

2. Ecology & Ecosystem

VISION

PAGE NO.

DATE: / /

1. Define ecology & explain scope of ecology.
→ Ecology is the study of the interrelationship b/w living organisms and their physical and their physical environment on biological environment.
- Ecology helps us to tackle following problems:
 - 1) Ecology helps us to tackle problems of pollution of air, water, land, erosion, floods, famine variation in seasonal patterns, green house effect ozone layer depletion, ice melting at poles etc.
- 2) Ecological studies are necessary in maintaining ecological balance and understanding different cycles like Nitrogen, Carbon, Oxygen, Water etc.
- 3) It helps in protecting flora and fauna.
- 4) Helps in finding out the productivity of the area.
- 5) By proper and deep study of ecology we can maintain balance in nature and can prevent many ecological disasters.
- 6) Ecology plays an important role in human welfare, in agriculture, management of grasslands, farosry, biological survey, pest control and in conservation of wildlife.

2. Give classification of ecology.

- Ecology may be divided into:
- 1) Autecology and 2) Symbiology
- Autecology :- It deals with study of individual organism or many individual species. In other words, it is the study of interrelationship between individual species.

LDRP-ITR

→ **Synecology :-** It deals with study of group of organism or species which are associated together as a unit. It is concerned with structure, nature, development and causes of distribution of forest.

⇒ Further subdivision of ecology is based on following:-

1) Based on Taxonomic affinities :-
According to this, ecology is divided into two parts - plant ecology and animal ecology.

2) Based on habitats :-

Ecology

Aquatic Ecology

- Marine ecology
- Fresh water ecology
- Stream ecology

Terrestrial Ecology

- Grass land
- Forest
- Desert.

3) Based on level of organization :- Depending upon the level of organism, synecology can be divided into

- | | |
|-----------------------|----------------------|
| 1) Productive ecology | 5) Microbial ecology |
| 2) Population ecology | 6) Radiation ecology |
| 3) Community ecology | 7) Pollution ecology |
| 4) Ecosystem ecology | 8) Space ecology |

3. Explain components of ecosystem.
- These are mainly two components of ecosystem.
- 1) Abiotic components
 - 2) Biotic components
- ⇒ Abiotic components :- The non-living factors or the physical environment prevailing in an ecosystem from the abiotic components.
- They mainly include :-
- a) Physical factors which include climatic factors like sun, temperature, light, wind, humidity etc. and Ecological factors like soil, pH, topography etc.
 - b) Inorganic substance like water, minerals, gases which are required for synthesis of organic substance and are called biogenetic substance.
 - c) Organic substances like carbohydrates, proteins, lipids and humic substance that link the abiotic components with the biotic components.
- ⇒ Biotic components :- The living organisms including plants, animals and microorganisms that are present in an ecosystem are included in biotic components.
4. Define ecological pyramid and relationship to cone structure
- 1) Pyramids of numbers : It represents the number of individual organisms at each trophic level of food chain per unit area at any time.

- Pyramids of numbers can be either upright or inverted, depending upon the type of ecosystem and food chain as shown.
 - In grassland ecosystem and aquatic ecosystem, pyramid is always upright but in case of parasitic food chain, the pyramid is always inverted.
 - The upright or inverted depends on the number of producers, consumers and carnivores.
- 2) Pyramids of biomass :- It is based upon the total biomass at each trophic level in the food chain. The pyramid of biomass can also be inverted or upright.
- The pyramid of biomass in a forest ecosystem is upright in contrast to its pyramid of numbers. This is because the producers accumulates a huge biomass while the consumers total biomass decreases at higher trophic levels.
 - The pond ecosystem shows an inverted pyramid of biomass. The biomass of producers is much less compared to herbivores. This pyramid takes an inverted shape.
- 3) Pyramid of Energy :- The amount of energy present in each trophic level is considered for this type of pyramid. Pyramid of energy gives the best representation of the trophic relationships and it is always upright.

- At each successive trophic level, there is a loss of about 90% of energy in the form of heat, respiration etc. Thus at each next higher level only 10% of energy passed on.
- Hence there is a sharp decline in energy level of each successive trophic level as we move from producers to top carnivores. It is based on productivity instead of standing crop.

