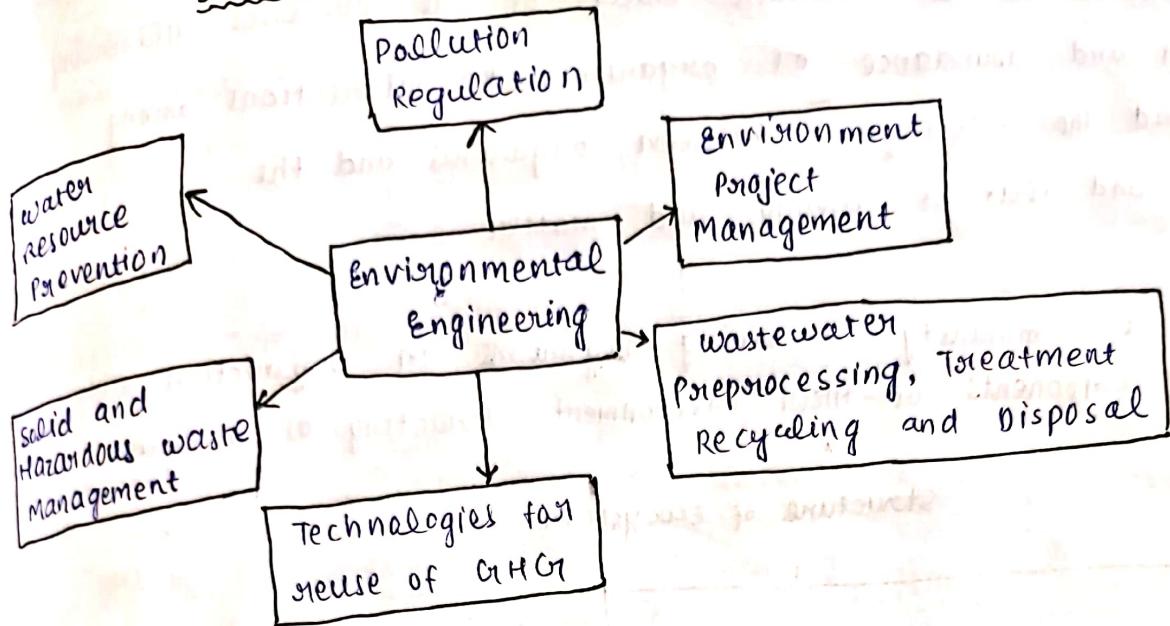


Unit-1

Environment and Ecosystem

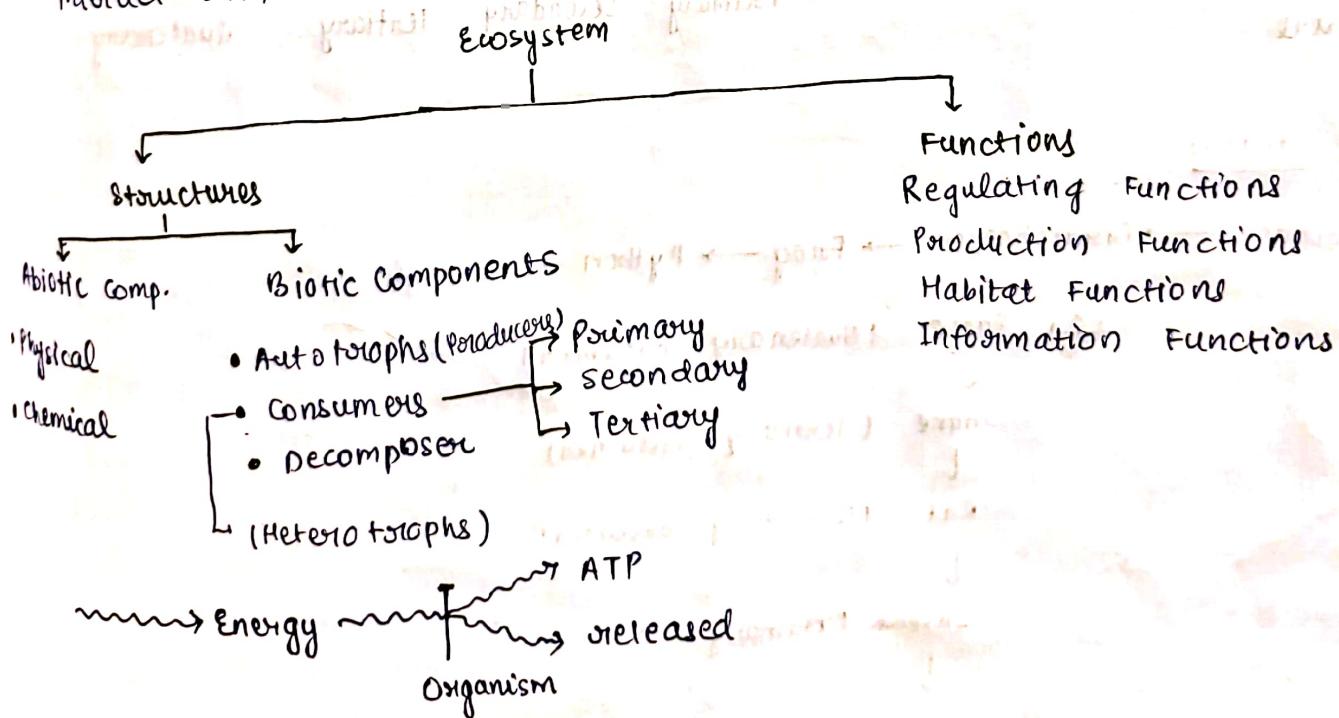


Environment :-

Environment refers to the surroundings, whereas, ecosystem is the interaction between the environment and living organism.

