ENVIRONMENTAL ENGINEERING

→ The term environment directly means surroundings.

→ This study deals with every issue that affects a living organism.

→ Environment is a complex of so many things (light, temp, soil, water etc.) which surround an organism.

3) → Any external force, substance or condition, which surrounds and affects the life of an organism in any way, becomes a factor of its environment. These factors have been variously called as environmental factors, ecological factors or simply factors and may be living (biotic) as well as non-living (abiotic).

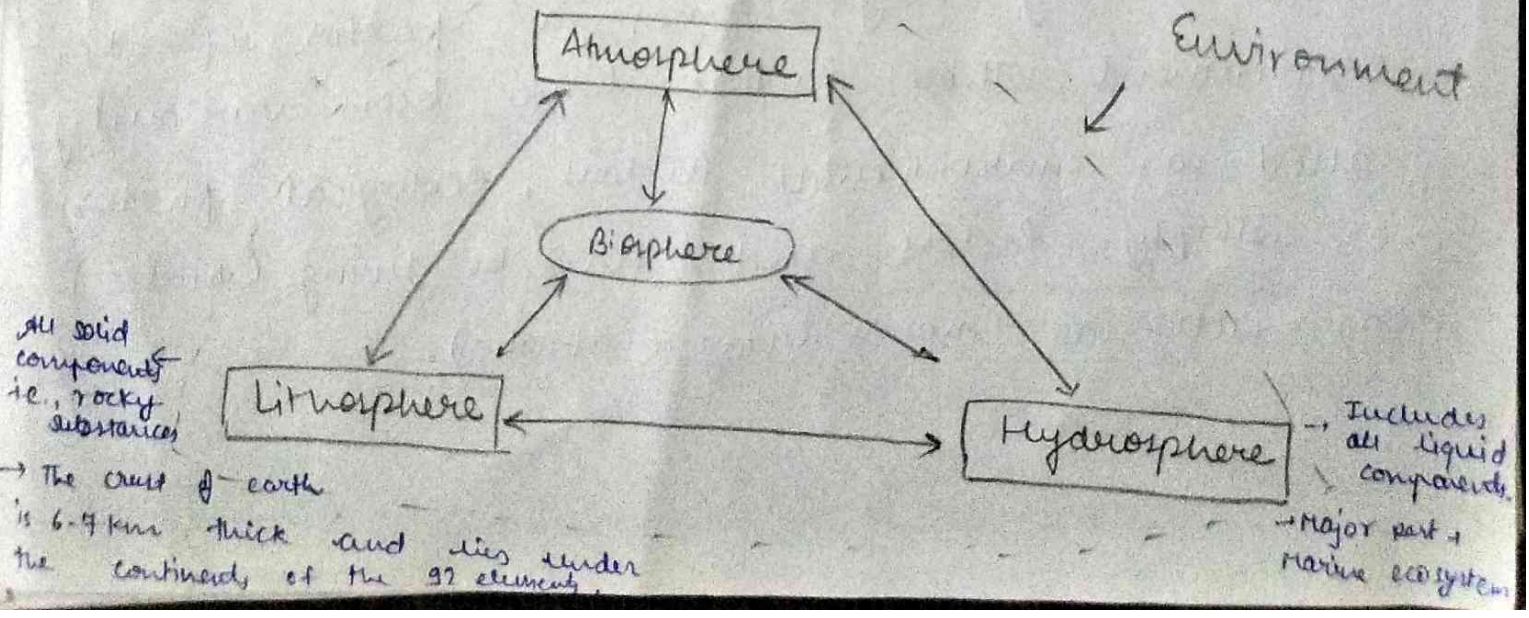
→ the totality of the physical environment is called an ecosystem and the total world of life is called the biosphere.

→ Every organism within the biosphere affects the life of every other organisms, directly or otherwise. Man for example, cannot ~~so~~ continue to live without the bacteria in the soil, the green plants on the land and in the sea and even the scavengers that feeds upon the dead organisms.

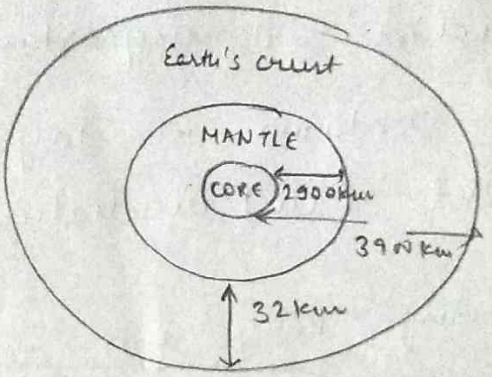
Biosphere :- [that part which contains living organisms].

→ Extend about 22.5km in thickness from ocean bottom to mountain tops. But, all the parts of the biosphere are not suitable for life because of :-

(i) Low temp
(ii) Less concentration of O_2 and
(iii) too high comic radiations.



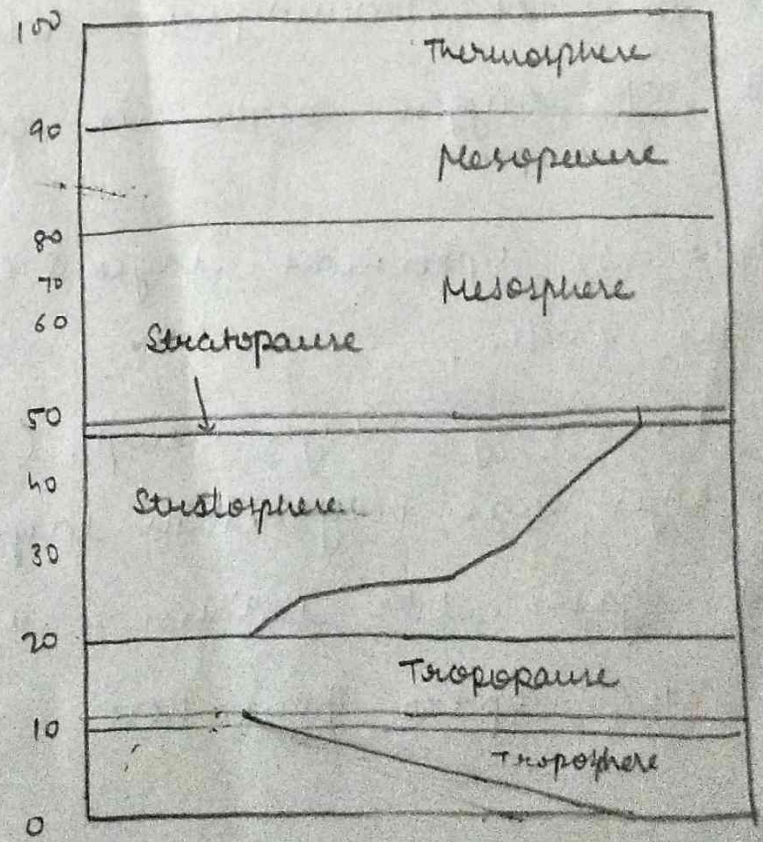
Lithosphere



3.) Atmosphere :- Gaseous layer which envelops the hydrosphere and the lithosphere.

→ It behaves like an insulator and filters dangerous rays of sun.

1) ★ Troposphere
3) ★ Mesosphere
2) ★ Stratosphere
4) ★ Thermosphere
5) ★ Exosphere



1) Troposphere :- Lower most portion of atmosphere,
→ the only part warm enough for us to survive and is 12 Km thick, the only part which has essential gases necessary for life processes.

2) Stratosphere :- 50 km thick and contains a layer of sulphates, which is important for the formation of rain, also contains a layer of ozone, which absorbs ultraviolet (UV) radiations.

3) Mesosphere :- Having very low "space" atmospheric pressure Main constituents of this layer are N_2, O_2, O^+_2 & NO^+. Height of 80 km

4) Thermosphere : (Ionosphere) → Above Mesosphere
Extends upto 500 kms above earth's surface
→ upper zone top thermosphere where ionization of molecules of oxygen occur is called ionosphere.

5) Exosphere :- Uppermost layer & extends upto 1600 Km from the earth.
→ It has very high temp. (solar radiations).
→ This layer has very thin layer of air.
→ Light gases like helium and hydrogen float into the space from here.

Environmental Pollution :-

→ It is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water.

→ As a result of over-population, rapid industrializations, and other human activities like agriculture and deforestation etc.

Classification of Environmental Pollution :-

- Air pollution
- Water pollution
- Soil pollution
- Noise pollution
- Radioactive pollution
- Thermal pollution.

Environmental Acts and Regulations :-

→ Acts imposes a duty on every citizen 'to protect & improve the environment and to safeguard the forests and wildlife of the country'. included rivers, lakes etc.

→ The department of Environment was established in India in 1980 to ensure a healthy environment for the country.

→ This later becomes the ministry of environment and Forests in 1985.

→ The EPA (Environment Protection Act), 1986 came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gas in the existing laws.

* Handling & Management of Hazardous Waste Rules in 1989

- EPA (1986)
- The Air (Prevention & Control of Pollution) Act (1981)
- The Water (Prevention & Control of Pollution) Act (1974)
- The Wildlife Protection Act (1972)
- The Forest (Conservation) Act (1980)
- The Motor vehicles Act (1988)

Campus: ..... Course: ..... Class/Section: ..... Date: .....
Name of Faculty: ..... Name of Subject: ..... Code: .....

Various acts and Regulations for Environment Protections :-

→ In 1974, the Parliament enacted the water (Prevention and control of Pollution) Act, 1974.

→ Following this legislation, the Water (Prevention & Control of Pollution) cess Act was enacted in 197- and in order to increase the scope of this legislation the Act of 1974 was amended in 1978. Besides this,

→ The Parliament of India has passed a number of laws to control pollution and to protect the environment which include :-

(1) Wildlife Protection act, 1972 (EPA)

(2) The Water (Prevention and control of Pollution) Act, 1974.

Page No.:

(3) The forest (Conservation) Act, 1980

(4) The Air (Prevention and control of Pollution) Act, 1981

(5) The Environment (Protection) Act, 1986.

(6) The Motor Vehicle Act, 1988

1) The Wildlife Protection Act, 1972

→ In this Act mainly concerned with wildlife conservation and protection of endangered species both inside and outside forest areas.

→ This Act prohibits hunting of about 50 species of animals, 43 birds and many reptiles.

Main objectives :-

(i) To preserve biodiversity

(ii) To protect and conserve wildlife.

(iii) To maintain essential ecological processes and life supporting systems.

2) The Water Act, 1974 :-

objectives :-

(i) Prevention and control of water pollution.

(ii) Maintaining and ~~restore~~ restoring the water.

(iii) Establishments for prevention and control of water pollution.

(iv) It takes measures to protect & improve the water quality.

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5) The Environment Protection Act, 1986 :- [EPA]

(i) Protection and improvement of environment (water, air, soil)

(ii) Prevention of hazards to living organisms (humans, plants, animals).

(iii) Maintaining proper relationship b/w humans, living, and environment.

(iv) Make rules to regulate environmental pollution.

6) The Motor Vehicle Act, 1988 :-

→ Main objective is the reduction and control of traffic pollution. Main points includes matter which should be duly neglected.

(i) Authority empowered to issue licences.

(ii) Outlines the conditions for determining the fitness of vehicles.

(iii) Also provides to use the vehicles as emergency vehicle.

(iv) Undertaking providing hired transport vehicle is controlled by State Govt. or Central Govt.

3) The Indian Forest Act, 1980 :-

→ This Act has been passed to provide protection and conservation of forest and to ensure judicious use of forest products. Main points are :-

(i) Any land, composed to predominantly trees, and woody climbers can be considered as forest.

(ii) Any offence to harm the forests punishable under any rule in this Act.

(iii) Forest officers are appointed by government for purpose of carrying out duties and objectives under this Act.

4) The Air Act, 1981 :-

Objectives :-

(i) Prevention, control and abatement of air pollution.

(ii) Defines air pollution as any solid, liquid, gas or noise present in air which harms humans and other organisms.

(iii) Maintaining the quality of air.

(iv) Establishment of boards for prevention and control of air pollution.

Functional concepts of ecology :-

→ Ecology is the scientific study of the distribution and abundance of living organism and the interactions among organisms and b/w organisms and their environment.

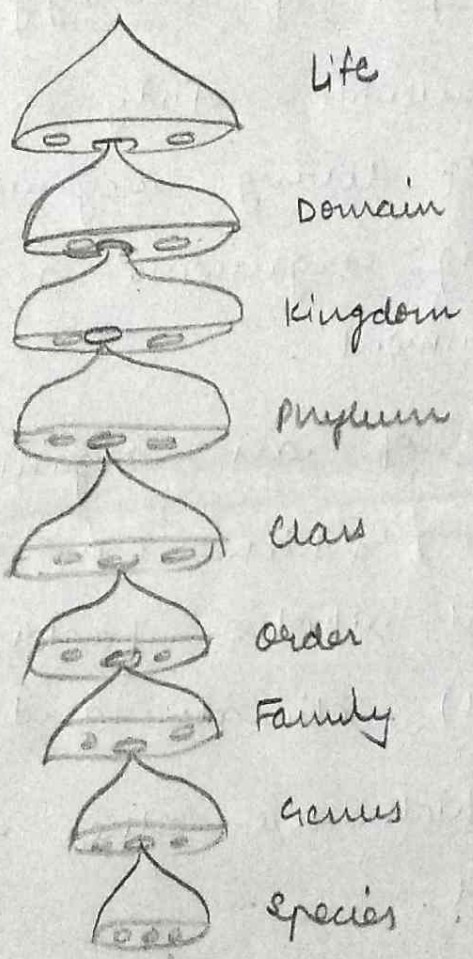
→ The environment of an organism includes both physical properties, which can be described as the sum of local abiotic factors such as insolation (sunlight), climate and geology, and biotic factors, which are other organisms and share its habitat.

Scope :- It is considered as a branch of biology, the general science that studies living organisms.

→ organisms can be situated at many different levels, from proteins and nucleic acids (in biochemistry & molecular biology, to cells (in cellular biology), to individuals (in botany, zoology, and other similar disciplines),

and finally at the level of populations, communities, and ecosystems, to the biosphere as a whole; these latter strata are the primary subjects of ecological ~~injury~~ inquiry.

Basics of Species :-



→ A species is often defined as a group of organisms capable of interbreeding and producing fertile offspring

→ The lowest taxonomic rank, and the most basic unit or category of biological classification.

→ A group of plants & animals having similar appearance.

DETAILED LECTURE NOTES

General classification of Species :-

* Ecological species :- A set of organisms adapted to a particular set of resources, called a niche, in the environment

* Biological / Reproductive species :-

Two organisms that are able to reproduce naturally to produce fertile / offspring of both sexes.

* Biological / Isolation species :- A set of actually or potentially interbreeding populations.

* Genetic species :- Based on similarity of DNA of individuals or populations.

* Vulnerable speies :-

→ It has been categorised by the International Union for Conservation of Nature (IUCN)

ECOSYSTEM :-

→ All living organisms and their environment are mutually reactive, affecting each other in various way.

→ An ecosystem is the whole biotic community in a given area plus its abiotic environment.

→ When both, biotic and abiotic components are considered, the basic structural and functional units of nature are ecosystems.

Components of Ecosystem :-

→ All ecosystem, whether terrestrial, fresh water, marine or man made, consist of two major components : Biotic
Abiotic

Components of Ecosystem

- **Biotic or living**
  - Producers
  - Consumers
    - Herbivores
    - Carnivores
    - Top carnivores
  - Decomposers
- **Abiotic or non-living**
  - Physical
    - Light
    - Temperature
    - Climate
    - Rain, humidity
    - Air, water, soil etc.
  - Chemical
    - Oxygen
    - Carbon
    - Nitrogen
    - Minerals
    - Organic matters etc.

Flow diagram of components of ecosystem

(A) Biotic components :-

→ The organisms that make up the living part of the ecosystem are divisible into two major categories.

1) Autotrophs :-

→ Autotrophs, the green plants, certain photosynthetic or chemosynthetic bacteria and algae, by capturing the solar energy and utilizing the simple inorganic substances, manufacture the food needed by plants for their own growth and development.

→ It is also utilized by the heterotrophs, which can not manufacture their own food.