5. Explain energy flow in ecosystem.

- To maintain life energy is required. Energy enters in any ecosystem from solar radiation. In earth's atmosphere about 25×10^2 cal/m²/year of solar energy is present.
- Out of which only 47% of energy reaches the earth's surface and only 1 to 5% of energy reaching the ground is converted into chemical energy by green plants.
- The plants make the use of raw materials from the environment in the form of water salts and CO₂ to prepare starch with the help of energy from sunlight.
- Thus, energy from the sun enters the living world through photosynthetic organisms and passes on from one organism to another in form of food.
- The flow of energy is unidirectional and non cyclic. Energy enters the ecosystem from solar radiation and is converted to chemical form by producers and passes to lower trophic level to higher one.

- This one way flow of energy is governed by laws of thermodynamics which state that Energy is neither created nor destroyed but may be transferred from one to another.
- b) During energy transfer there is degradation of energy from a concentrated form to a dispersed form
- No energy transformation is 100% efficient; it is always accompanied by some dispersion or loss of energy in the form of heat. Heat energy is not utilized by biological system and ultimately lost from the body.
- Therefore, biological system including ecosystem must be supplied with energy on a continuous basis. It also indicates that shorter the food chain, greater would be the available food energy and with an increase in the length of the food chain there is corresponding increase in loss of energy.

6. Write a note on symbiotic relationship.

- Symbiosis is a biological relationship in which two species live in close proximity to each other and interact regularly in such a way to benefit one or both of organisms.
- There are 2 types of symbiosis :-

- ↳ Mutualism :- When both parameters benefit, this type of symbiosis is known as mutualism.
- ↳ Parasitism :- When only one of the parameters benefits, this type of symbiosis is known as parasitism and a parasite is an organism that obtains nourishment or other life support from a host, usually without killing it by their nature, parasites are never beneficial and sometimes they can be deadly.
- Commensalism : The type of symbiosis in which only one of the two organisms or species derives benefit is known as commensalism.
- In this case it manages to do so without causing harm to the host while in parasitism, usually the parasite causes damage to the host.

- 7 Explain food chain and food web in detail.
- In food chain each organism eats the smaller organism and is eaten by the larger one. All those organisms which are interlinked with each other through food constitute the ecosystem.
- The different levels in a food chain are called trophic levels each food chain has 3 main trophic levels
- 1) Producer level
 - 2) Consumer level
 - 3) Decomposer level.

→ If any of the intermediate stage of food chain is removed, the succeeding links of food chain will be affected.

→ Sunlight → Producers → Primary → Secondary → Tertiary → Quaternary
 consumers

Grass → Rabbit → Fox → Wolf → Tiger → Decomposers

→ Forest Ecosystem :-

Plant → Deer / Goat → Lion / Tiger

→ Pond Ecosystem :-

Phytoplantation → Zooplankton → Small fish → Big fish → Crocodile

→ It is estimated that only 10% of potential energy of previous trophic level is made available to the next trophic level.

→ Food web :- Various food chains are often interlinked at different trophic levels to form a complex interaction between different species from the point of view of food. This network like interaction is called web.

→ The food web provides more than one alternatives of food to most of the organisms in an ecosystem and therefore increases their chances of survival.