Environment is the area where the living organisms live.

Ecosystem is the community where biotic and abiotic elements interact with each other.

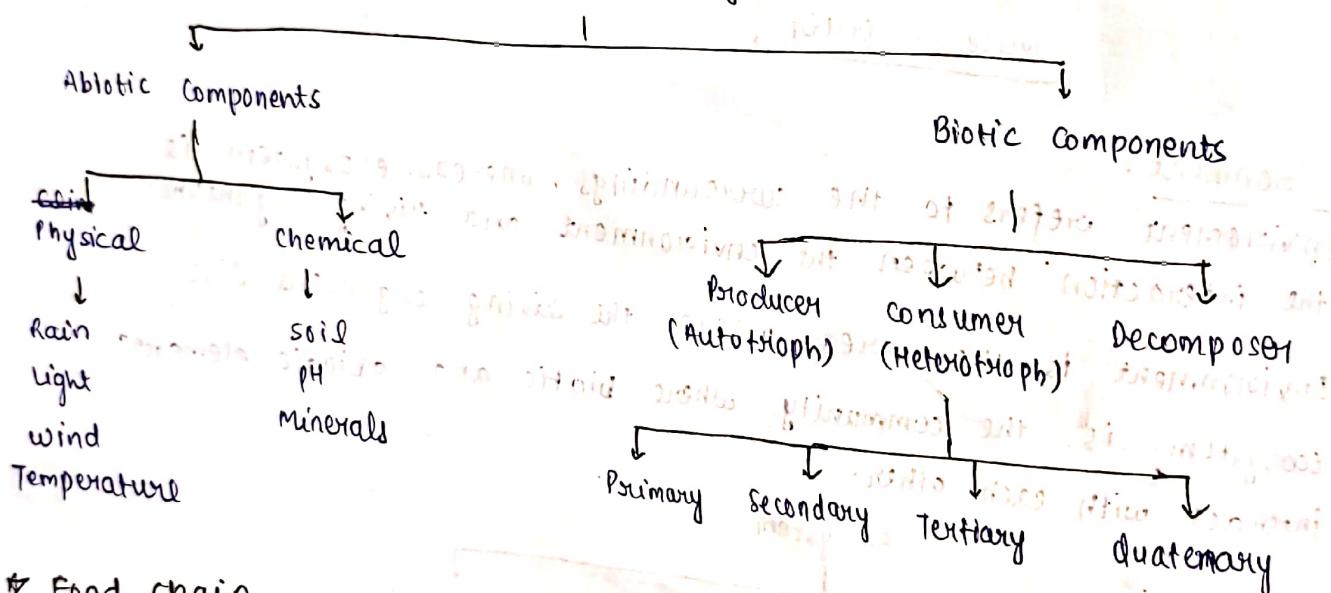
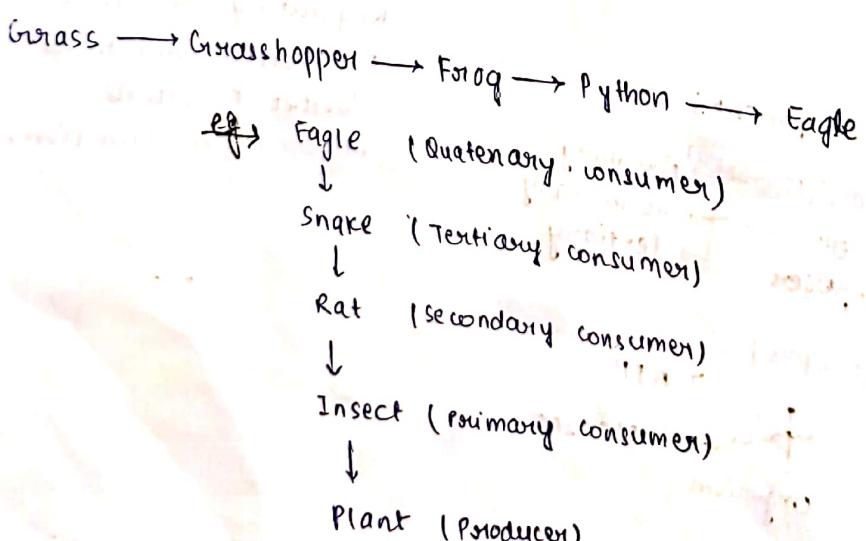