2) Heterotrophs :-

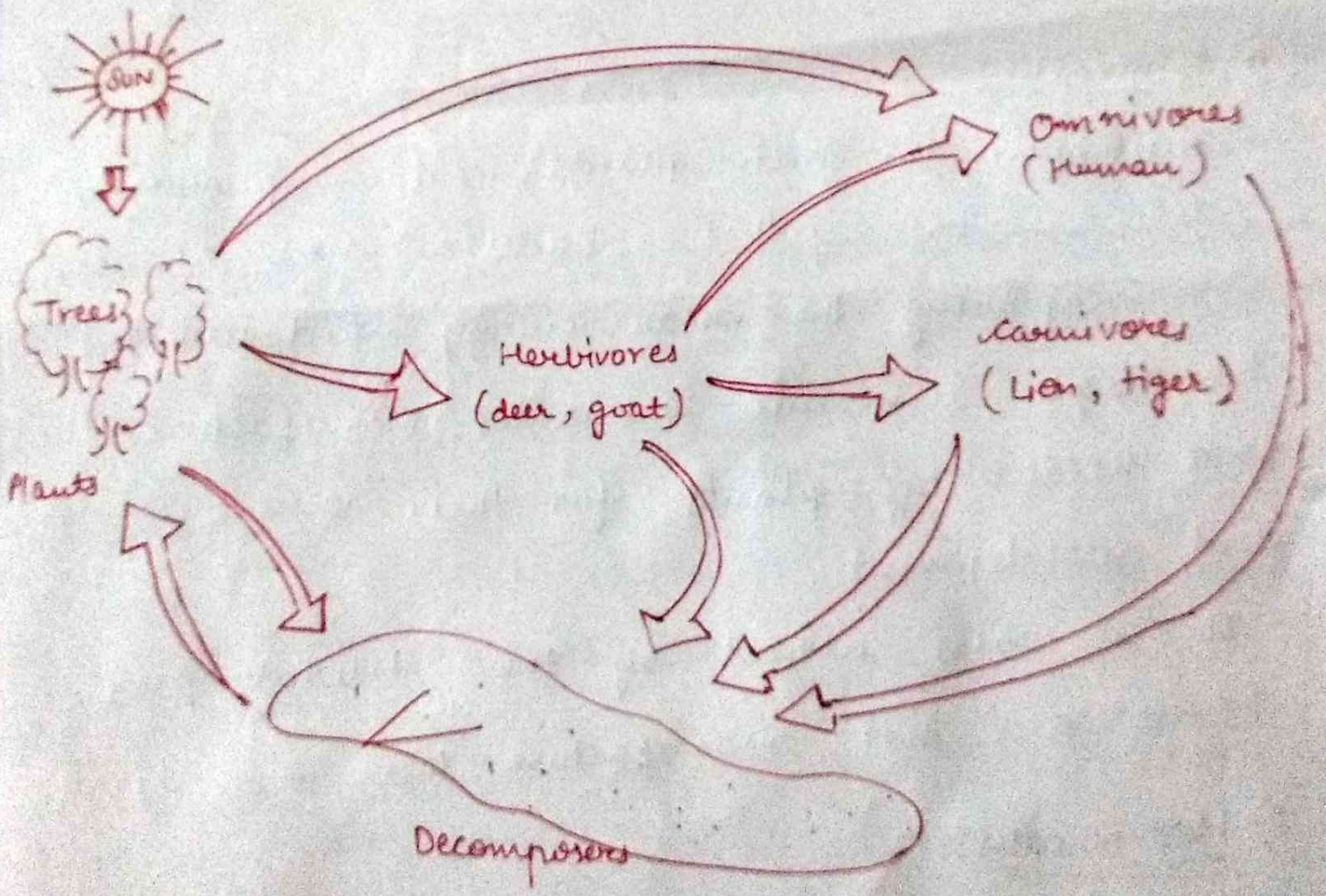
→ They are dependent directly or indirectly upon the autotrophs for their food.

→ Also known as consumers because they consume.

Heterotrophs → Two types
- Macro-consumers (phagotrophs)
- Micro-consumers (saprotrophs)

Macro-consumers :- includes chiefly the animals that ingest other organisms or particular organic matter.

- Herbivores (ingesting plants i.e, Goat, deer)
- Carnivores (ingesting other animals, eg. tiger, lion)
- Omnivores (ingesting both plants & animals eg, bear, man)



Interactions among the biotic components

Micro-consumers (Decomposers) :- [Scavengers]

→ Mainly bacteria and fungi, that break down the complex compounds of decomposition products, and release simple substances usable by the producers.

[B] Abiotic components :-

→ The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. Abiotic components are mainly of two types :-

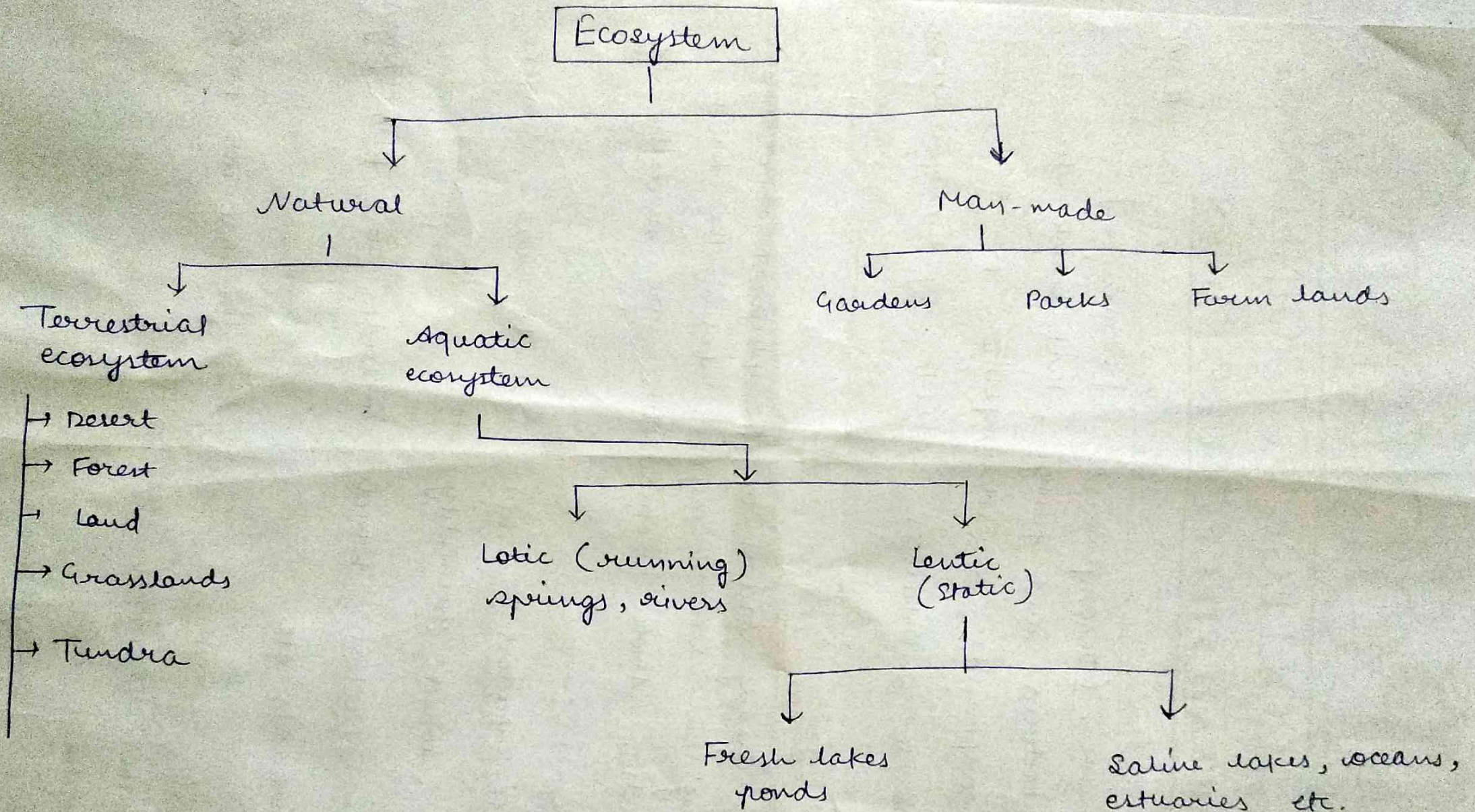
(a) Climatic factors :- which include rain, temp, light, wind humidity etc.

(b) Edaphic factors :- which include soil pH, topography minerals etc.

Types of Ecosystem :- May be natural or man-m and further classified as :-

(i) Terrestrial and

(ii) Aquatic ecosystems.



The flow diagram of ecosystem

(i) Terrestrial Ecosystem :- → Grass land ecosystem
→ Forest ecosystem
→ Desert ecosystem.

(a) Grass ecosystem :-

→ occur in temp. regions which is moderately dry clim
→ This vegetation is completely renewed each year.
→ Insects are in very huge quantity due to dry habitat of grasslands.
→ Sparrows, marsh, owls etc are generally found in grassland ecosystem.
→ Secondary consumers like fox, wolf, jackals & snakes are also ~~find~~ found in the grassland ecosystem.

(b) Forest Ecosystem :-

→ Forest are composed of trees growing sufficiently close together to dominate the entire area of ground surface.
→ Dominant animals are small mammals like monkies, squirrels, mice etc.
→ Acc. to climatic conditions, the composition of forest vary from one place to another.
→ • Decidous forest
• Coniferous forest
• Woodland
• Tundra

(c) Desert Ecosystem :-

→ It include arid waste-land which contain considerable vegetation in the form of bushes, shrubs (Shrubs) and trees especially adopted to tolerate hot dry climates.

→ Desert occur where rainfall is less than 50cm/year.

→ Animals of the desert have both structural and behavioral adaption to meet hot and dry climates in terms of water deficiency and high heat.

(ii) Aquatic Ecosystem :-

→ Located in body of water.

→ Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems.

Types of aquatic ecosystem :-

Marine

it covers 71% of Earth's surface and contain approx. 97% of the planet's water.

Freshwater

It covers 0.8% of earth's surface and 0.009% of its total water.

→ It contains 41% of the world's known fish species.

Lentic (Slow-moving water) — ponds, ponds & lakes

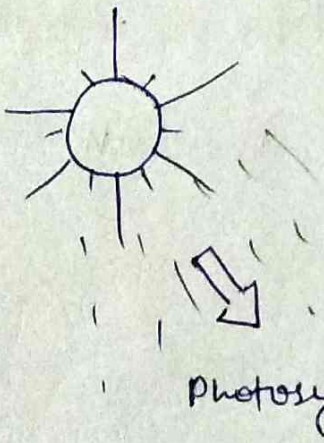
Lotic (Rapidly-moving water) — Streams, rivers.

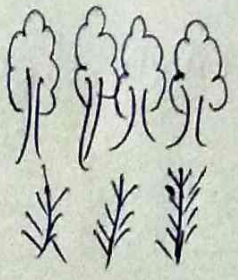
FUNCTION OF AQUATIC ECOSYSTEMS :-

→ They recycle nutrients, purify water, attenuate floods, recharge ground water and provide habits for wildlife.

Energy flow in ecosystems :-

→ Energy flow through ecosystems in one direction typically from the sun, through photosynthetic organisms including green plants and algae, to herbivores to carnivores and decomposers.





Carbohydrates → Rabbit, Cow, deer etc → Lion, fox, etc.

Plants (Producers) — (Primary Consumers) — (Secondary consumers)

[First trophic level] [Second trophic level] [third trophic level]

Energy flow in ecosystem

Various Functions of ecosystem can be explained in following ways

(i) Food chain
(ii) Food web
(iii) Energy pyramid
(iv) Energy flow through food chains
(v) The pyramid of energy
(vi) The pyramid of Biomass
(vii) The pyramid of Numbers.

(i) Food chain :-

(a) Producer → Grasshopper → Shrew → Hawk
(b) Producer → Rabbit → Fox → Wolf → Tiger
(c) Producer → Frog → Snake → Peacock

Terrestrial

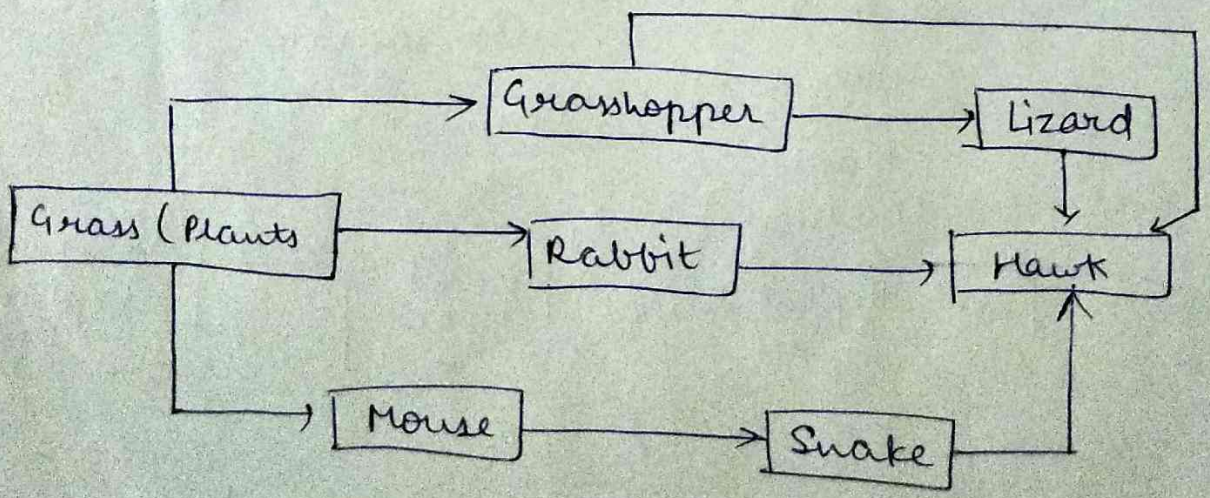
(d) Phytoplankton → Zooplankton → Small fish → Large fish → Shark

Aquatic

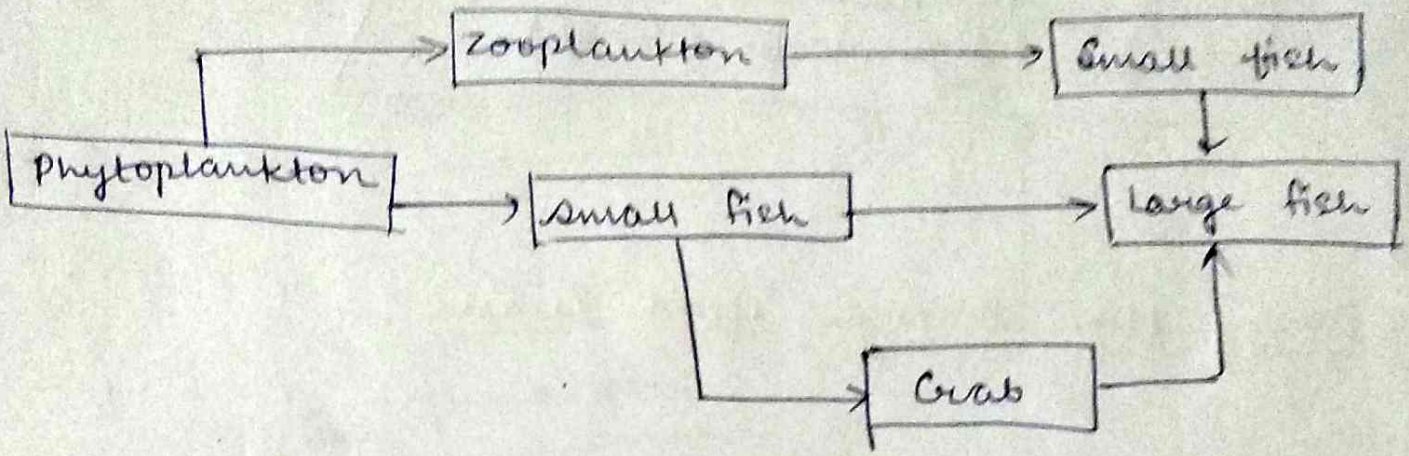
(e) Phytoplankton → Zooplankton → Fish → Crane → Hawk