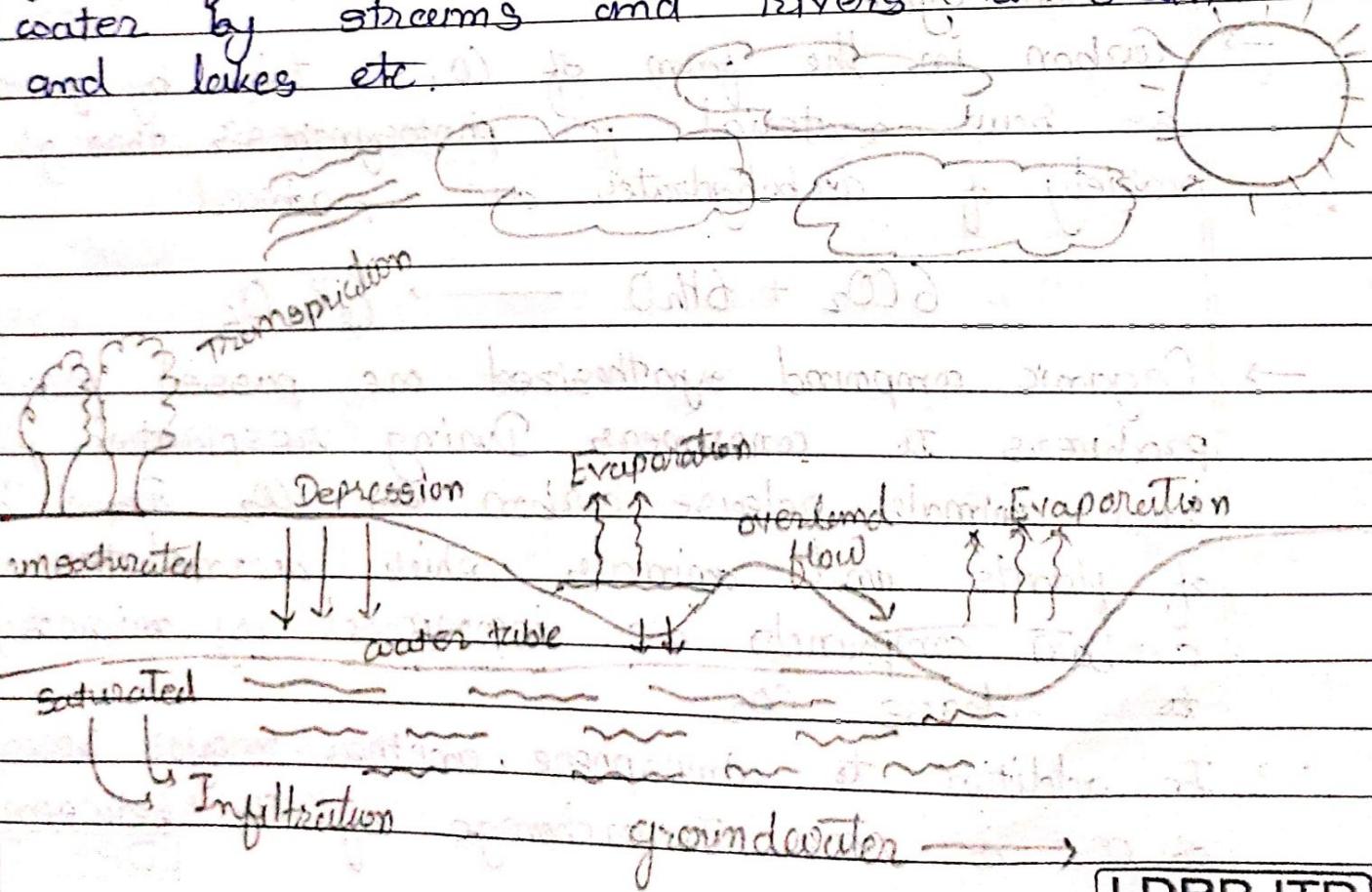
→ Charles B' Elton a British ecologist however concluded that the no. of links a chain rarely exceeds five because in the process of energy transfer

LDRP-ITR

there is always loss of energy.
 → It is the energy transfer mechanism which determines the no. of links in a food chain. Man and many other animals who are omnivores occupy different trophic levels in food chains in relation to pure carnivores.

8. Explain 1) Hydrological cycle 2) Carbon cycle 3) Nitrogen cycle 4) Sulphur cycle 5) Phosphorous cycle in detail with sketch.

- Except for the deep groundwater, total water supply of earth is in constant circulation from earth to atmosphere and back to earth.
- Hydrologic cycle is the process of transfer of moisture from atmosphere to the earth in the form of precipitation convergence of the precipitation water by streams and rivers to ocean and lakes etc.