Ecology:-

Ecology is defined as the scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms and the interactions between organisms and the transformation and flux of energy and matter.

Ecosystem:-

Ecosystem is a community of living organisms in conjunction with the non-living components of their environment, interacting as a system.

Structure of EcosystemFood chain

In food chain every organism eats the smaller and is eaten by larger one. All those organisms which are interlinked by means of food together formulate food chain. Various species are known as trophic level.

Food web:-

Different food chains are usually linked at various trophic levels to form complex interaction amongst various species from the point of view of food.

Ecological Pyramid:-

Graphic representation of trophic structure and function of ecosystem

Producers at base and successive trophic levels at apex.

Types of Pyramid

- Pyramids of numbers
- Pyramids of biomass
- Pyramids of energy

1. Pyramids of numbers :-

It represents no. of individual organisms at each trophic level.

Represented by number / sq. m

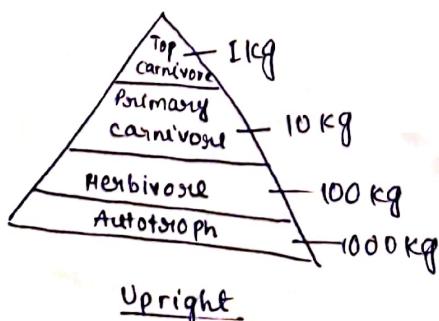
Drawbacks:

- Do not consider size of individual organism.
- No. of individual at each trophic level depends upon availability of biomass.

2. Pyramids of biomass :-

Based upon total biomass at each trophic level.

Represented by grams / sq. m.