(ii) Food Web :-

FOOD WEB OF GRASS LAND ECOSYSTEM



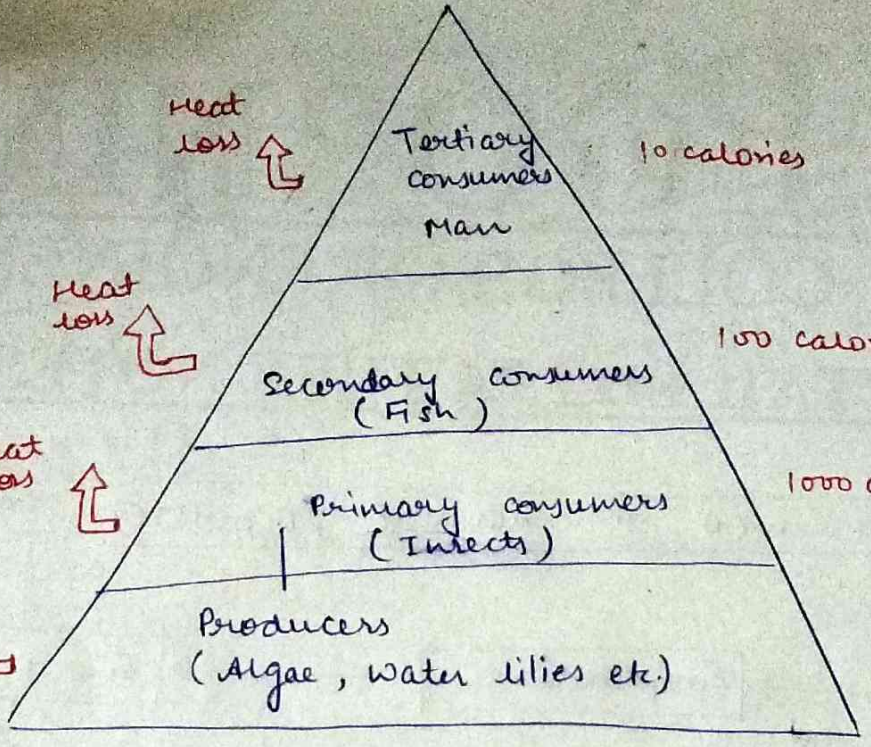
FOOD WEB IN AQUATIC ECOSYSTEM



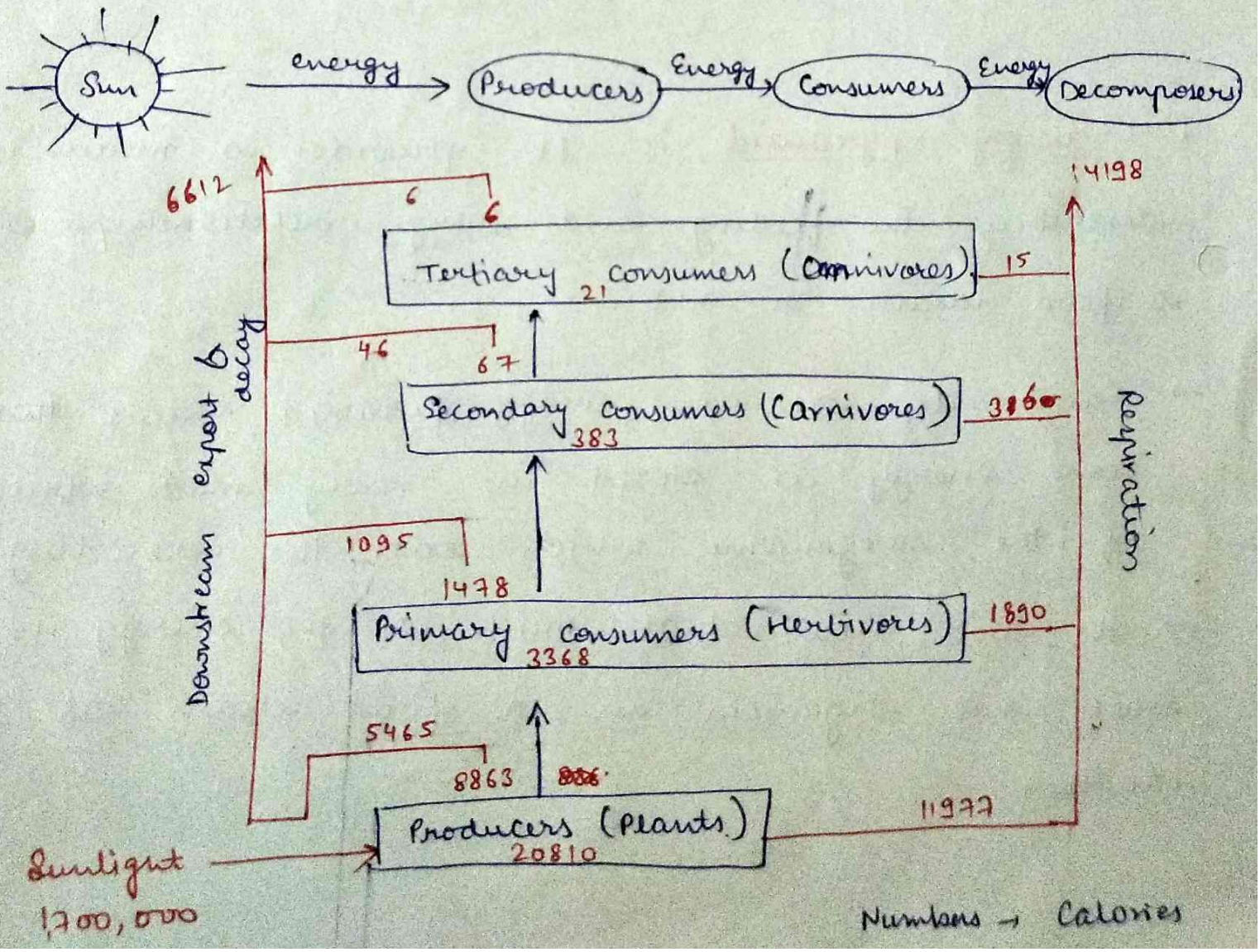
(iii) **Energy pyramid** :- It provides a means of describing the feeding and energy relationships within a food chain or web.

→ Each step of an energy pyramid shows that some energy is stored in newly made structures of the organism which eats the preceding one.

→ It also shows that much of the energy is lost when one organism in a food chain eats another.

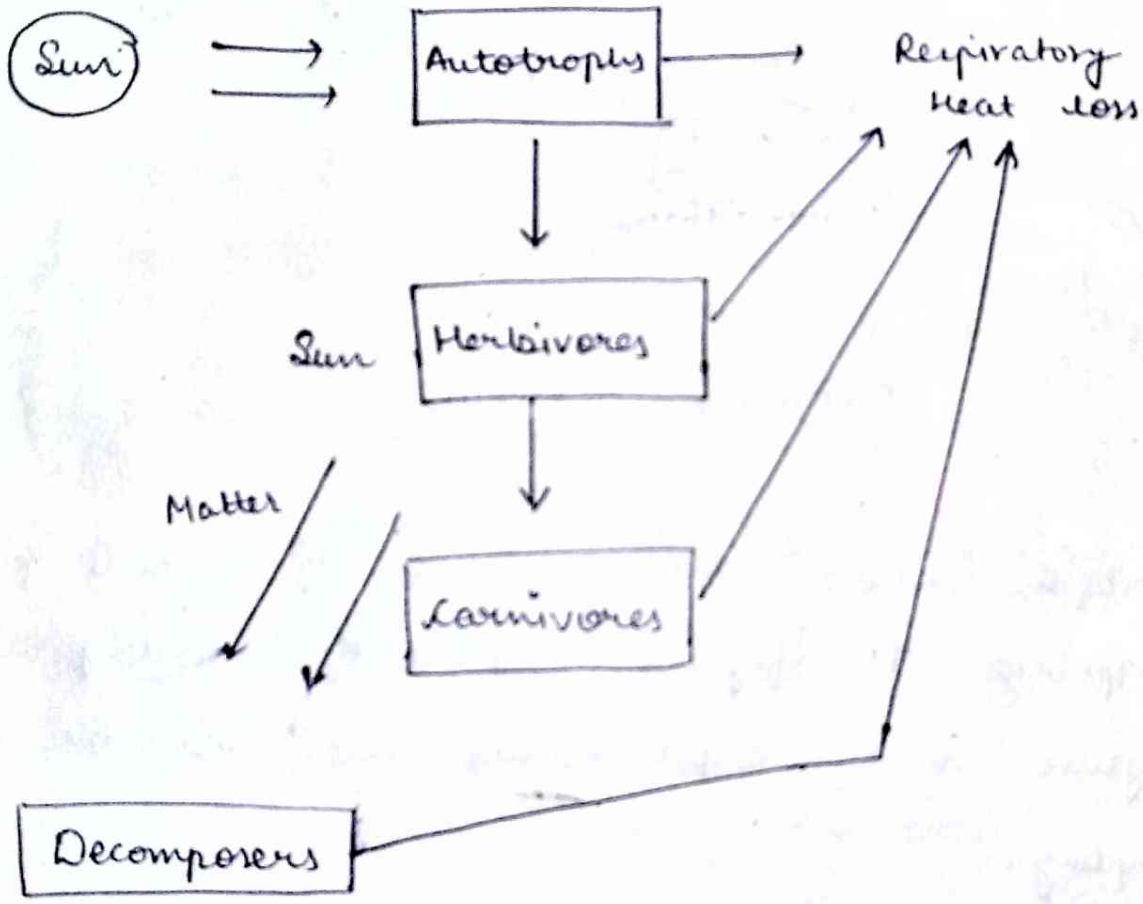


(iv) Energy flow through food chain :-



(v) The pyramid of Energy :-

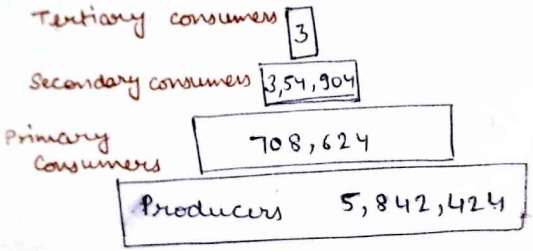
→



→ The total amount of energy in a population of toads must necessarily be far less than that in the insects on which they feed.

(vii) The pyramid of Biomass :-

→ A census of the population, multiplied by the weigh of an average individual in it, gives an estimate of the weight of the population. This is called the biomass (or standing crops).



→ The graphic shows the pyramid of biomass for Silver springs. The figures represent the dry weight of organic matter (per square meter) at the time of sampling.

(viii) The pyramid of Numbers :-

→ The pyramid of numbers resulting when a census of the populations of autotrophs, herbivores, and two levels of carnivores was taken on an area of grassland.

The pyramid arises because :-

- Each species is limited in its total biomass ~~at~~ by its trophic level.
- Occupying a higher trophic level, their biomass must be smaller.

Hydrological Cycle :-

→ It begins with the evaporation of water from the surface of the ocean.

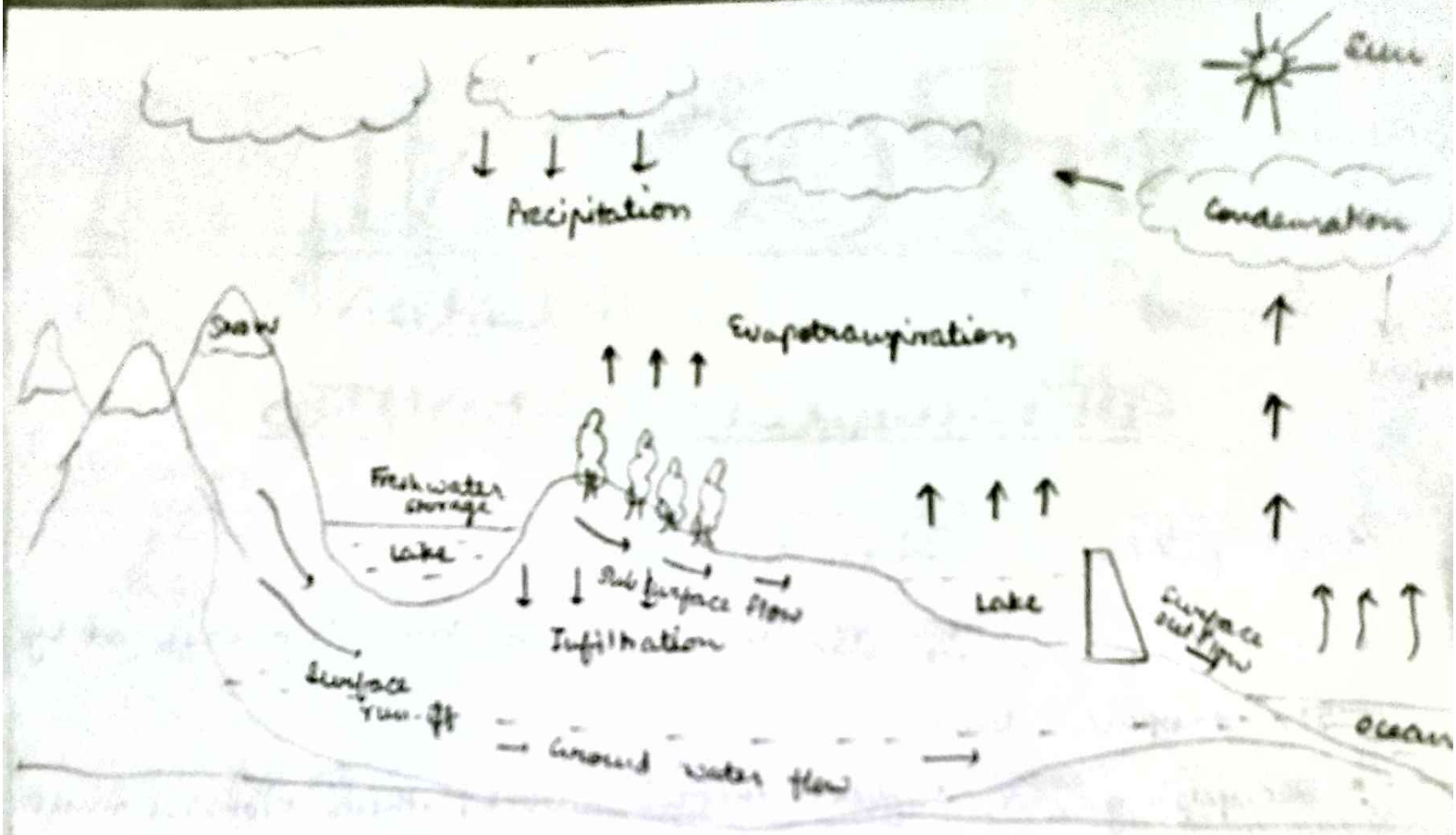
→ As moist air is lifted, it cools and water vapours condenses to form clouds.

→ Moisture is transported around the globe ~~dim~~ until it returns to the surface as precipitation.

→ Once the water reaches the ground, one of two proceses may occur;

a) Some of water may evaporate back to the atmosph

b) Some water may penetrate the surface and become groundwater.



Hydrological Cycle

Components of hydrological cycles :-

1) Runoff :- Water flowing over the land making its way towards rivers, lakes, oceans etc.

(a) Surface run-off :- Running water over the land and get discharged ultimately in the sea.

(b) Sub-surface run-off :- The water getting infiltrated into pervious soil mass, making its way towards rivers and lakes.

2) Precipitation :- Fall of moisture from atmosphere to the earth's surface in any form.

eg - Rain, hail, snow, sleet, glaze, drizzle, snowflakes etc.

3) Evaporation :- The conversion of natural liquids like water into gaseous form like air.

4) Condensation :- conversion of a vapour or gas to a liquid.

5) Transpiration :- The evaporation taking place from any plant or greenery.

eg - water droplets on a leaf getting evaporated into atmosphere.

6) Evapotranspiration :- combination of evaporation & transpiration.

7) Infiltration :- Process of filtration of water to the inner layers of soil based on its structure and nature.

→ Infiltration in soils like sand, gravel and coarser material is more and for finer soil particles like clay and silt, infiltration is less.

Biogeochemical cycle :-

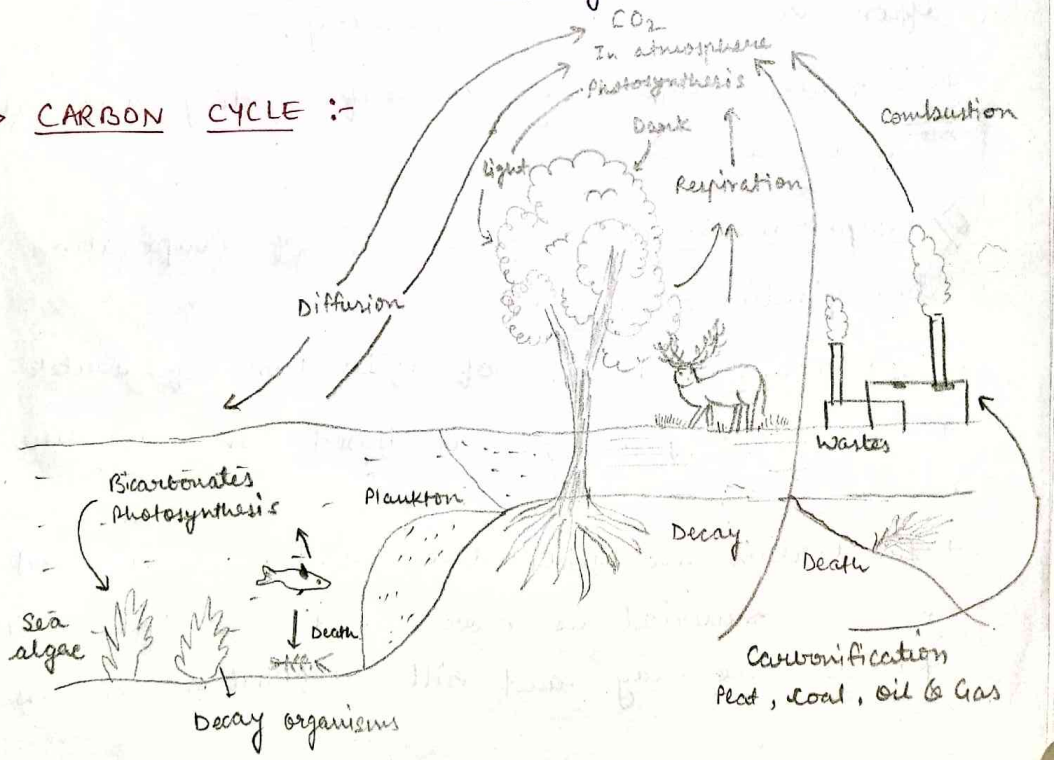
→ The flow of chemical elements and compounds b/w living organisms (biotic) and the physical environment (geo).

→ Chemicals absorbed or ingested by organisms are passed through the food chain and returned to the soil, air and water by such mechanisms as respiration, excretion, and decomposition.

It includes :-

- Carbon cycle
- oxygen cycle
- Sulfur cycle
- nitrogen cycle
- Phosphorus cycle
- Water cycle.

1) CARBON CYCLE :-



→ The continuous process by which carbon is exchanged between organisms and the environment.

→ CO_2 is absorbed from the atmosphere by plants and algae and converded to carbohydrates by photosynthesis.

→ Carbon is then passed into the food chain & returned to the atmosphere by the respiration & decay of animals, plants, and other organisms.

→ The burning of fossil fuels also releases carbon-~~dioxide~~ dioxide into the atmosphere.

2) Nitrogen cycle :-

→ Atmosphere is the reservoir of free gaseous nitrogen and nitrogen compounds are found in bodies of organisms and in the soil.

Nitrogen fixation :- Conversion of nitrogen into nitrates is called nitrogen fixation. It occurs in 3 ways.