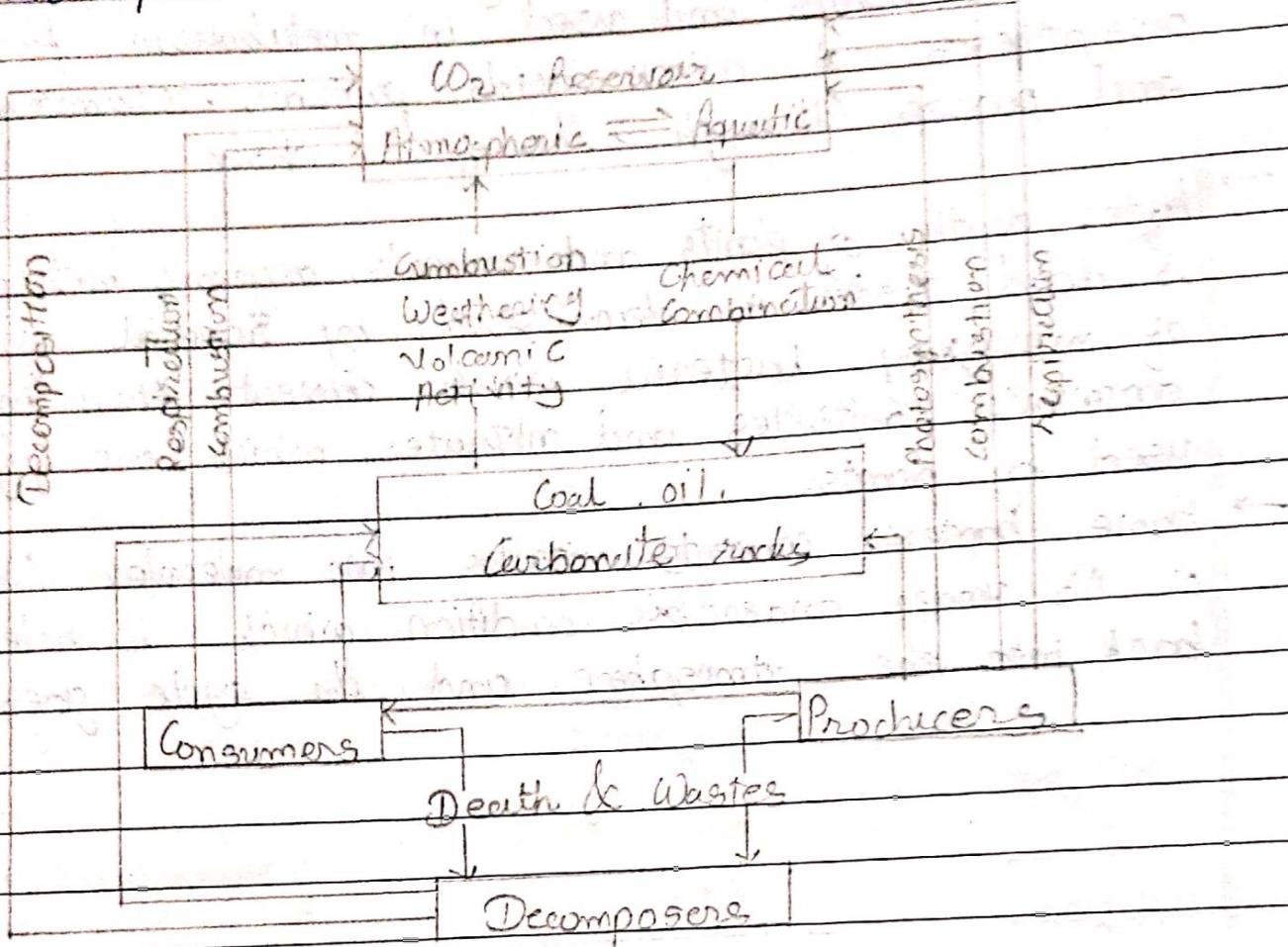


- The water from the surfaces sources like lakes, ocean etc. gets converted into vapour by evaporation due to solar heat. The vapour condenses in a large amount in atmosphere due to fall of temperature and pressure. So clouds are formed.
 - These clouds cause precipitation, some of the vapour is converted to ice at the peak of mountains. The ice melts in summer and flows as rivers to meet sea or ocean.
 - These processes of evaporation, precipitation and melting of ice, transpiration go on continuously. The hydrologic cycle may be expressed by the following equation:
- $$\text{Precipitation} = \text{Run off} + \text{Evaporation}$$

2) Carbon Cycle :-

- Carbon in the form of CO_2 is taken by green plants as raw material for photosynthesis, through which variety of carbohydrates are produced.
- $$6\text{CO}_2 + 6\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6$$
- Organic compound synthesized are passed from producers to consumers. During respiration, plants and animals release carbon as CO_2 . Dead bodies of plants and animals which accumulates carbon compounds are decomposed by microorganisms to release CO_2 .
 - In addition to atmosphere, another major reservoir of CO_2 is ocean. Interchange of CO_2 between

atmosphere and ocean takes place through diffusion.