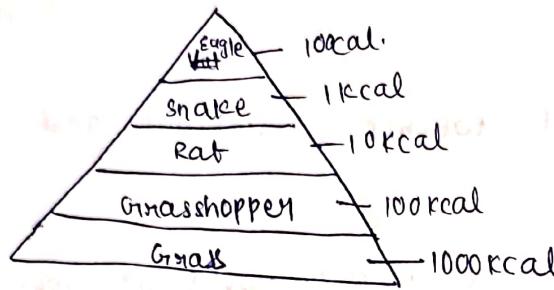


Can be upright or inverted

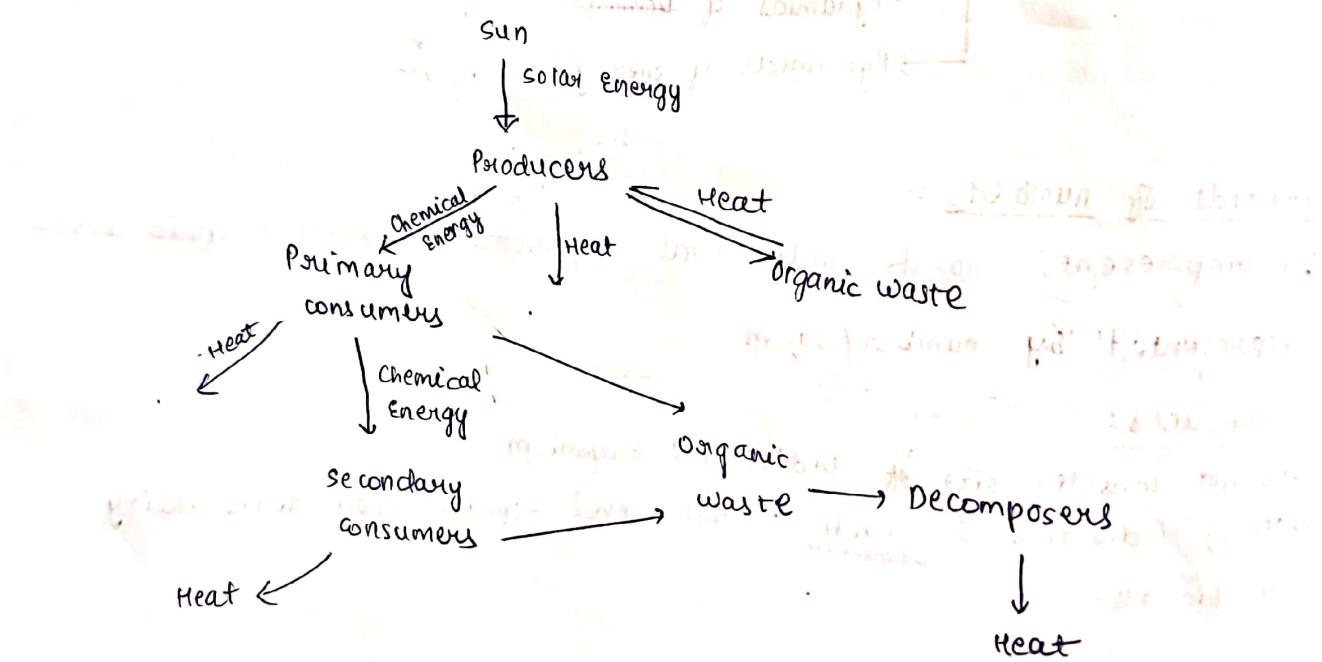
3. Pyramid of energy:-

Greatest amount of energy - base of pyramid.
least → top

Energy pyramid can never be inverted.



* Energy flow in ecosystem:



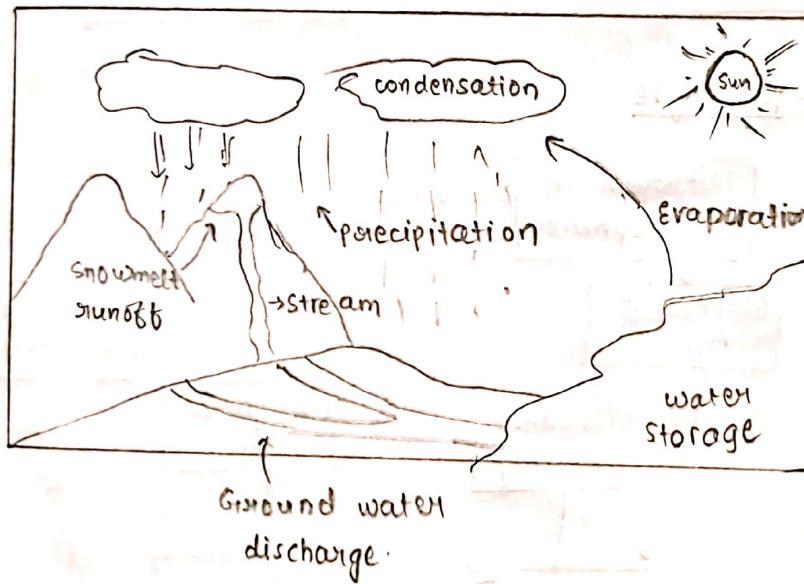
Biogeochemical Cycle :-

The cyclic exchange of nutrient materials between living organisms and their non-living environment is called as biogeochemical cycle.