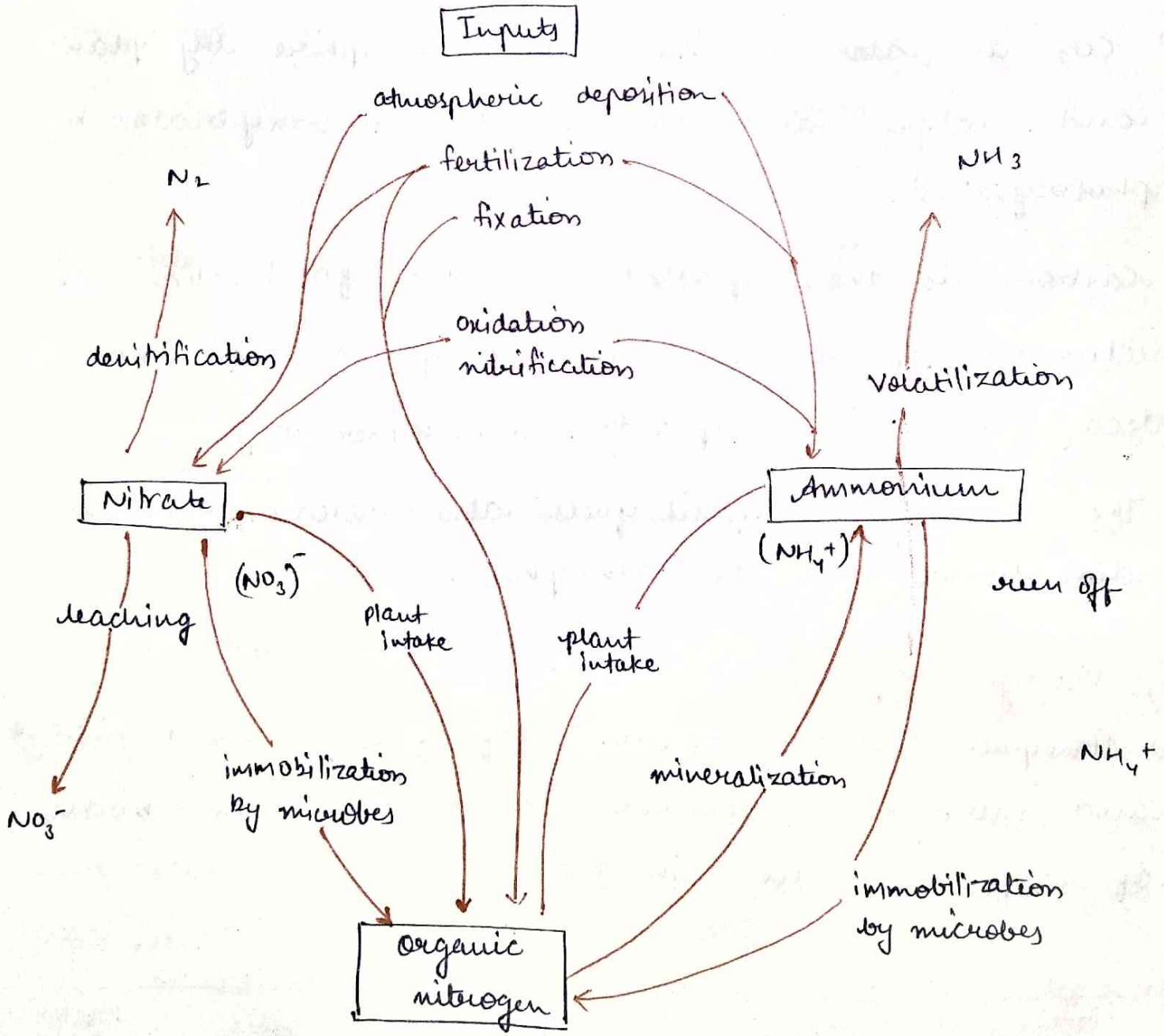
1. → Atmospheric nitrogen fixation. [by thunderstorm & lightning]
2. → Biological nitrogen fixation [by free nitrogen fixing organisms]
3. → Industrial nitrogen fixation. [combination of $N_2 + H_2$]

$$N + O_2 \longrightarrow 2NO$$

$$2NO + O_2 \longrightarrow 2NO_2$$

$$2NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$$

$$3NO_2 + H_2O \longrightarrow 2HNO_3 + NO$$



NITROGEN CYCLE

DETAILED LECTURE NOTES

B-17 (A)

Campus: PCE Course: B.Tech Class/Section: Iyr/H Date:
Name of Faculty: Sheshima Gautam Name of Subject: BCE Code: 1F43-09

Ammonification :- Involves the decomposition of protein of dead plants and animals, and nitrogenous wastes like urea, uric acid, etc. to ammonia.

Proteins ⟶ Amino acids ⟶ Ammonia

Nitrification :-

$$2NH_3 + 3O_2 \xrightarrow[\text{Nitrococcus}]{\text{Nitrosomonas}} 2NO_2^- + 2H^+ + 2H_2O$$

$$2NO_2^- + O_2 \xrightarrow[\text{Nitrocystis}]{\text{Nitrobacteria}} 2NO_3^- + \text{energy}$$

Involves the oxidation of ammonia to nitrates through nitrites in the presence of nitrifying bacteria, which are also chaemosynthetic autotrophs.

Denitrification :- It is the process where in the ammonium compounds, nitrates and nitrites are reduced to molecular nitrogen in the presence of denitrifying bacteria.

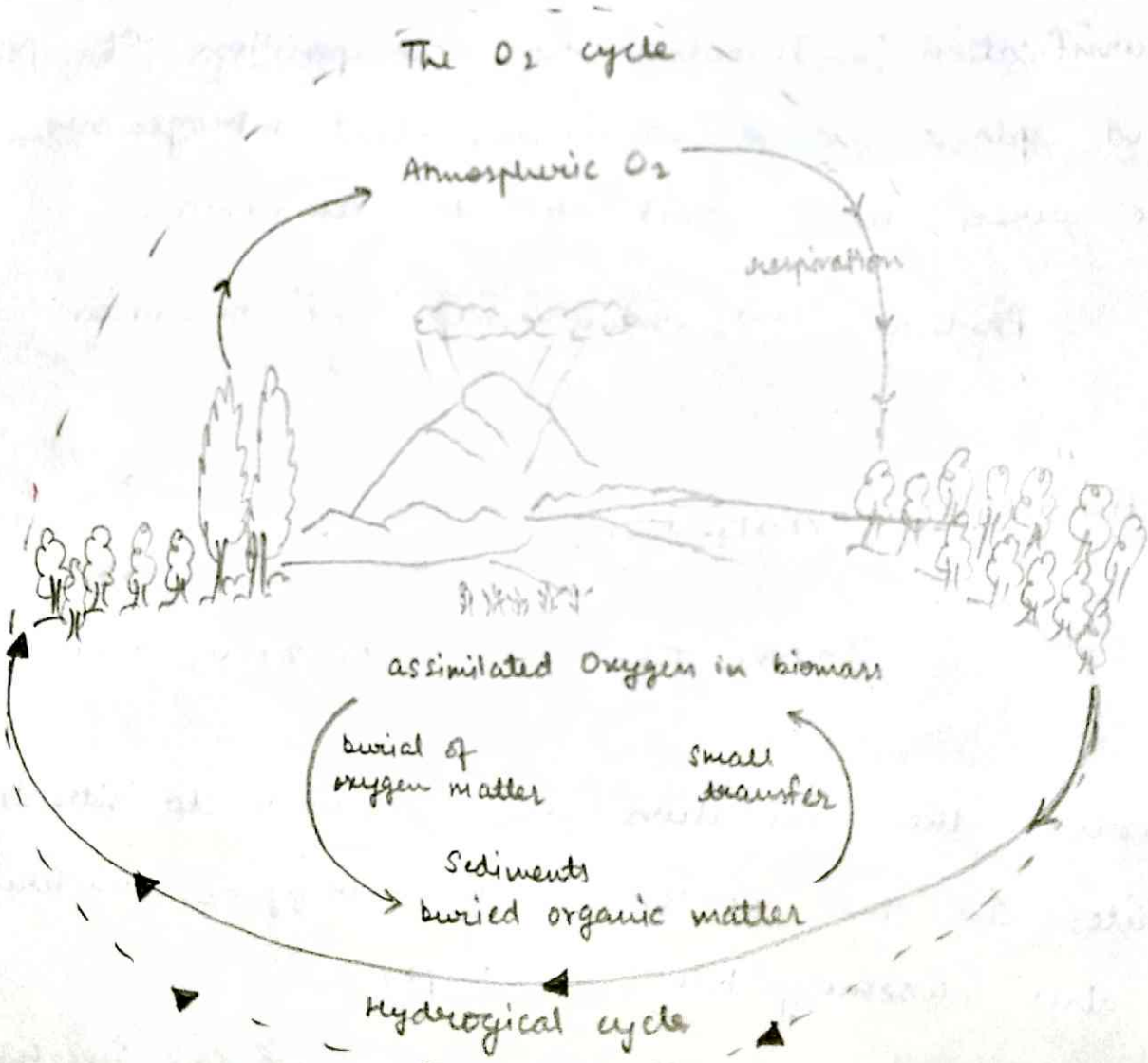
It reduces soil fertility and is stimulated by water logging, poor drainage, lack of aeration.

Page No.:

3) Oxygen cycle :- Dissolved O_2 in water is the source of O_2 for aquatic organisms.

→ Oxygen in the ozone layer (O_3) of the outer stratosphere of the atmosphere protects life from ionizing short wave radiations (UV radiations).

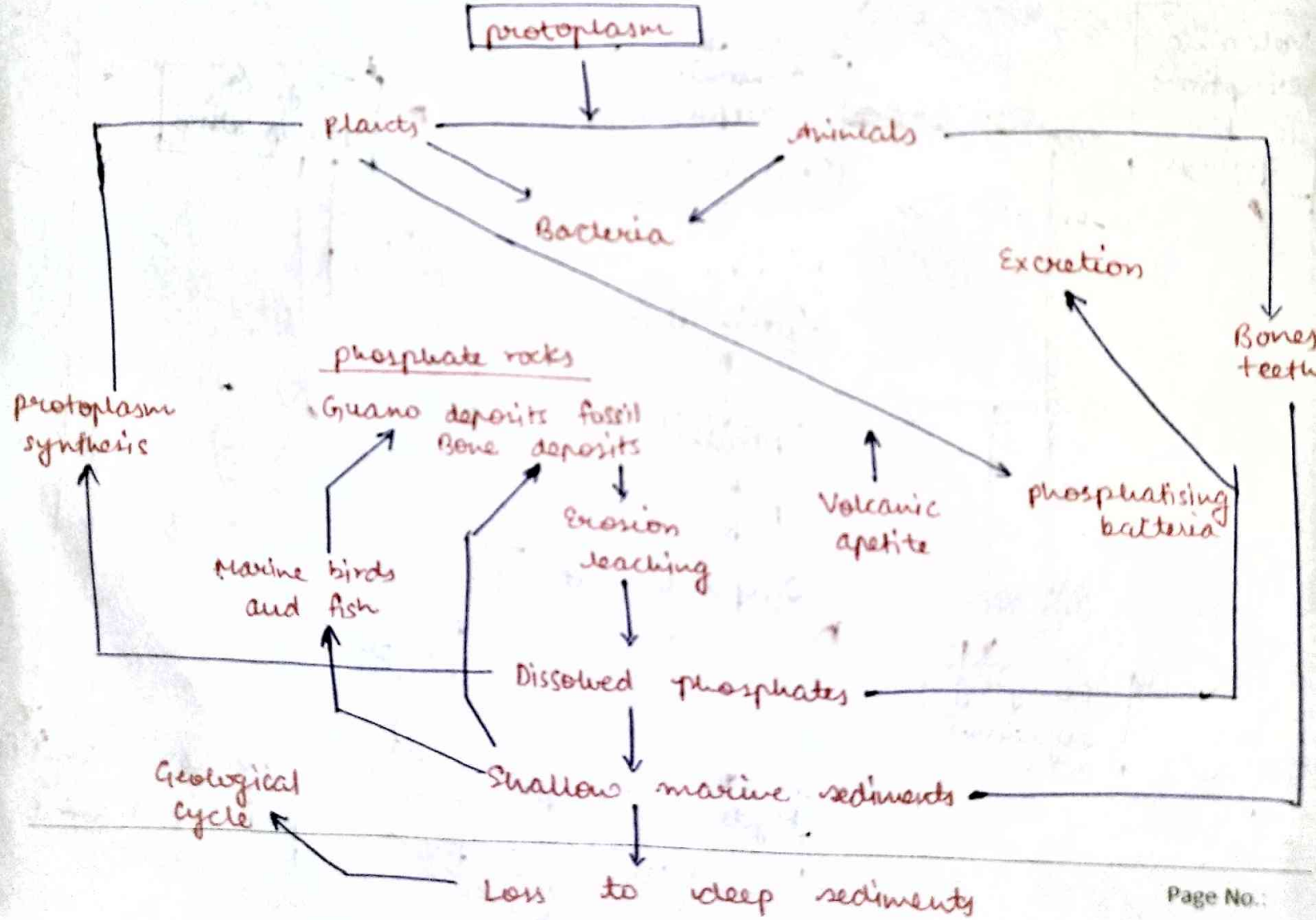
→ O_2 also occurs in combined state as CO_2 and water.



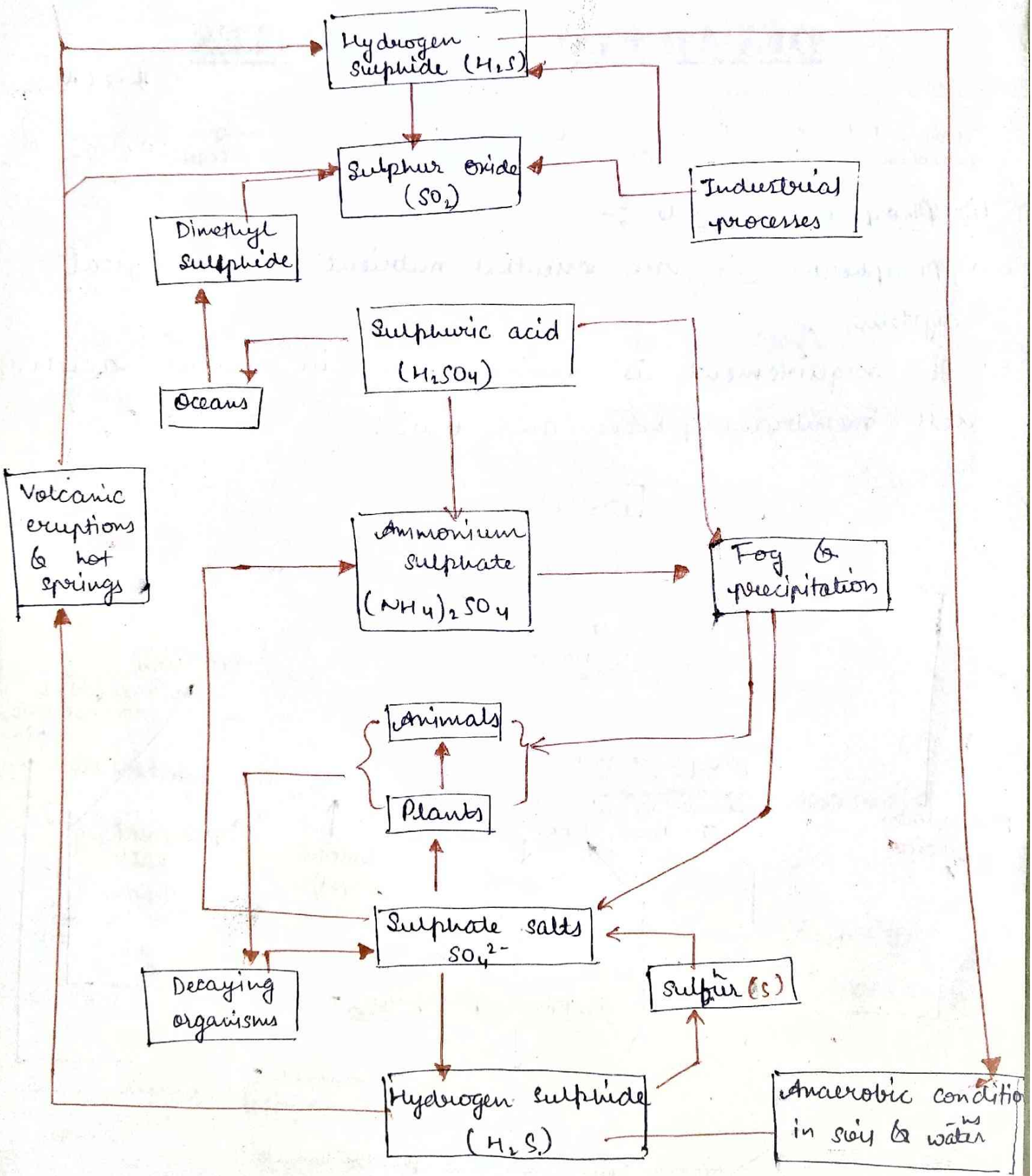
4) Phosphorous cycle :-

→ Phosphorous is an essential nutrient to biological systems.

→ Its requirement is mainly seen in nucleic acids, cell membrane, bones and teeth.



5) **Sulphur cycle** :- Sulphur is one of the components that make up proteins and Vitamins. Sulphur is important for the functioning of proteins and enzymes in plants, & in animals that depend upon plants for sulphur.



Campus: PCE Course: B.Tech Class/Section: IV / II Date:
Name of Faculty: Akshima Name of Subject: BCE Code: 1EY43-02

BIODIVERSITY :-

→ Biodiversity is the variety and differences among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part.

→ "Totality of genes, species and ecosystems of a region".

Definition

→ "Variation of life at all levels of biological organization."

→ "Diversity" in this definition includes diversity within a species and among species, and comparative diversity among ecosystems.

three levels →
- Genetic diversity
- Species diversity
- Ecosystem diversity

Measurement :-

- **Alpha diversity** :- Within a particular area, community or ecosystem, and is measured by counting the number of taxa within the ecosystem.