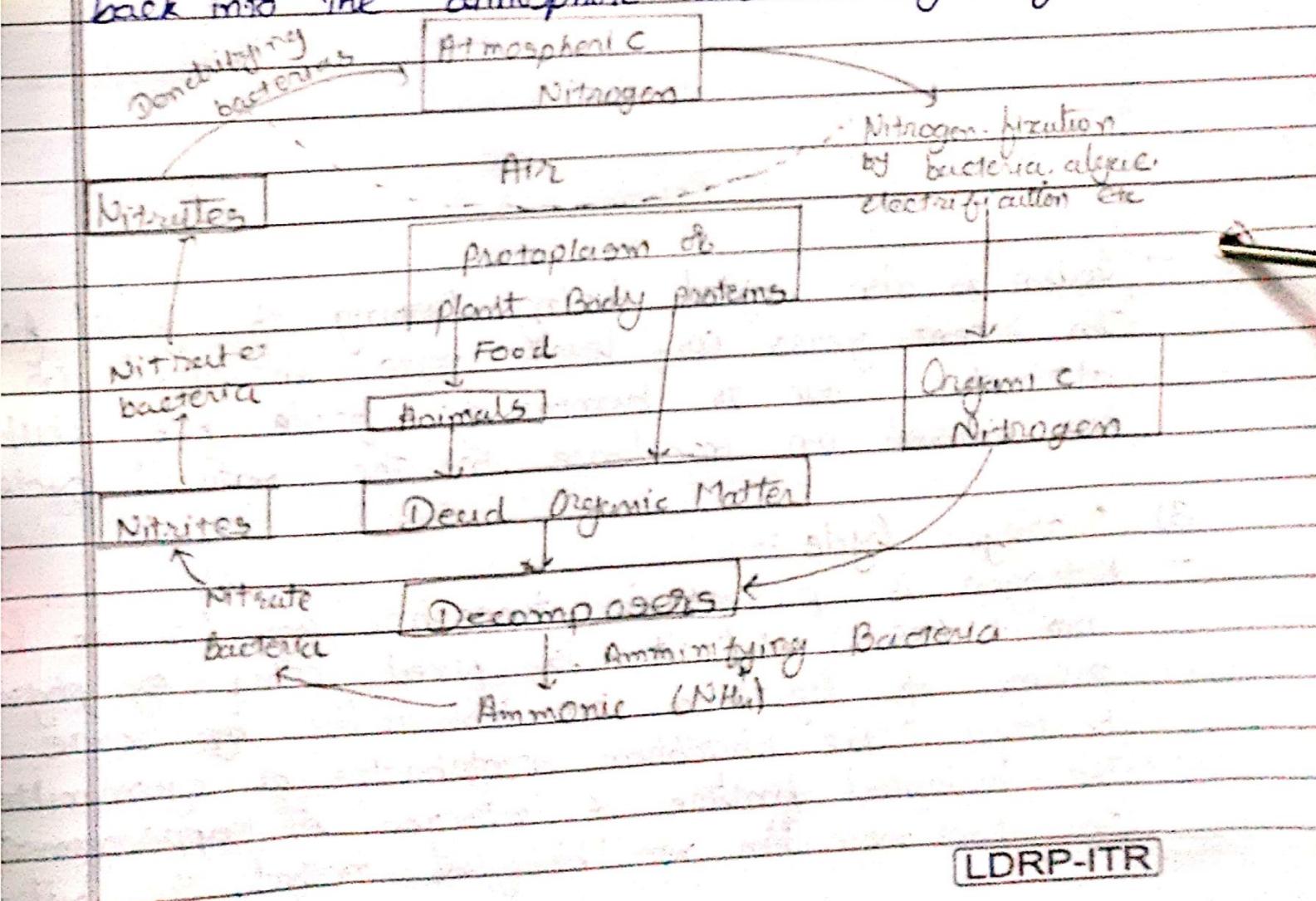
→ Carbon is also recycled during burning of fossil fuels.
In recent years CO₂ levels have increased in atmosphere due to burning of fossil fuels which has caused an imbalance in the natural cycle.

3) Nitrogen Cycle :-

- Nitrogen is present in atmosphere as N₂ in large amount (78.1%) and it is fixed either by physical process of lightning or biologically by some bacteria like rhizobium, azotobacter or cyanobacteria.
- The biological fixation of nitrogen is approximately 20 times more than non biological methods. The nitrogen