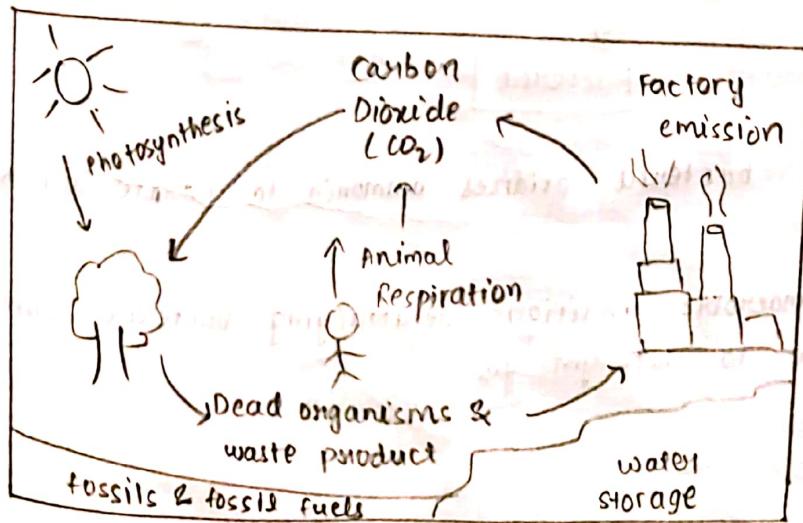
It includes :

- 1) Hydrological or water cycle
- 2) Gaseous cycle
- 3) Sedimentary cycle.