- **Beta diversity** :- [diversity b/w ecosystems]

→ It involves comparing the number of the taxa that are unique to each of the ecosystems.

- **Gamma diversity** :-

→ It is a measure of the overall diversity for different ~~of~~ ecosystems within a region.

Loss of Biological Diversity :-

→ The loss of biological diversity may take many forms but the most dramatic aspect is the extinction of species.

→ The extinction rate depends mainly on environmental changes and the possibility of species to adapt to these changes.

Conversion of Biodiversity :-

Reasons
- → Biodiversity as resources
- → Biodiversity is an ethical one
- → As aesthetic, intrinsic ways.

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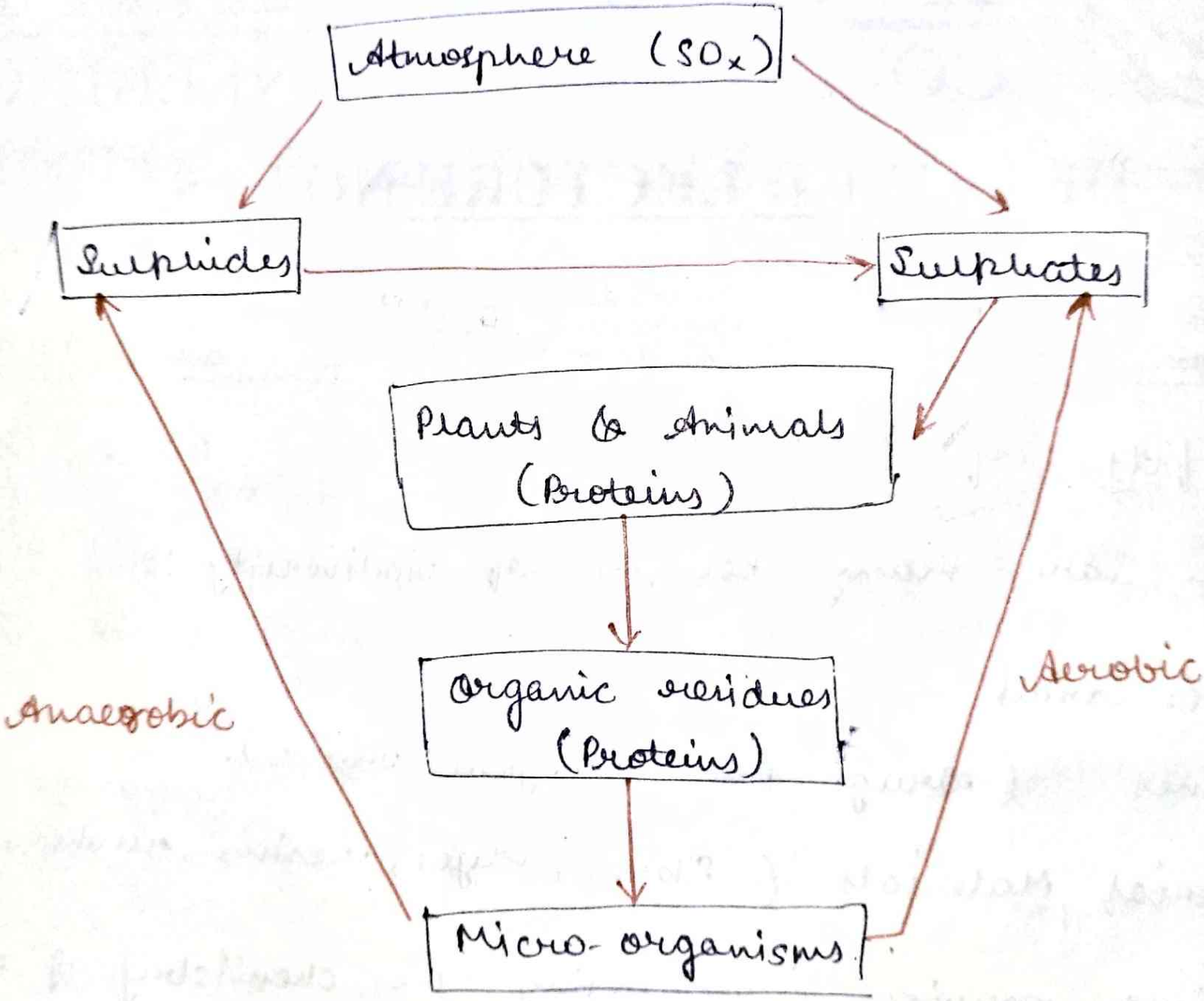
Benefits of Biodiversity :-

→ There are many benefits of biodiversity :-

- Food & drink
- Medicines (drugs from biological sources).
- Industrial Materials (fibres, dyes, resins, rubber, oil, etc)
- Ecological services (regulating the chemistry of our environment/atmosphere)
  Involves in nutrients & providing fertile soils.
- Leisure, cultural and aesthetic value :-
  → Such as enjoying a walk in the countryside, bird watching or natural history programmes on television.
- Climate change, biodiversity and health :-
  It provides numerous ecosystem services that are ~~crucib~~ ~~crucib~~ crucial to human well-being.
- Future options :- Conservation and use biological diversity for the benefit of present & future generations.

Sulphur cycle



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Water Pollution

Water is essential for human existance in terms of both quantity & quality. it is in its pure form. However all the available water is not suitable for human consumption.

Water pollution may be defined as "the presence of some foreign substance or impurities in water in such quantity so as to constitute a health hazard and maki it unfit for use.

Sources of Water pollution

1. Domestic Sewage :- Discharge of partly treated or untreated sewage in water bodies is one of the most common source of water pollutions.
2. Industrial Wastes :→ Industries are the major cause of water pollution. Industries discharge their wastes in the water. When wastes are let out in aquatic environment without adequate treatment, they cause water pollution.
3. Other Sources :→ Accidental oil spill is an another cause of water pollution during off shore oil drilling. These spills may be caused by a marine pipeline rupture, heavily leaking tanks etc.

Pollutants of Water Pollution :→

1. Heavy (Toxic) Metals :→ Arsenic, lead, cadmium, mercury & Cr etc.
2. Inorganic, Acid and Alkalies :→ Sulphuric acid and other acids are found in industrial waste.
3. Pathogens : Include bacteria, algae, viruses and dead organic matter etc.
4. Organic chemicals :- include herbicides and pesticides etc.

Effects of Water pollution :—

1. Organic and other toxic compounds cause health problem and harm aquatic life.
2. Inorganic chemical like acids, salts and heavy metal make the water unfit for drinking or irrigation and cause health problems for humans and harm aquatic life.
3. Sediments, excessive amounts of soil particles in the water reduce photosynthesis, destroy feeding grounds of fish, clog reservoirs and channels and disrupt aquatic life.
4. Oxygen demanding organic waste like animal and plants parts, sewage etc. decrease oxygen ~~ate~~ and cause death of fish and other aquatic organism.
5. Microorganis like bacteria and viruses affect human and aquatic organisms.
6. Radioactive substance from nuclear power stations cause cancer and birth defects etc.
7. Thermal pollution from industries lowers the Oxygen levels of water, affects aquatic organism and causes thermal shock in them.

Control of Water Pollution

1. Treatment of waste before being discharged.
2. Improving process & technology to reduce water demand.
3. Fix a quota for total fresh water withdrawal for each industry.
4. Make rain water harvesting compulsory.
5. Impose stiff penalties for non compliance with regulations
6. Avoid use of pesticides and fertilizers on sloped lands.
7. Prevent run off of manure and divert it in basin for settlements.
8. Nitrogen fixing plants to be used to supplements the use of fertilizers.
9. Planting trees reduce pollution by sedimentations.
10. Separate drainage of sewage and rain water helps to prevent over flow of sewage with rain water.
11. Before the discharge of waste water it should be disinfected to kill the disease-causing bacterias.
12. The treated water should be reused for several purposes.

Water Quality Standards :→

Water quality standards are important because they help to protect and restore the quality of the nation's surface water consistent with the requirements of the clean water act.

There are some water quality standards given by diff. organization.

1. Indian standards Institution (ISI)
2. World Health Organization.
3. Indian Council of Medical Research
4. United States Public Health Science
5. Ministry of Work & Housing (MWH)
6. National Drinking Water Managment

According to IS 10500, ~~1991~~ 2012

Sr. No.	Parameter	desirable limit	permissible limit
1.	pH	6.5 — 8.5	No relaxation.
2.	Colour (Hazen unit)	5	15
3.	Iron	0.3	No relaxation
4.	fluoride	1.0	1.5
5.	Total Hardness	200	600
6.	Total Alkalinity	200	600
7.	Chloride	250	1000
8.	Nitrate or NO_3	45	100
9.	Calcium (Ca)	75	200
10.	Free Residual Cl	0.2	1
11.	Mg	30	100
12.	Total dissolved Solid	500	2000
13.	Odour	Agreeable	Agreeable
14	Turbidity	1	5

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Sewage treatment Method

(1) Unit Operation :→ Physical force are predominentes
exa → Screening, mixing, Sedimentations. etc.

(2) Unit Process :→ Treatment procen are envalued with addition of Chemical or the use of biological mass or microbial activities are known as unit procen.

Based on Biological unit

Suspended growth process.
1. Activated sludge process.
2. Aerated lagoon
3. Oxidation Pond
4. Aerobic & Anaerobic digester

Attached growth proce
1. Trickling filter
2. Rotating Biological Contactors.
3. Bio-Towers etc..

The type of Combination used ~~for~~ from the available unit operations and process for treatment of a particular wastewater is known as the treatment system.

① Preliminary Treatment System :-

Remove floating material & large inorganic particulate contents of waste water. They ar Consist of.

SCREEN CHAMBER → GRIT CHAMBER → SKIMMING TANT

⇓ ⇓ ⇓

Large debris are Removed | Inorganic Salids | Removing oil & grease

② Primary Treatment System :→ They are Consist of

SCREEN CHAMBER → GRIT CHAMBER → SKIMMING TANK → Primary Sedimentation tank

⇓

Organic Suspended Solid are removed

⇒ Primary treatment remove approx 60 to 70 % of Suspended Solid.

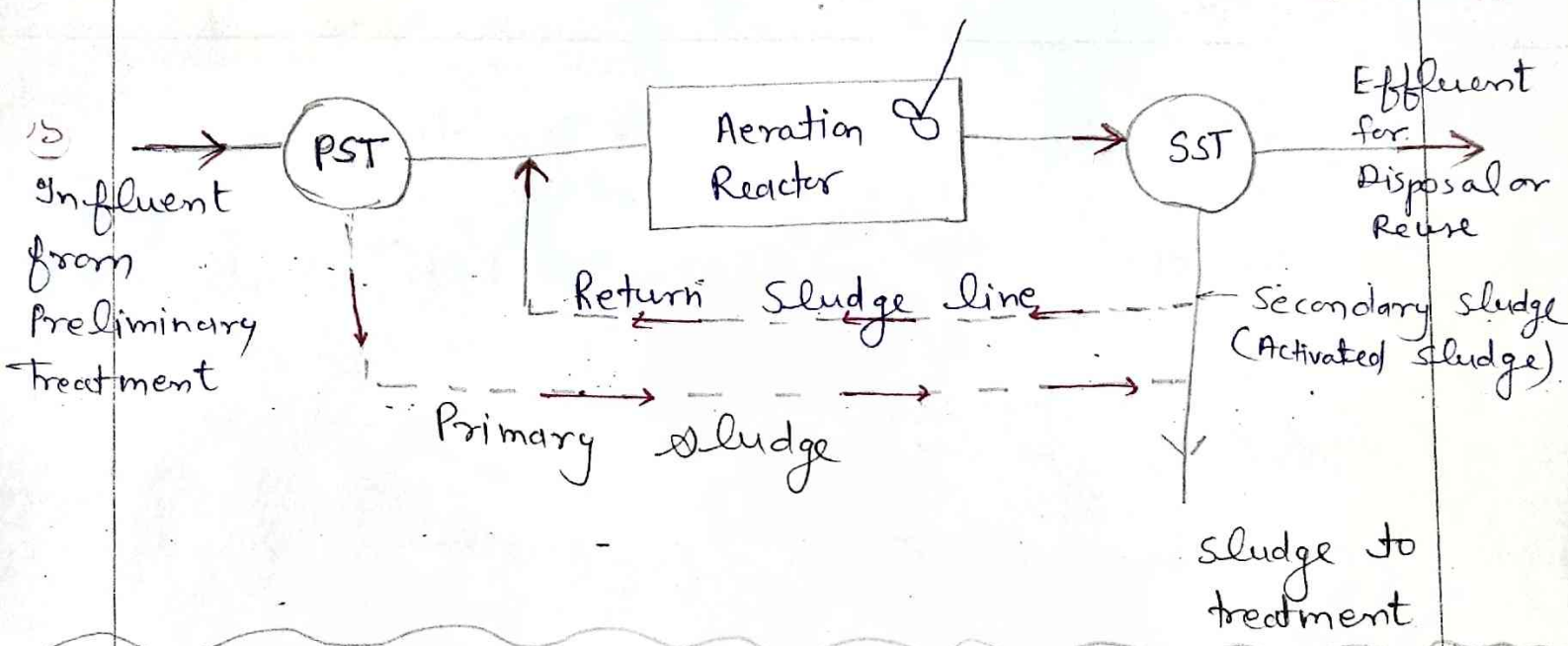
⇒ 30 % of influent BOD is removed in primary treatment.

③ Secondary Treatment System :→

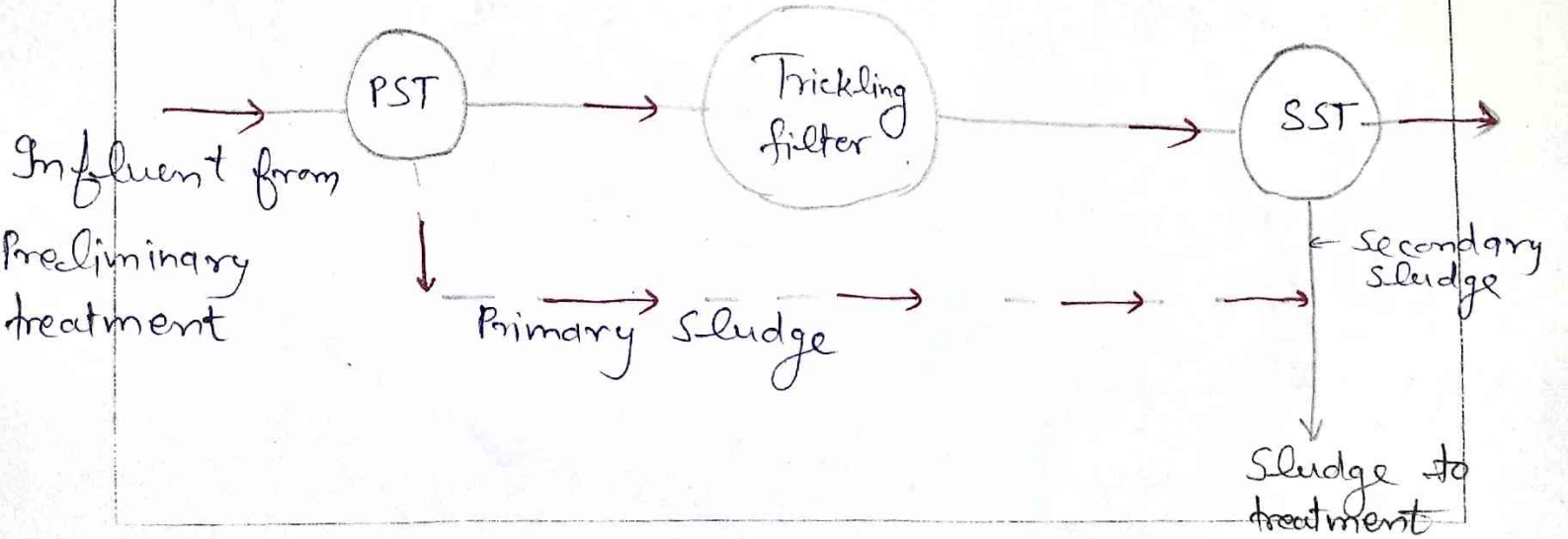
after primary treatment if waste water is further treated for the removal of calloidal and soluble organic matter Present in waste water. → it's called Secondary treatment.

⇒ Secondary treatment usually consist of biological conversion of dissolved and calloidal organic into biomass that can subsequently be removed by sedimentation.

(a) Secondary treatment system with activated sludge process :→



(b) Secondary treatment system with trickling filter :→



(4) Tertiary treatment :→

⇒ In most cases, secondary treatment of municipal wastewater is sufficient to meet effluent standards. In some instance, however, additional treatment may be required.

⇒ It's involve further removal of suspended solid and removal of nutrients.

⇒ ~~It's~~ Solid removal may be ~~co~~ accomplished by filtration, and phosphorus and nitrogen compounds may be removed by combination of physical, chemical and biological process.