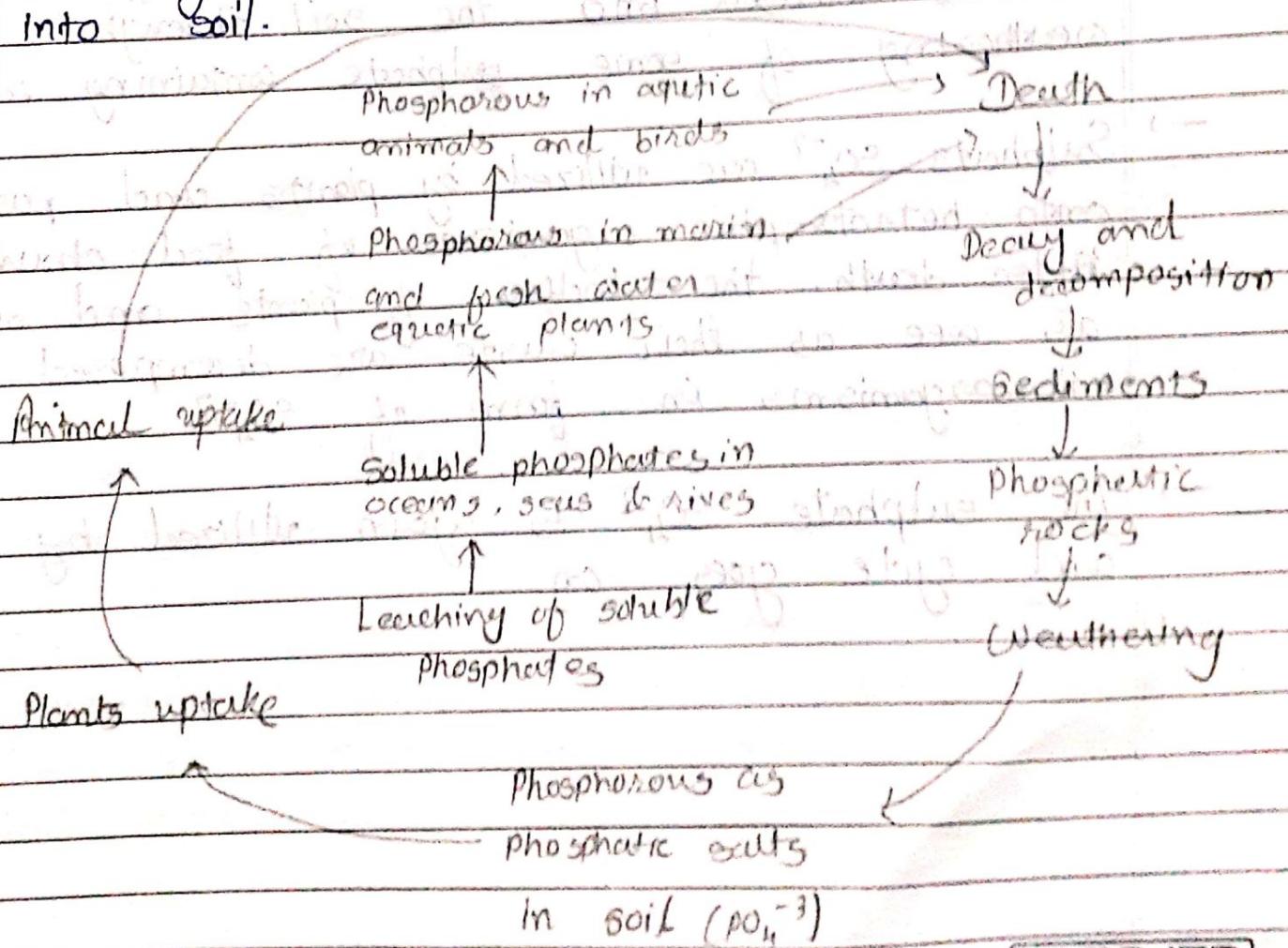
is taken up plants and biological methods. The nitrogen is taken up plants and used in metabolism for biosynthesis of amino acids, proteins, vitamins etc and passes through the food chain.

- After death of plants and animals, organic nitrogen in dead tissues is decomposed by several groups of nitrifying bacteria which convert them into ammonia, nitrites and nitrates, which are again used by plants.
- Some bacteria converts nitrates into molecular Nitrogen or N_2 under anaerobic condition, which is released back into the atmosphere and the cycle goes on.



4) Phosphorous Cycle :

- Phosphorous is the main constituent of NTP and ADP and is very essential for the growth of plants as well as animals. Many rocks contain phosphorous usually in the form of PO_4^{3-} . Due to weathering PO_4^{3-} is released into the soil and becomes available to plants.
- The phosphates are utilized by the plants in metabolism and passed onto the heterotrophic organisms through the food chain. After death, bodies of both plants and animals as well as their waste are decomposed by microorganism releasing phosphorous in the form of phosphates into soil.



