and other plants.

→ Atmospheric fixation

Energy from lightning can break the nitrogen molecules allowing them to combine with oxygen to form nitrogen oxides.

→ Industrial fixation

Nitrogen can also be fixed through the industrial processes that manufacture fertilizers.

2) Nitrification (oxidation of ammonia to nitrate)

It is a two step process where specific bacteria convert ammonia into nitrates, the form most easily absorbed by the plants.

i) Ammonia is converted into nitrites NO_2^-

ii) Nitrites are then converted into nitrates.

3) Nitrogen assimilation

In this process plants absorb nitrates and ammonia from the soil through their roots and use them to synthesize amino acids, proteins, DNA and other organic molecules.

Nitrogen is transferred to the food chain

when animals consume plants or other

4) Ammonification (Decomposition of organic matter into ammonia)
When organisms die decomposers breakdown the organic nitrogen and convert it back to ammonia.

5) Denitrification (Return of nitrates to nitrogen)
In the fifth stage of nitrogen gas cycle denitrifying bacteria convert nitrates back into nitrogen gas which is then released then into the atmosphere completing the cycle. Nitrogen cycle maintains the flow of this essential element making it available for living organisms and supporting the entire food web.

Sulphur cycle

Sulphur cycle is the circulation of sulphur between earth's lithosphere, hydrosphere, atmosphere and biosphere. The sulphur cycle involves the following steps: -

- In atmosphere sulphur is found in the form of sulphur dioxide and enters in three ways from:
- i) Decomposition of organic molecules.
 - ii) volcanic and geothermal vents.
 - iii) Burning of fossil fuels.

→ Sulphur enters the ocean via run off from land, atmospheric fall out and from under water geothermal vent.

→ Sulphur is deposited on land in four major ways namely precipitation, direct fall out from the atmosphere, rock weathering and geothermal

- In atmosphere sulphur comes in contact with the air and is converted into sulphates.
- These sulphates are consumed by plants and microbes and are converted into organic form.
- Organic forms of sulphur is then consumed by animals and thus sulphur makes in the food chain.
- When animals die some of the sulphur is released to the atmosphere by decomposition and thus sulphur cycle completed.

Sulphur ~~also~~ in plants helps to form insect and enzymes and assists in the formation of plant proteins. Sulphur also helps to make the cell rigid and strong that are in hair, nails and skin. Fertilizers pesticides etc are the primary source of sulphate.

Phosphorus cycle

→ phosphorus cycle is the movement of the essential nutrient phosphorus through rocks, soil, water and living organisms.

→ Since phosphorus and its compounds are present only on land, atmosphere plays no significant role in the phosphorus cycle.

→ phosphorus cycle is vital for life as it is a key component of DNA, RNA, ATP, phospholipids. It is a very slow process and involves following steps.

i) weathering:-

phosphorus primarily in the form of phosphate compound is stored in rocks over long period. weathering process gradually breakdown this rock. P release in phosphates into the soil in water.

ii) Absorption by plants:-

Plants and other micro-organisms absorb these phosphate salts from soil or water and grow.

iii) Transfer to animals:-

Animals obtain phosphorus by consuming plants or other animals.

iv) Return to the environment:-

When plants and animals die the micro-organisms decompose the organic form of phosphate, into inorganic form and return it back to the environment via soil and water.

Global Warming

- Global warming refers to the gradual increase in temperature near earth's surface.
- It is the result of various factors like ozone depletion, increase in green house gases, deforestation etc.
- Green house gases such as CO_2 , methane, chloro-flouro carbons (CFC) and nitrous oxide have been identified as major factors of global warming.
- The green house gases are emitted from industrial establishments, domestic appliances etc. and these gases are concentrated in the lower part of the atmosphere.
- For the last 40 years we have seen the global annual temperature rise by 0.18°C per decade. Now the scientists have concluded that we must limit the global warming to 1.5°C by 2040.
- If unchecked it could result in adverse effects like extreme drought, wildlife, flood, changes in rainfall patterns, melting of ice caps and glaciers and submergence of coastal areas.
- Therefore, there is an urgent necessity of reducing our consumption of fossil fuels.

Ozone Depletion

- Ozone is a triatomic molecule made up of three atoms of oxygen.
- Ozone layer is mostly concentrated in the stratosphere which is about 16 to 40 km from the sea level.

- Date _____
Page _____
- The rich zone of ozone in the stratosphere is called ozone layer or ozonosphere.
 - The ozone layer is considered as a protective shield and earth umbrella because it prevents high energy UV radiations from reaching the earth's surface.
 - The thinning of ozone layer is called ozone depletion.
 - The ozone depleting substances are chlorofluoro carbons, methane, nitrous oxide, carbon tetrachloride and chlorine. which are responsible for depletion of ozone layer in the stratosphere. Out of these chloro-fluoro carbons are the principle ozone depleting substances which are widely used in fire-extinguishers, air conditioners, aerosol sprayers and as propellants.
 - These harmful chemicals produce active chlorine in presence of UV-radiations and destroy the ozone by converting it into oxygen. Due to this the ozone layer in the stratosphere becomes thinner.
 - The thinning of ozone layer allows more UV radiations to pass through and strike the earth which causes harmful effects on man, animals and plants like skin cancer, cataract in eyes, lowering of immune system and global warming.

- Date _____
Page _____
- The rich zone of ozone in the stratosphere is called ozone layer or ozonosphere.
 - The ozone layer is considered as a protective shield and earth umbrella because it prevents high energy UV radiations from reaching the earth's surface.
 - The thinning of ozone layer is called ozone depletion.
 - The ozone depleting substances are chlorofluoro carbons, methane, nitrous oxide, carbon tetrachloride and chlorine. which are responsible for depletion of ozone layer in the stratosphere. Out of these chloro-fluoro carbons are the principle ozone depleting substances which are widely used in fire-extinguishers, air conditioners, aerosol sprayers and as propellants.
 - These harmful chemicals produce active chlorine in presence of UV-radiations and destroy the ozone by converting it into oxygen. Due to this the ozone layer in the stratosphere becomes thinner.
 - The thinning of ozone layer allows more UV radiations to pass through and strike the earth which causes harmful effects on man, animals and plants like skin cancer, cataract in eyes, lowering of immune system and global warming.

Written by Rajashree Sahoo,
Guest faculty Math and Science Dept.