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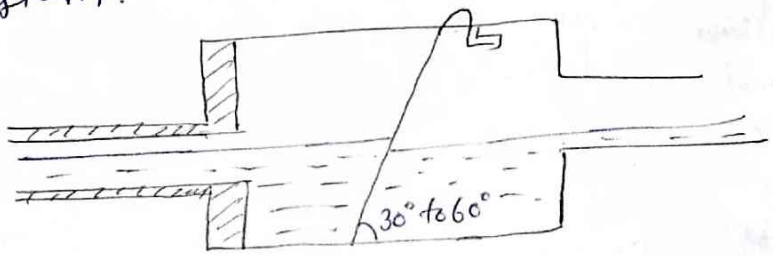
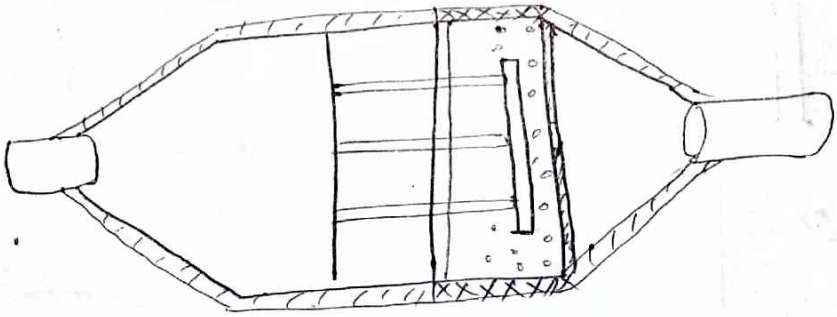
Waste Water treatment

Important terms in treatment Method.

① **Screening** :→ Waste water contains coarse solids such as sticks, rags, leaves, boards and food object and other large objects that often find their way into waste water collection system.



fine Screen



Coarse Screen

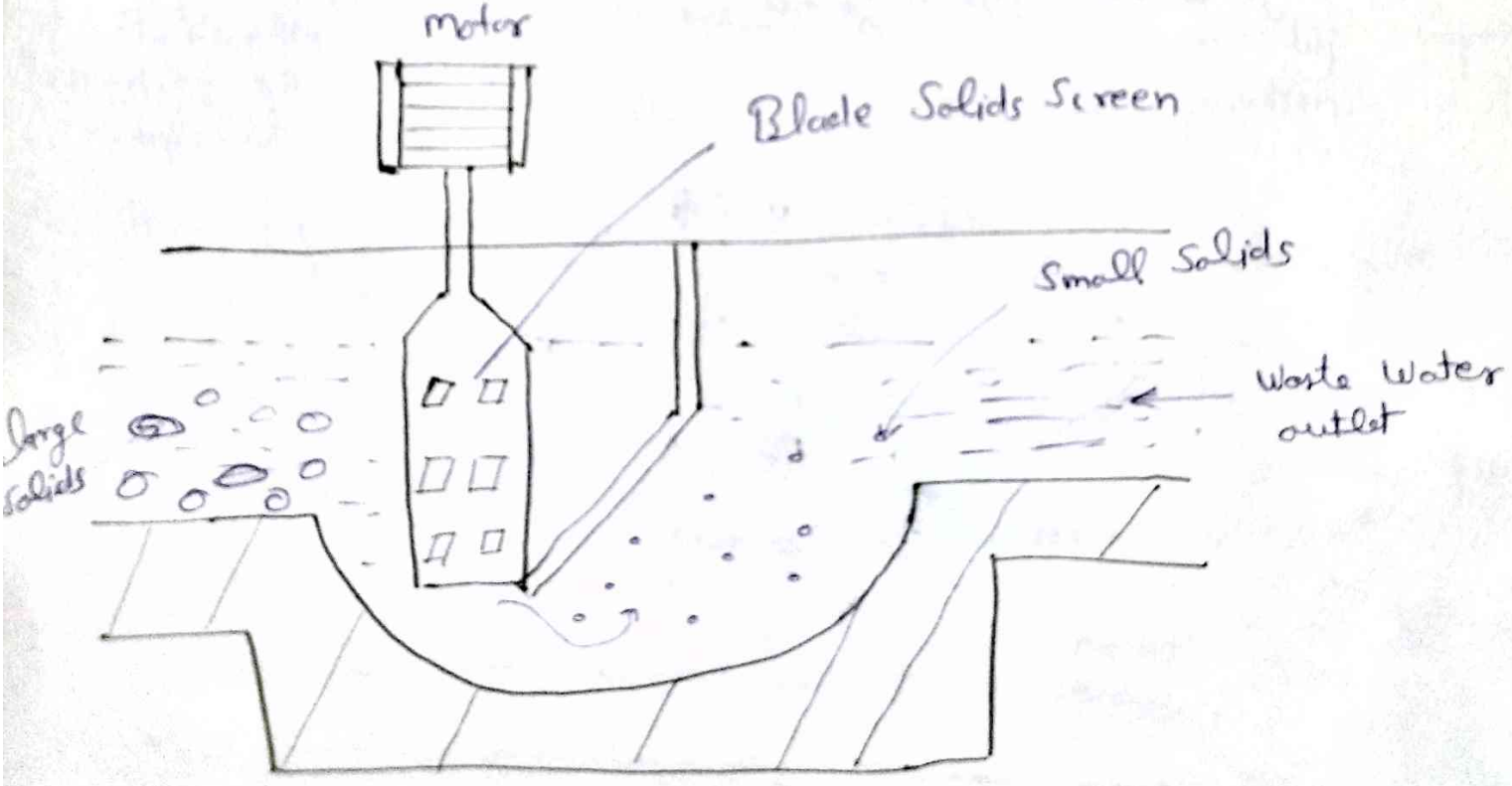
Fine Screen :- Fine Screen (10-20mm) Consist of woven wire cloth or perforated plates mounted on a rotating disk or drum partially submerged in the flow, or a travelling belt.

Coarse Screen :→ Coarse screen usually consist of vertical bars spaced 20-60mm apart and inclined away from the incoming flow. Solids retained by the bars are usually removed by manual raking in small plants while mechanically cleaned units are used in larger plants.

② Comminuting Devices :→ / Grinding Device :→

Grinders, cutters, and shredders etc are the device ~~used to~~ used to break or cut-up solids, to such a size that they can be returned to the waste water without the danger of clogging pumps or piping or affecting subsequent treatment devices.

There may be separate devices to grind solids removed by screens or a combination of screen and cutter installed within the waste water flow channel in such a manner that the objective is accomplished without actually removing these large solids from the waste water.



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(3) Grit Chamber :→ Waste water usually contains a relatively large amount of inorganic solids such as sand, silt, metal segment cinders and gravels are removed.

Grit Chambers are generally located ahead of pump or Comminuting devices. In these channels, the velocity is reduced sufficiently to deposit heavy inorganic solids but to retain organic material in suspensions.

Channel type chamber should be designed to provide controlled velocities as close as possible to 1.0 feet/sec. so that inorganic particle are settled easily.

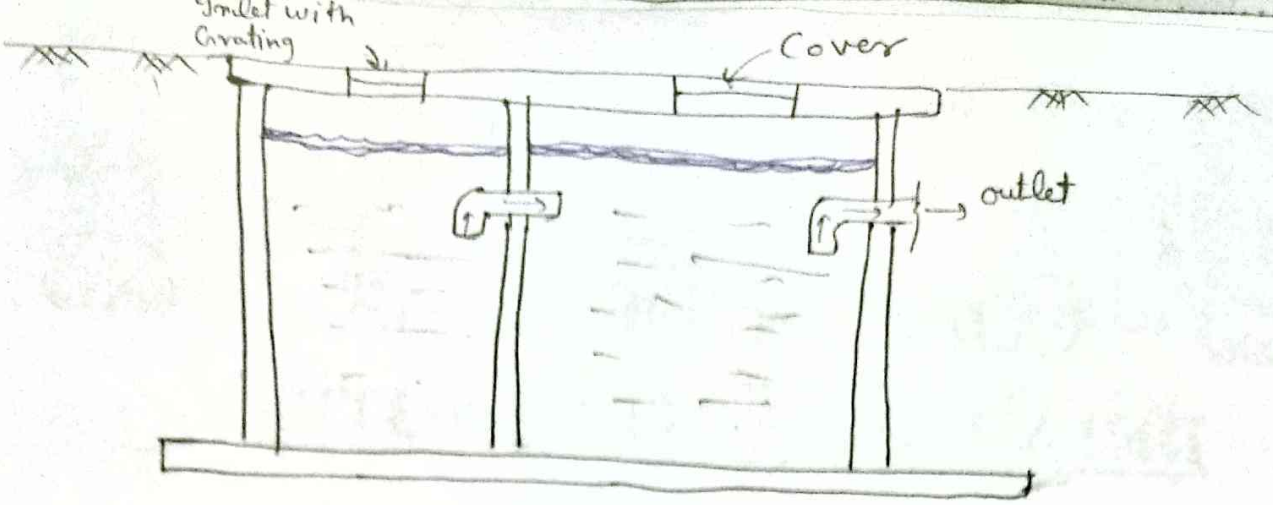
Cleaning of grit Chamber :- Grit Chamber are cleaned by hand, mechanically or hydraulically. There are number of mechanical cleaning units available which remove grit ~~require~~ by scrapers or bucket while grit chamber is in normal operation.

(4) Skimming tank

→ For removal of oil & greases, soaps, skimming tank is provided before sedimentation tank.

→ Chlorine gas may also be blown with compressed air or Chlorine may be added to the water to destroy the colloidal effects of proteins which hold grease in emulsified form.

→ Vacuators may also be used to remove grease.



(5) Pre-aeration Tanks: Pre aeration of waste water, that is aeration before primary treatment is sometimes provided for the following purposes:

1. To obtain a greater removal of suspended solids in sedimentation tank.
2. To assist in the removal of grease and oil carried in the waste water.
3. To freshen up septic waste water prior to further treatment.
4. BOD reduction.

(6) Pre chlorination: Pre chlorination is the chlorination of waste water prior to primary treatment. In general the objective of pre chlorination is eliminating problem associated with waste water decomposition.

1. Odour Control
2. Protection of plant structure
3. Aid in sedimentation
4. Reduction of BOD.

(1) + (2) + (3) + (4) + (5) + (6) + (7)

(1) + (2) + (3) + (4) + (5) + (6): Preliminary treatment

(7): Primary sedimentation tank

(1) + (2) + (3) + (4) + (5) + (6) + (7): Primary Tank.

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⑦ Sedimentation tank :- In primary sedimentation tank, organic suspended solids are settled. They have specific gravity normally 1.2

Types of Settling

ⓐ Discrete settling :→ occurs when particles do not change this size, shape or mass during settling. Grit, in waste water behave like discrete particle.

ⓑ Flocculent Settling :→ Flocculent particles coalese during settling increasing the mass of particles which settle faster.

ⓒ Hindered or Zone Settling :→ In hindered settling zone, the concentration of particle increases from top to bottom leading to thicking of sludge. ~~&~~ settled.

ⓓ Compression :→ In compression zone, concentration of particles becomes so high that particles are in physical contact with each other. the lower layer supporting the weight of upper layers & squeezing out of water from the pores between solid particles & settle to the bottom.

① + ② + ③ + ④ + ⑤ + ⑥ + ⑦

Primary Tank

Secondary Treatment (Biological Treatment)

aerobic treatment
- → Trickling filter
- → Activated Sludge process
- → Oxidation pond etc.

anaerobic treatment
- → Septic tank
- → Imhoff tank
- → UASB Reactor (upflow Anaerobic Sludge Blanket)

→ Attached growth → Trickling filter, Rotating Biological Contactor, Bio-Towers etc.

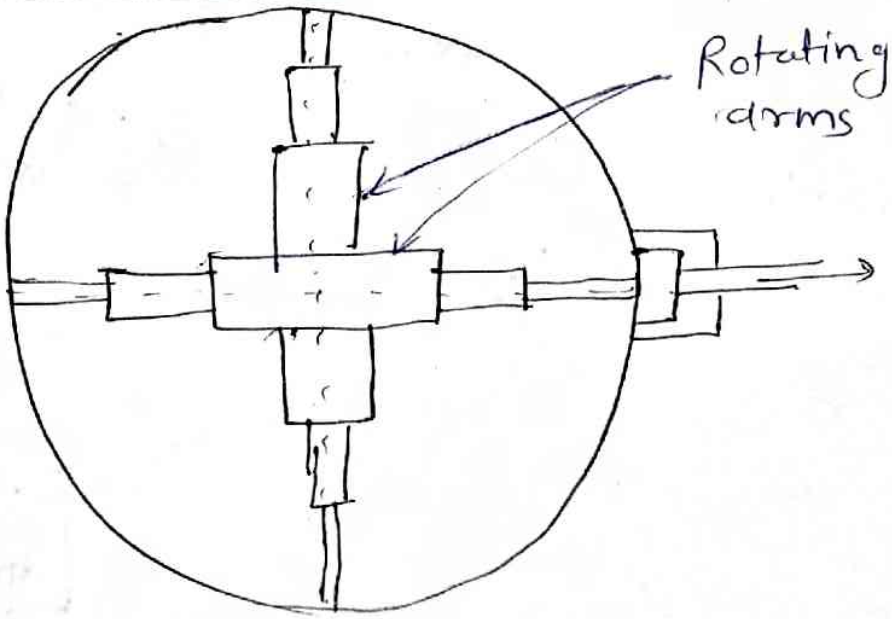
→ Suspended growth.
- → Activated sludge process
- Aerated lagoon
- Oxidation Pond
- Aerobic & Anaerobic digesters

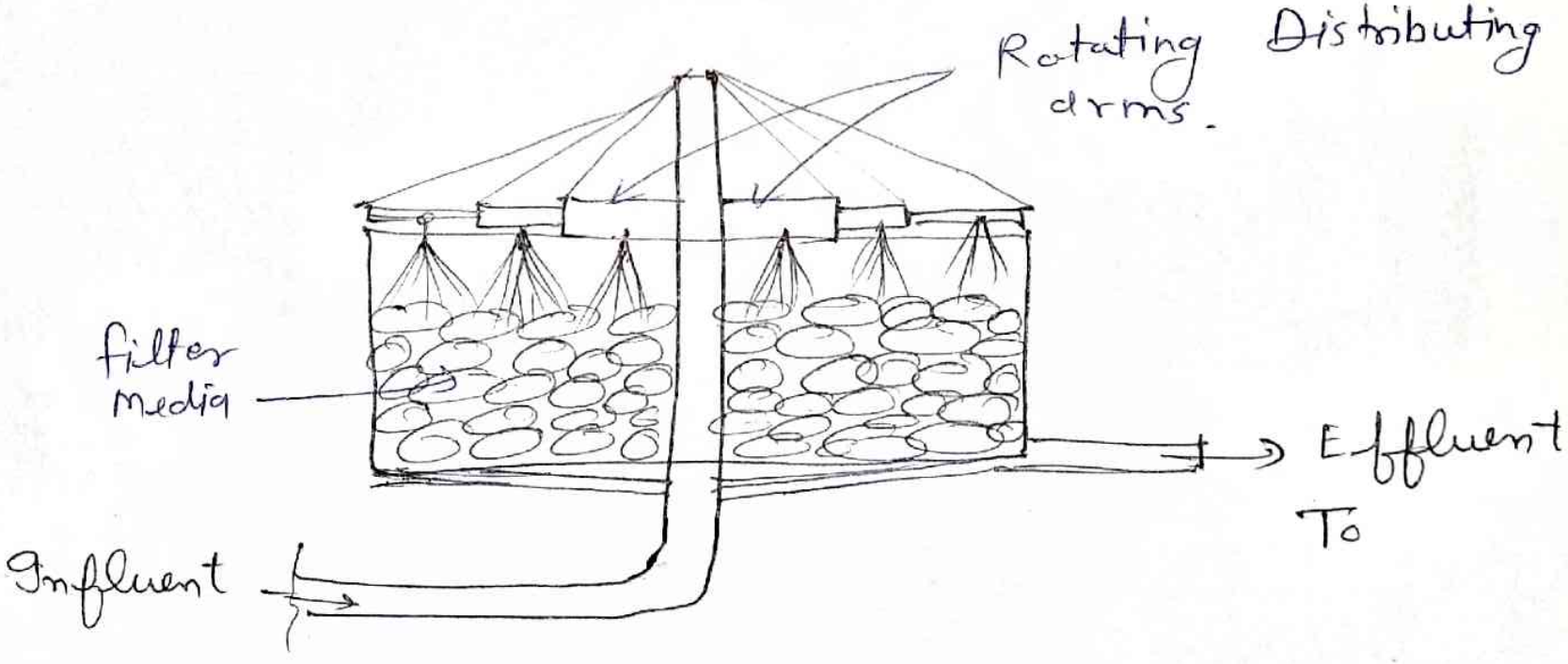
Trickling Filter → Trickling filter is the most common biological process for small and medium works in temperate climate.

→ Filters are constructed as beds of stone or gravel onto the surface of which settled sewage is sprinkled.

→ Air for oxidation process enters the bed through vents at the base.