5)

Sulphur Cycle :-

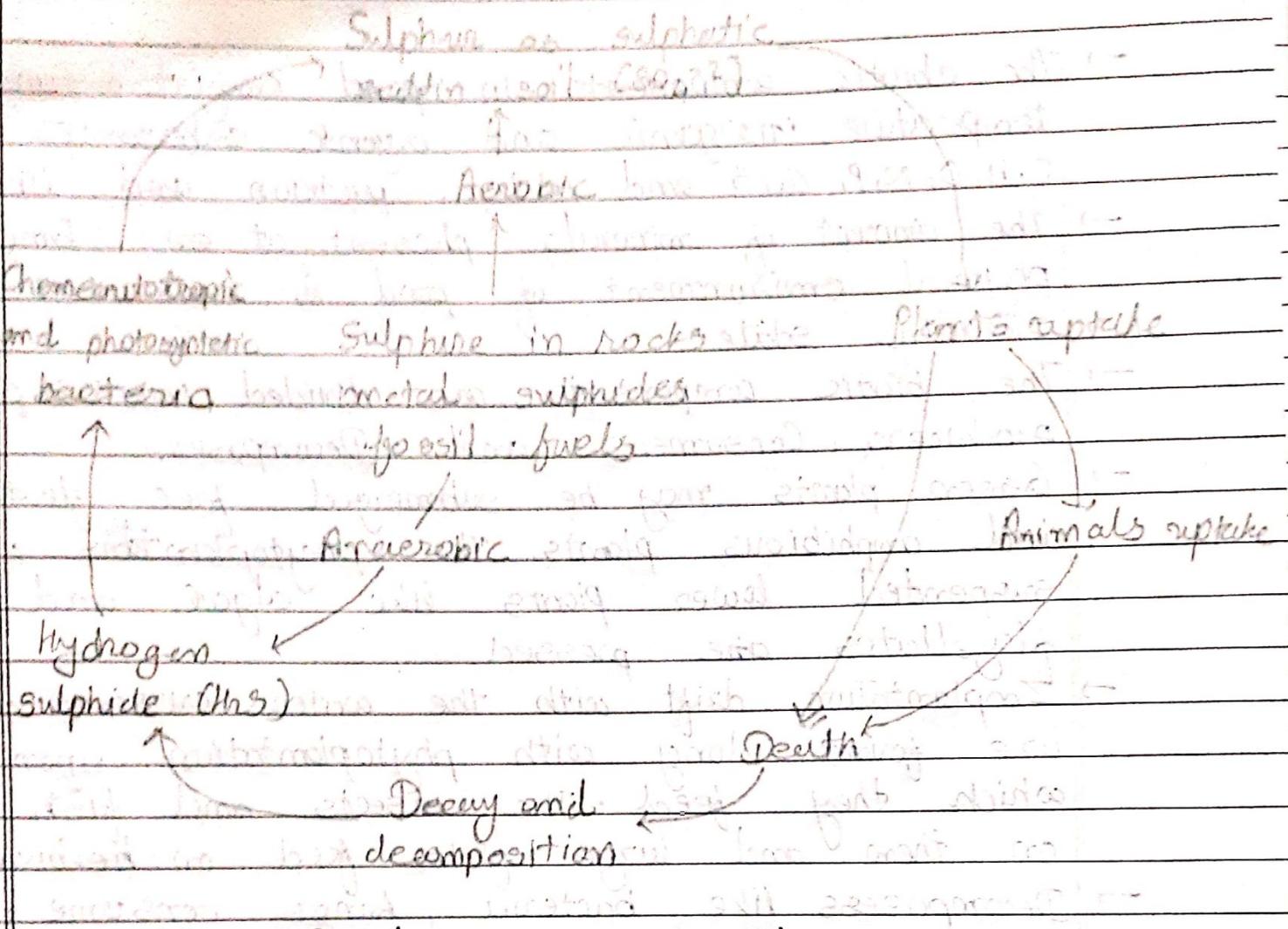
Sulphur occurs both in free state as well as sulphides and sulphates as P_2S_5 , ZnS , BaSO_4 etc. Sulphur is very essential element for living organism for synthesising amino acids, enzyme co-factors and certain vitamins.

The burning of fossil fuels and volcanoes releases H_2S and SO_2 gas in atmosphere, which ultimately returns to soil as sulphuric acid along with rain, forming sulphate compounds.

Sulphur in form of SO_4^{2-} is absorbed by the plants. The elemental sulphur converted to sulphates SO_4^{2-} is also released into the soil through weathering of some sulphate containing rocks.