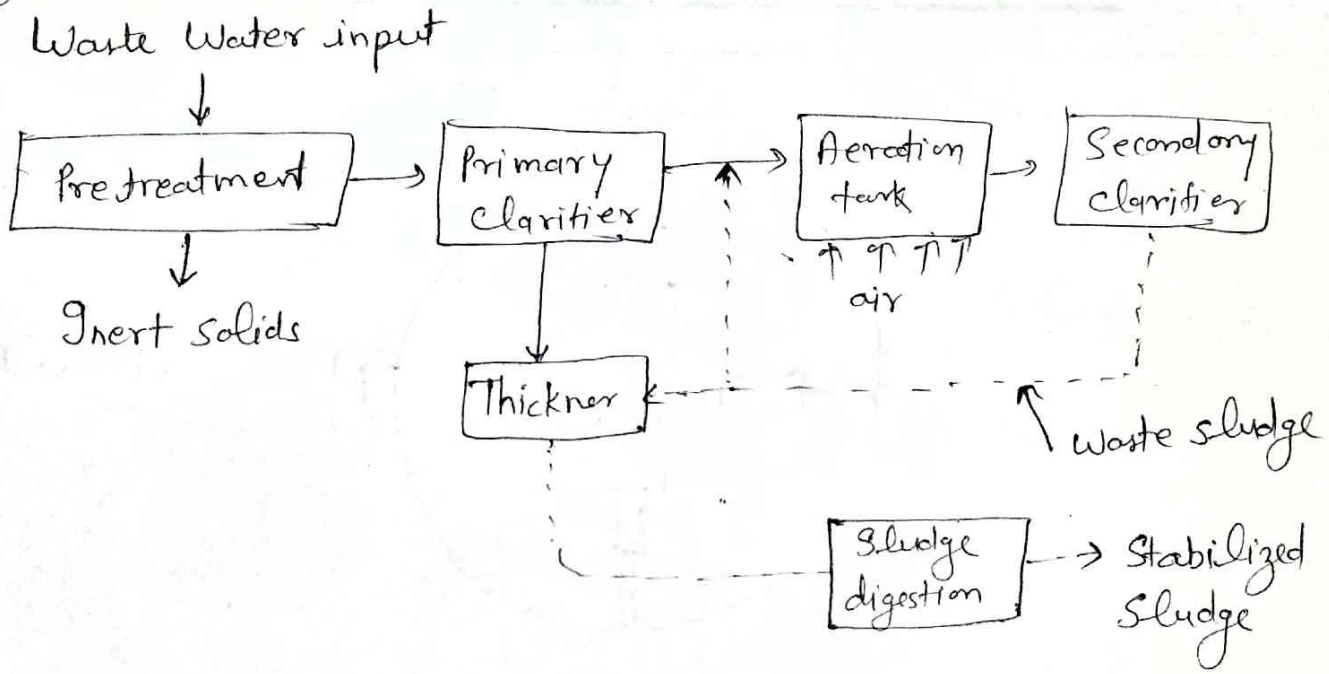
→ The filter usually consist of a 2m deep circular bed of random packed angular stone about 50mm in size and supported on a tile floor which allows the treated liquid to escape freely and ventilation air to enter the bed.

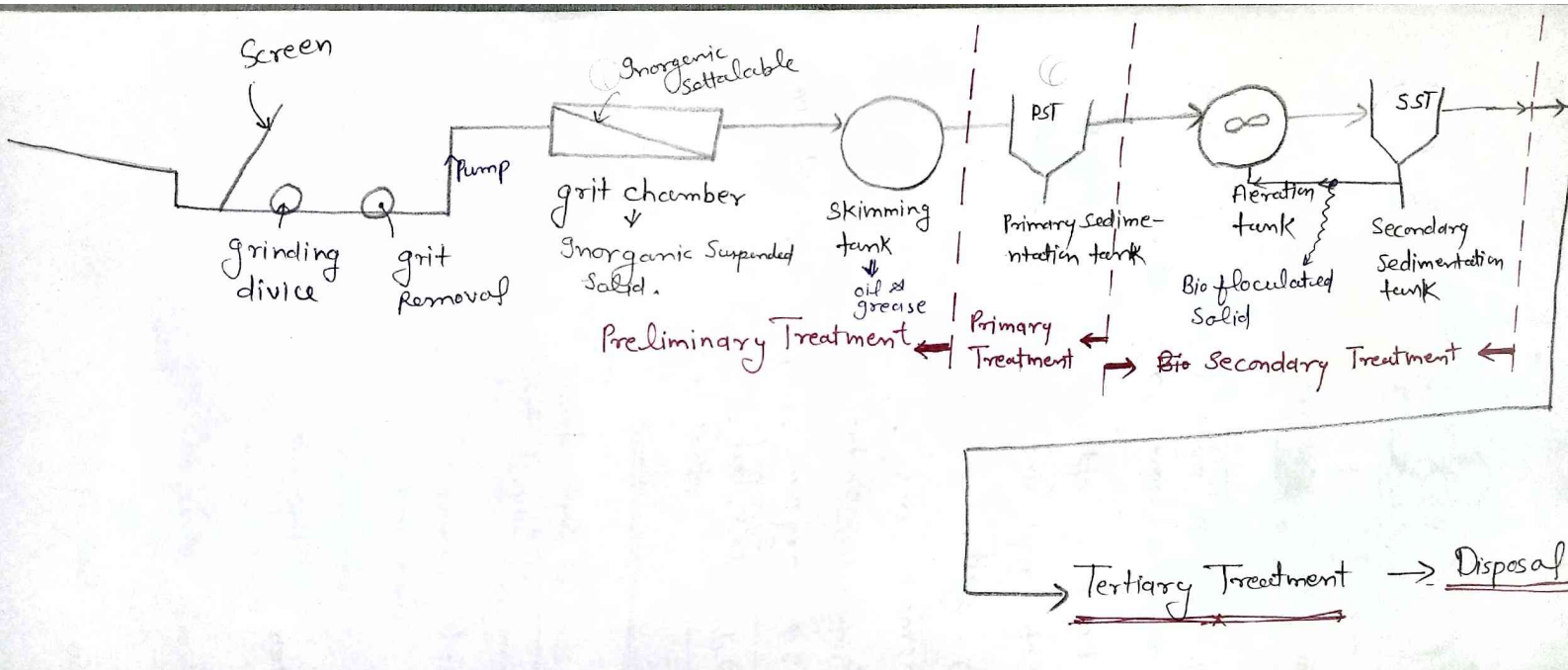

Rotating arms
Distributing
effluent


Rotating arms.
Distributing
filter media
Effluent
To
Influent

Activated Sludge Process (Suspended Growth System)

→ It is an aerobic suspended growth type biological process that uses the active micro organisms kept in suspension in the reactor to decompose and stabilize the soluble and particulate (colloidal and suspended) organic matter present in waste water.




Screen
grinding divice
grit Removal
Pump
grit chamber
Inorganic Suspended Solid.
Inorganic Settalable
Skimming tank
oil & grease
PST
Primary Sedimentation tank
Aeration tank
Bio flocculated Solid
SST
Secondary Sedimentation tank
Preliminary Treatment
Primary Treatment
Bio Secondary Treatment
Tertiary Treatment
Disposal

PAGE NO. .....

→ Primary Treatment
→ Preliminary Treatment

① Screening :→ Removal of certain material such as piece of wood, floating debris. leaves, rags etc.

② Grit Chamber :→ Befor & after sewage pump
→ Prevent clogging of pipe line, channel etc due to settlement of grit.

③ Skimming Tank :→ remove oil & grease
→ Provided before sedimentation tank.

④ Sedimentation tank :→ organic suspended solids are settled.

Secondary Treatment :→

- aerobic
  - → Trickling filter
  - → Activated Sludge process
  - → Oxidation pond etc.
- anaerobic
  - → Septic tank
  - → Imhoff tank

→ Tertiary treatment

→ Disposal of Waste Water

Disposal of Waste Water

There are two general method of disposing of the sewage effluents.

(a) Dilution i.e. disposal in water

(b) Disposal on land.

⇒ Disposal by dilution is more common of these two method

⇒ Standards of dilution for discharge of waste water into River

$$\text{Dilution factor} = \frac{\text{diluting water}}{\text{Sewage water}}$$

Dilution factor	Standards of Purification Requireds
> 500 →	No treatment
300 - 500 →	Primary treatment & suspended solid not more than 150 ppm.
150 - 300 →	Sedimentation, Screening, chemical Precipitation are required & suspended solid not more than 60 ppm.
< 150 →	Complete treatment, 5 Day BOD not exceed 20 PPm Suspended solid not more than 30 PPm

(8)

Disposal in Water

→ (a) Disposal in lake
→ (b) Disposal in river
→ (c) Disposal in sea

Disposal in land → On this case waste water disposed in sandy soil.
⇒ if we disposed in clay soil

Disposal in land :→

⇒ More organic load can be placed on a sandy soil than a clayey one.

⇒ overloaded soils develop anaerobicity, clogging and ponding of waste water reduction in soil permeability is referred to as a sewage sick soil

Reuse and Saving in use of Water

Many parts of the world are facing changes in climatic conditions such as rainfall pattern, flood cycle and drough which affect the water cycle.

Facing with these challenge, Reuse & Saving of water is nessary.

Water Reuse in Industries :→

Waste water reuse for irrigation is quite common in many places

Practices of waste water reuse vary among countries, as target applications and technology options differs significantly depending on socio-economic circumstances, Industrial structure, climate culture, religious preference as well as policy readiness.

Water Reuse in Homes :→

Some tips on saving and reuse water at home:

→ Turn off the tap when not in use.

→ Regularly check taps and pipes for leaks and repair any leaks detected.

→ Never pour water in sewage sewer line when there may be another use for it.

→ Washing machine rinse water, especially the last few batches of rinse water can be used for toilet flushing and floor cleaning.

→ Reuse water from washing of fruits, vegetables, and kitchen utensils water to water plants.
→ Install water efficient taps and shower heads to cut water usage.
→ Use a pail of water to wash your car rather than a hose.

Categories of waste water Reuse.

→ Urban area → Irrigation of parks, playgrounds, etc.
→ used in fire protection
→ disaster preparedness, construction

→ Agricultural area → used for food crops.
→ used for fodder, fibre, flowers etc.

→ Recreational use → fishing, Boating, swimming

→ Environmental enhancement → Artificial wetlands creation, natural wetland enhancement, stream flow, ~~stre~~

→ Ground water Recharge → Ground water replenishment for potable water, salt water intrusion control, subsidence control.

→ Industrial reuse → Cooling system water, boiler feed water, toilets, laundry, construction wash-down water, air conditioning.

→ Residential Use → Cleaning, laundry, toilet, etc.

→ Potable reuse → Blending with municipal water supply, Pipe to pipe supply

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Rain Water Harvesting and its Methods: →

Rain water harvesting is the accumulation and storage of rainwater for reuse before it reaches the ~~the water~~ aquifer

Necessity of Rain Water Harvesting

1. To meet increasing demands of water
2. To raise water table by recharging ground water
3. To reduce ground water contamination form salt water intrusion.

Surface water is inadequate to meet our demand and we have to depend on ground water.

Rain Water Harvesting methods

1. Storage of rain water on surface for future use.
2. Recharge to ground water

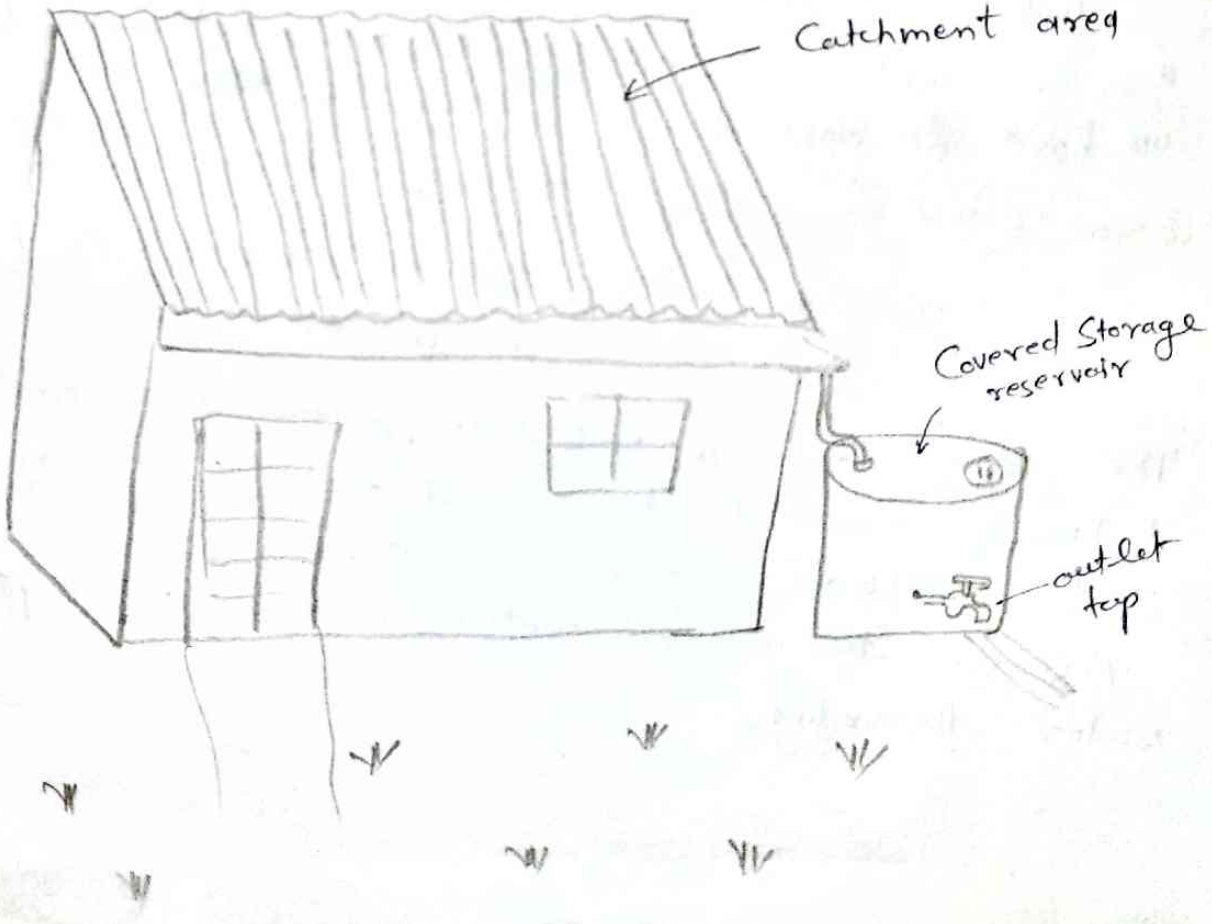
The storage of rain water on surface is a traditional techniques and structure used were under ground tanks, ponds, checkdams and weir etc.

Recharge to ground water is a new concept of rain water Harvesting.

Component of Rain water Harvesting

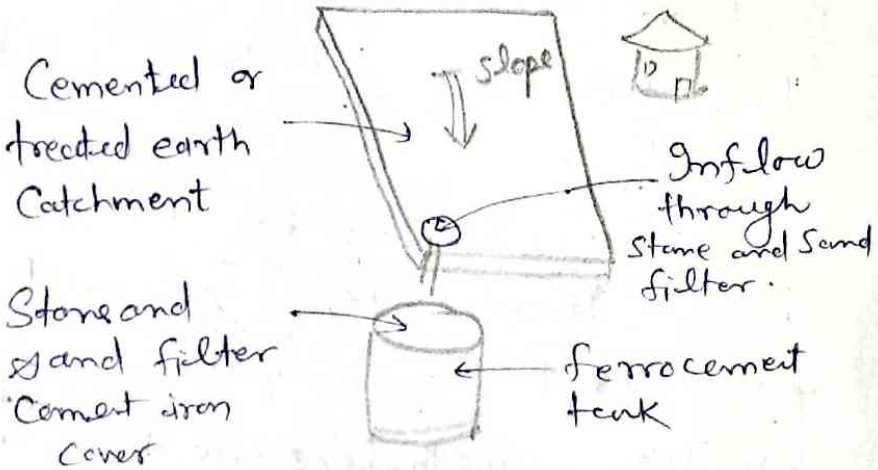
- Cathment Area
  - → Roof top Catchment
  - → Land surface catchment
  - → Clearing or altering vegetation cover
  - → Increasing slope of collect
  - → Soil Compaction by physical means
  - → Soil Compaction by Chemical treatments.
- Collection device
  - Storage tank
  - Rainwater Containers
- Conveyance System

① Roof top Catch ment :-



In the most basic form of this technology, rain water is collected in simple vessel at the edge of the roof.
→ Roof catchment should clean so collected water is pure otherwise wise dust, leave etc are presents

(2) Land surface Catchment :→
Rainwater harvesting using ground or land surface catchment area is less complex way of collecting rain - water. It involve improving run off capacity of the land.



(3) Increasing Slope of Collection :→
Steeper slope can allow rapid runoff of Rainfall to the collector. However, the rate of runoff has to be controlled to minimise soil erosion from the cathment field.

4. Clearing or Altering Negetation Cover: → Clearing vegetation from the ground can increase surface runoff but also can induce more soil erosion. Use of dense vegetation cover such as grass is usually suggested as it help to both maintain high rate of runoff and minimize soil erosion.

5. Soil Compaction by Physical means:- This inoulu, compacting of soil surface using equipment such as graders and rollers, increase the runoff rate.

6. Soil Compaction by Chemical treatments:-
In addition to clearing, shaping and compacting a catchment area, chemical application with such soil treatments as sodium can significantly reduce the soil permeability.
→ use of aqueous solution of a silicon-water repellent is another techniques for enhancing soil compaction technologies.

Collection Device

① storage tanks:- Storage tanks for collecting rainwater harvested using guttering may be either above or below the ground.

② Rain water Containers:- As an alternative to storage tanks, battery tanks (i.e, interconnected tanks) made of pottery, ferrocement, or polyethylene may be suitable.
→ The polyethylene tanks are compact but have a large storage capacity (1000 to 2000l).

Conveyance System :→ Conveyance system are required to transfer the rain water collected ~~to~~ on the rooftops to storage tank. This is usually accomplished by making connection to one or more down pipes connected to the rooftop gutters.

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Solid Waste Management :→

① Solid Waste → arising from
human, animal

they are normally solid and hence are useless or unwanted.

Types of Solid Wastes

① Municipal Wastes ② Industrial waste ③ Hazardous Waste.

Municipal Waste → generated from different zone of the city. also known as Community refuse.

→ Consists of refuse, trash,
(garbage & rubbish)

Refuse :→ Non hazardous solid waste

Garbage :→ highly decomposable (puterscible) food, (450 to 900 kg/m³) waste, vegetables and meat scraps.
(liable to decay)

Rubbish :→ mostly dry, non decomposable (non puterscible)
(50 to 400 kg/m³) material → glass, rubber, tin cans, or
Combustible material → paper, textiles, wooden etc.

Ashes :→ incombustible waste products from hearths and furnaces, and houses or industry.

→ 700 to 850 kg/m³

Industrial Waste :→ generated from industrial activities

non hazardous hazardous.

Some Common industry waste are

(I) Paper and pulp
(II) metallurgical Industries
(III) Pesticides / Insecticides
(IV) Fertilizers
(V) Plastics
(VI) Refinieries

Hazardous Waste :→ those substance contribute to increased mortality, illness or hazard to human health and environme

→ According to RCRA (Resource Conservation and Recovery Act) USA, → define in four part

(I) ignitability → ज्वलनशीलता
(II) Corrosivity
(III) Reactivity
(IV) toxicity

Some Common Hazardous Waste :→

(I) ferrous, Non ferrous industries
(II) foundris
(III) Cement industry
(IV) Petroleum "
(V) chemical

Biomedical Waste :→ Produced from Hospital & Medical Store.

E waste :→ Electronic Waste

→ (T.V, Computer, chip, memory Card, Mobile etc.)

Agriculture Waste :→ agricultural operation from farms, Poultry houses & slaughterhouses.

Collection and transportation of Solid Waste

→ In India, refuse is generally collected in individual houses in small containers and from there it is collected by sweepers in small hand driven lorries/ carts and then dumped into the community storage bins made by municipalities placed at intervals of 50 - 200 m depending on the layout of street and density of population.

→ While transporting, spreading & scattering should be avoided

→ Transport vehicle should be cleaned periodically.

→ Community storage bin as well as transport vehicle should be covered.

→ Transport vehicle should be water tight.

→ Mechanical device should be installed in these vehicle for lifting the body ~~to the sides~~ so that empty it quickly and easily

→ for transported the waste material for large and densly populated area should be selected in order to optimize the collection system.

Disposal of Solid Waste :-

1. open dumping
2. Sanitary land fill → Imp
3. Composting
4. Pulverisation (shredding)
5. Incineration
6. Pyrolysis

1. open dumping

→ Very simple method and commonly adopted in our country
→ In open dumping, SW dumped in low lying areas located far off from the city.
→ ~~Not an~~ This method is highly unacceptable as it gives nuisances, obnoxious smell and is a breeding place for flies and mosquitoes.
→ Still in practice in semi-urban and rural areas.

2. By sanitary land filling (Imp)

Important terms included in

1. Site selection
2. landfilling method & operation
3. occurence of gases and leachate in landfills
4. movements and Control of land fill gases and leachate.

Methods in sanitary land filling

→ Select the area for dumping operation.
→ Entire area divided into grid patterns (smaller portion)
→ It invalves a controlled disposal of SW on or in the upper layer of the earth's surface.
→ Refuse is dumped and compacted in layer of 0.3 to 0.6 m and after the day work when depth of filling becomes about 1.5 m, it is covered by earth layer of about 15 to 30 Cm thickness.
→ Befor dumping the second layer, compaction is done by movement of bull dozers etc.

→ A minimum clearence distance of 6m from the surrounding area.

→ Insecticides like DDT, creosote etc. should by sprayed to prevent mosquito breeding

Land filling method divided into → 3 Part

① area method :→ when the ground is unsuitable for trench excavation especially when the water table is high.
→ entire area is divided into subarea & same procedure follow as above.

② Trench Method :→ ideally suitable where adequate depth of cover material is available at the site and where the water table is well below the surface.
→ In this method, a trench is excavated and then filled waste & cover by earth cover. as describe earlier

③ Depression Method :→
At location where natural or artificial depression exist. it is possible to use them effectively for land filling operations Canyons, ravines, dry borrow pits and quarries have all been used for this purpose.

Steps involving refuse stabilisation

→ Due to absence of O_2, anaerobic and facultative bacteria develop to decompose the organic matter and H_2 and CO_2 gases produce through acidogenic activity

→ methanogenic bacteria gets stablised the orgenic matter and produce methane gas.

→ Within 2 to 4 months, original heights settle down by 20-40% and can be used for park, green land etc.

Gases and leachates in land fill :→

Gases :→ air, NH_3, CO_2, CO, H, H_2S, CH_4, N_2, O_2

↳ CO_2 & CH_4 are principal gases

→ movement of landfill gases can be controlled by the landfill sealants.

(compacted clay is most commonly used)

Leachate :→ may be defined as liquid that has percolated through solid waste & soil ~~& goes to contact etc~~ this leachate pollute the soil & ground water.

→ Control :→ clay liners, synthetic liners, geotextiles use for controlling the leachate.

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③ Composting Method :→ It is the natural process of decomposition of organic waste which contains 35% to 40% organic matter & very rich in nutrients.

→ Composting is a biological process in which micro-organisms mainly fungi and bacteria, convert degradable organic waste into humus like substance.

→ This end product looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants.

④ Pulverisation (Shredding)

→ Refuse is pulverized in grinding machine & redue its volume & change its physical character.

→ This pulverized refuse, contains fertilising elements like potash, Phosphorous and N_2 material yet cannot be suitably used as a manure. It has, therefore, to be further disposed of by filling in trenches, or digested in open windrows or closed digestors.

⑤ Incineration

→ Reducing the volume and weight of SW by burning it in a well designed furnance.

→ When the available land is scarce, disposal requirements are string out and destruction of toxic water is necessary, incineration is the best method for treatment of SW.

→ Estimation of O_2 requirements and heat balance are very vital for efficient functioning for the incineration Process.

6 Pyrolysis :→ Most organic compounds can be converted into gaseous, liquid and solid fraction through a combination of thermal cracking and condensation reaction in absence of oxygen.
→ This process is known as pyralysis and destructive distillation.

Recycling of Solid Waste :→

① energy recovery, ② sanitary land fill, ⑤ Onsite Sanitation.
(above topics)

~~② Energy Recovery :→~~

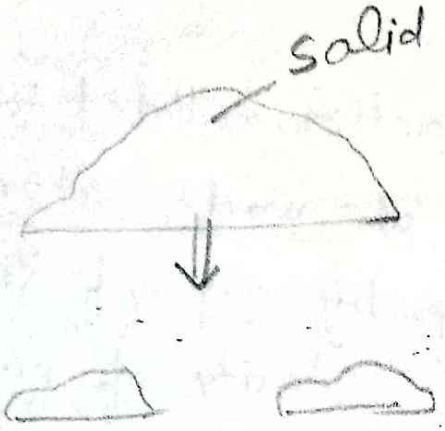
① Reuse : Waste being used for the same purpose again (such as refilling a soft drinks bottle);

② Recovery : Processing of waste material so that it can be used again as the same material, such as the processing of waste paper to make pulp and then new papers.

③ Conversion :→ Processing the waste to make something different like → Padding from clothing
Sleeping Bag from plastic bottles
Compost (खाद) from food waste

④ Energy Recovery : Usually refering to the burning of waste so that the heat can be used for heating water of swimming pools.
Another method of energy recovery is to Collect the gas that is produced in very large sanitary land fills and use it as a fuel or to generate electricity

@ Thermo Chemical Conversion :→



④ Bio-chemical Conversion :⇒

used when high percentage of organic material (like food, vegetable etc.)

→ anaerobic method is adopted.

→ absence of O_2

→ Produce biogas → used in electricity & Heat

→ Residue of anaerobic digester → used in Agriculture field. & work as Soil Conditioner.

⑤ On Site Sanitation :⇒

On site sanitation is the whole of action related to the treatment and disposal of excreta & waste water, that cannot be carried away by an off site Sanitation system because of low density of population.

off site Sanitation :⇒ It is appropriate for large scale exploitation based on technical and economic feasibility studies (sewer networks, run off water drains, etc.)

Characteristics of on site Sanitation

Individual on site sanitation : Single home

grouped on site sanitation : when many individual house are linked to a network of small communities leading to a single treatment system.

Methodologies of Sanitation

→ On Site Sanitation is low cost disposal methods. like septic tank, Soak Pit. etc.

→ find the capacity of particular located field like School hospital, industry etc. for designing of excreta tank.

→ Adapt Better Methodology for the implementation of technologies developed for Construction of hygienic toilets for on site sustainable sanitation facilities and prevention of environmental pollution on a large scale in urban area as well as thousands of village.

→ Consultancy services are provided in the field of sanitation. It organize seminars/conference to bring about a change in socio cultural attitude related to toilet.

→ Workers are getting job for Construction & maintenance of toilets.

EFFECTS :→

→ Preventive health care due to safe disposal of human excreta.

→ Prevention of ~~defect~~ defecation in the open.

→ Provision of privacy and dignity to women and girls.

→ Prevention of environmental pollution of water bodies i.e. ponds, rivers and lakes.

→ Reduction of emission of gases in the atmosphere which reduce green house effects.

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Air Pollution

Air pollution may be defined as, any atmospheric condition in which certain substance are present in such concentrations that they can produce undesirable effects on man and his environment.

Sources of air Pollution

(1) Natural Sources:→
- (a) Pollen grains
- (b) fungal spores
- (c) bacteria
- (d) forest fires
- (e) Smoke
- (f) marsh gas or methane
- (g) Aero sols → Dispersion of solid or liquid particles of microscopic size in gaseous media.
- (K) Dust → liquid particle of large size
- (i) Mist
- (j) fog → if mist Concentration is high & affect the visibility, called fog
- (k) fumes → fine solid particle (

(2) Man made
- (i) Gases →
  - (i) Sulphur dioxide
    Source: → Combustion of fuel & Coal, refineries chemical plants etc.
  - (ii) Hydrogen Sulphide & Mercaptans
    → foul Smellings gas

Source: →

→ [illegible] catalyst during processes [illegible] and in the ocean
→ Fertilizers
→ Paper industry
→ Manufacture of [illegible] in chemical plants

(III) Hydrogen fluoride :
Sources : Phosphate fertilizers, Al industry, brick plants, Pottery.

(IV) Oxide of nitrogen
Industry where nitric acid is produced

(V) Nitric oxide & nitrogen dioxide are classified as pollutants
(NO) (NO_2)

Carbon monoxide
Incomplete combustion of carbonaceous material
→ automobile exhausts.

(VI) Oxide hydro[illegible] :
Produced by the combustion of gasoline, diesel oil, fuel oil or natural gas.

Primary air pollutants are those emitted directly from identifiable sources.

Eg :→ Fine particles (less than 100 micron)
Coarse " (greater than 100 micron)
Sulphur compounds
Oxides of Nitrogen
Carbon monoxide
Halogen compound
Organic "
Radioactive compound

Secondary air Pollutants :→ are those which are produced in the air by the interaction among two or more primary pollutants.

Eg :→ Ozone, formaldehyde, PAN (Peroxy acetyl nitrate)
Photochemical smog, formation of acid mists (H_2SO_4)
(Sulphur dioxide + H_2O)

SMOG → Smoke & fog (mixture)
↳ 2 type → ① Photochemical
② Coal Induced.

Photochemical Smog → Interaction of some hydrocarbon and oxidant (mainly nitrogen oxide) under the influence of sunlight giving rise to dangerous. PAN

modern Smog → traffic Smog.

Effect of air Pollution on Human.

① Sulphur di oxide(SO_2) → irritant gas, effects mucous membrance when inhaled. it leads to bronchial spasms Asthma patients are badly affected.

② CO → react with haemoglobin of the blood to form carboxyhaemoglobin (COHb.) & reduce the O_2 carrying capacity.

③ Oxide of Nitrogen: → causes eye & nasal irritation & pulmonary discomfort.

④ Hydrogen Sulphide & Mercaptans: → ratten egg like odour. fatigue of the sense of smell.

⑤ Ozone: → irritant action in the respiratory system & reaching much deeper into the lungs than the oxide of Sulphur.

⑥ Lead: → effects on liver, kidney, gastro intestinal damage.

⑦ Hydro carbon Vapour: → eye & respiratory irritation caused by photo chemical smog.

⑧ Carcinogenic Agents: → responsible for cancer.
origin → incomplete of combustion of hydro carbon.

⑨ Insecticides: → affect central nervous system.

⑩ Radio active Isotopes: → anaemia, leukaemia and cancer.

effects of air Pollution on Animal: →

When the animals feed upon the particulate coated plants especially with lead, arsenic, they get affected with lead or arsenic poisoning (cattle & sheep). Lead poisoning results in bronchitis and lack of appetite in animals.

effects of air pollution on plants

SO_2, Hydrogen fluoride, Ozone, Cl_2, HCl, NO_2 etc affect plants.

→ Recovery of plants from Hydrogen fluoride effect is much slower than SO_2 attack.

→ Chlorine is more toxic to vegetation than SO_2

Control of Air Pollution

→ Using non conventional energy sources.
→ Anti pollution measures should be adopted by all industries.
→ Removing oxides of nitrogen during combustion, sulphur from coal, particulates from exhausted gases etc.
→ Less polluting fuel should be used (eg. Hydrogen gas)
→ Planting more trees.
→ Sites for industries should be located after paper EIA studies.
→ Control the vehicle pollution by modification of engine technology, fixing catalytic converters using cyclone separators, electrostatic precipitators and scrubbers.

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→ **Noise Pollution** :→ It defined as "unwanted sound in atmosphere"

→ Noise is measured in decibels (dB). a basic unit of Sound.
→ Hearing loss begins if a person is exposed to noise level of 80-90 dB (for more than 8 hr a day.)
→ A noise level of 180 dB Could kill a person.

Sources of Noise pollution

→ Road traffic
→ Aircraft
→ Industrial operation & construction activities such as generators, road rollers, factory equipment etc.
→ The celebrations, elections, functions, religious festivals Public meeting etc. contributes to noise pollution.
→ Entertainment sources like TV, radio, loud speakers etc. also causes noise pollution.

CPCB → (Central Pollution Control Board) Standards of noise level.

	dB
Rural	→ 25-35
Suiburban	→ 30-40
Residential (urban)	→ 35-45
Residential & Business (Urban)	→ 40-50
City	→ 45-50
Industrial	→ 50-60

Ambient air quality Standards :→

	Day time	(Night time)
Silence Zone →	50	40
Residential area →	55	45
Commercial area →	65	55
Industrial area →	75	70

Effects of Noise Pollutions : →

→ Affects hearing ability
→ Heart Problem (Increase in heart beats)
→ Head ache → impairment of night vision.
→ Lowering concentration and effect on memory.
→ Muscular strain
→ Nervous break down
→ Depression & fatigue
→ Stress
→ frustration
→ Irritability
→ Disturb the concentration & interferes with conversation
→ Serious damage to wild life
→ hypertension

Noise Pollution level & Harmful effects.

Level	effects
< 23 dB	No disturbance
30 - 90 dB	– stress tension, psychological effects, muscle pains, high blood pressure, insomnia etc.
60 - 120 dB	→ Health damage, ear diseases.
> 120 dB	→ Painful effects.

Control of Noise Pollution :→

1. Producing less noise is the best method to reduce this pollution.
2. Machineries should be redesign to reduce noise.
3. Shields like earphones, earplugs earmuffs and other noise absorbing materials should be provided.
4. Heavy vehicle & old vehicle should not be allowed in the populated areas.
5. Proper oiling of old machinery reduce noise.
6. Silencers can reduce noise pollution. Sound proof Chambers should be installed.
7. More no of tree (having broad leaves) should be Planted.
8. Noise producing aerodromes, railway stations, industries etc should be located away from human settlements
9. there should be silence zone around residential area hospitals and educational institutions.
10. The rule should be fixed for the noise level of fire crackers, industrial activities etc.

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Ozone layer depletion :→ 90% of the total ozone content of our atmosphere occurs in the stratosphere at altitude between 15 to 50 Km.

→ the ozone layer acts as a filter for Ultra-Violet radiation from the sun & serves as a protective shield to human life against the adverse effects of UV like burn be harmful to ∄ life on this earth. Hence ozone layer termed as ozone umbrella.

→ Primary reason for ozone layer depletion is CFC (Chlorofluoro carbon) or freons.

→ Ozone is destroyed due to the photolytic reaction of CFC as shown below:

$$CFCl_3 \xrightarrow{UV} Cl + \text{other substance}$$

$$Cl + O_3 \longrightarrow ClO + O_2$$

→ if we destroyt the cl then we can protect to ozone layer

Protection :→→ Methane, destroys cl and thus offords protection to the ozone layer. &

→ NO_2 reacts with cl and helps to prevent the depletion of ozone layer.

→ When there is no cl present in floro carbons, they are called hydro floro carbon. This is the very important replacement for CFC & protect the ozone layer.

→ VIENNA Convention & MONTREAL Protocol was concerned with ozone layer depletion.

① Green House Gas & global Warming :→ The atmospheric gas which are permeable to short wave solar radiation like U.V or Visible, but are strong absorbers of long wave radiation (IR) emitted from the surface of earth and do not allow their escape from the atmosphere are known as greenhouse gases.

Exq :→ CO_2 , CH_4 , nitrous oxide (N_2O) , CFCs ,
O_3 & Water Vapour (H_2O)

→ These gases in the lower level of atmosphere behave like the glass covering of a greenhouse.

→ greenhouse gases do not allow these radiation to escape from the atmosphere & increse the temp of earth that is already present on the earth's surface. This result in an increase in temp. and is commonly known as greenhouse effect.

→ Global Warming & Climate change difined as. Charge in average surface temp of the globe due to increasing Concentration of greenhouse gases in the atmosphere.