Sulphates SO_4^{2-} are utilized by plants and passed onto heterotrophic organisms of food chain. After death, the bodies of plants and animals as well as their waste are decomposed by microorganisms in form of SO_4^{2-} .

The sulphate SO_4^{2-} is again utilized by plants and cycle goes on.



- Q. Explain : 1) Pond ecosystem 2) Marine ecosystem
 3) Forest ecosystem 4) Grass land ecosystem.
- I) Pond ecosystem :-
- It is a self-sufficient and self-regulating ecosystem. Location, size, depth and substratum of a pond influence the biology of the pond ecosystem.
- The ponds are however very often exposed to tremendous anthropogenic (human-generated) pressure. They are used for washing clothes, bathing, swimming, cattle bathing and therefore get polluted.

- The abiotic components in pond ecosystem are light, temperature, inorganic and organic substances like C, H, O, N, P, Cu, S and water, protein and lipids.
- The amount of minerals present at any time in physical environment of pond is known as standing state.
- The biotic components are divided into 3 parts producers, Consumers and Decomposers.
- Green plants may be submerged free floating and amphibious plants. The phytoplantations or suspended lower plants like algae and flagellates are present.
- Zooplantation drift with the water current and are found along with phytoplantation upon which they feed. The insects and fish feed on them and large fishes feed on herbivores.
- Decomposers like bacteria, fungi consume the large fishes after their death.

2) Marine Ecosystem:

- It include oceans, estuaries and coral reef ecosystem.
- The Ocean ecosystem covers about 70-71% of the earth surface. Ocean represent the largest most diverse and most stable of all ecosystem.
- It plays a key role in survival of about 2,50,000 marine species. serving as food for humans and other organisms give a huge

DATE / /

variety of sea products and drugs

- Oceans are major links of CO₂ and play an important role in regulating many biogeochemical cycle and hydrological cycle, thereby regulating the earth's climate.
- Oceans provide us iron, phosphorous, magnesium, oil, natural gas, sand and gravel.
- The Oceans have two major life zones:
 - 1) Coastal zone and 2) Open sea.
- There are 3 regions of open sea:
 - 1) Euphotic zone
 - 2) Bathyal zone
 - 3) Abyssal Zone

3) Forest Ecosystem :-

- Forest ecosystem have a predominance of trees that are interspersed with a large number of species of herbs, shrubs, climbers, lichens, algae and a variety of wild animals and birds.
- Forest are found in distributed areas receiving moderate to high rainfall and usually occurs as a stable complex communities.
- Depending upon the climatic conditions forest can be of different types:
 - 1) Tropical rain forest
 - 2) Tropical scrub forest
 - 3) Tropical deciduous forest
 - 4) Temperate rain forests
 - 5) Evergreen coniferous forest
 - 6) Temperate deciduous forest

- The abiotic components are inorganic and organic substances found in the soil and atmosphere. The climate and soil, apart from minerals occurrence of litter is feature of majority of forest
- There are biotic components which are divided into producers, consumers and decomposers. There are plants which grow around the world. They capture sun energy and produce food through photosynthesis
- There are herbivores which feed on leaves for energy consumption like ants, flies, bugs, spiders etc. They are eaten up by deer, moles, mongooses, squirrels etc.
- Then these animals are eaten up by lion, tiger etc. Forests have higher gross production and net ecosystem production compared to any other ecosystem because of their large biomass

4. Grassland ecosystem.

- Grasslands are dominated by grass species but sometimes also allow the growth of few trees and shrubs. Rainfall is average but erratic.
- About $4.6 \times 10^7 \text{ km}^2$ of earth is covered with grasslands which occupy about 30% of plant cover of the world.

- The most fertile and productive soils in the world have developed under grass lands and in many cases the natural species have been replaced by cultivated grasses such as cereals, pulses etc.
- Three types of grassland are found to occur in different climatic region:
 - 1) Temperate grasslands (75-100 cm of rainfall)
 - 2) Tropical grasslands (150cm of rainfall)
 - 3) Polar grasslands where severe cold, strong and frigid winds along with ice and snow create too harsh climate for trees to grow.
- Grassland soils are highly fertile and contains large amount of exchangeable bases and organic matter.
- This is because rainfall in grassland is inadequate and hence excessive leaching of minerals is blocked. The human soil partially decomposed organic materials expand its capability by as much as 20%.
- Grassland soils are generally subjected to high temperature, greater evaporation, periodic drought and more transpiration per unit of total biomass.