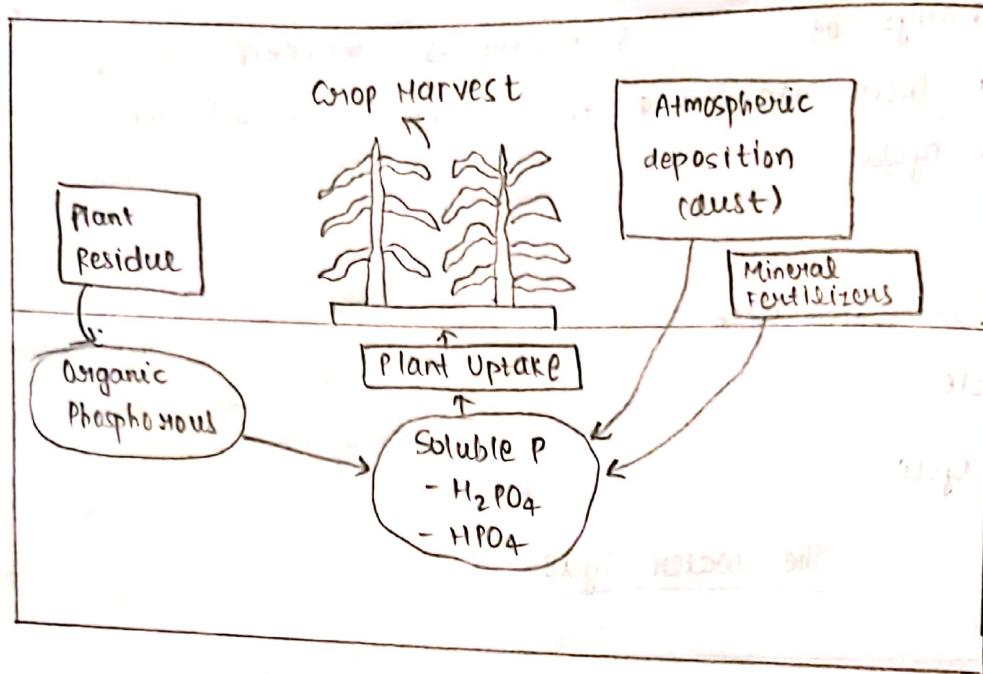
The Water Cycle



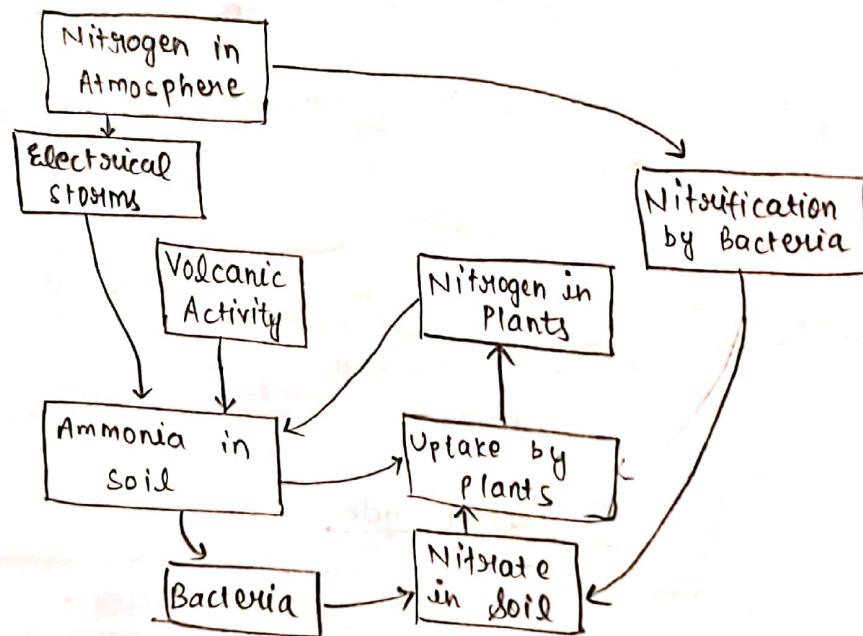
The Carbon Cycle



Phosphorous Cycle



Nitrogen Cycle



Nitrification :- Nitrifying bacteria oxidizes ammonia to nitrate and then to nitrite.

Denitrification :- Under anaerobic conditions, denitrifying bacteria converts nitrate to nitrogen gas.

It can be affected by:

- Fertiliser production
- Burning of fossil fuel.
- Increasing animal wastes
- Increased sewage
- Increased erosion of and runoff nearby streams.

Ecology

Auto Ecology

ecology of individual species and its population

Syn Ecology.

ecology of communities and their composition.

Types of Ecosystem:-

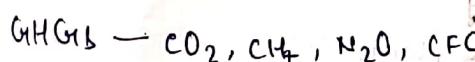
1. Grassland
2. Forest
3. Desert
4. Aquatic
5. C.M.P
6. Urban

Three Major Principle of Ecosystem

1. Nutrient cycling
2. Energy flow
3. Structure

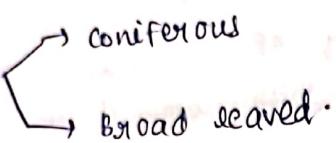
* Carbon Footprint :-

A carbon footprint is the total greenhouse gas (GHG) emission caused directly or indirectly by an individual, organisation or product.

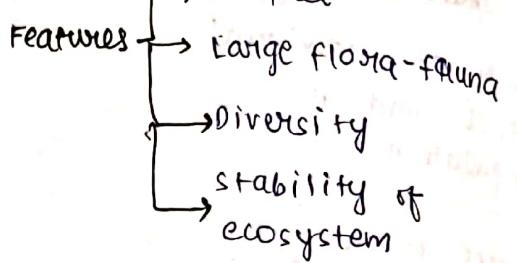
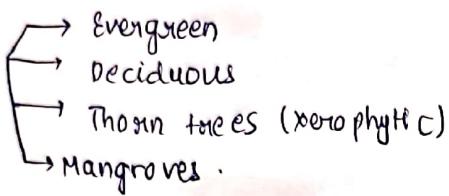


* Forest Ecosystem :-

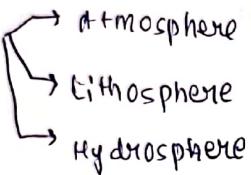
Based on leaf characteristics



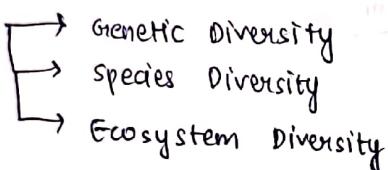
Based on tree species



* Ecosystem

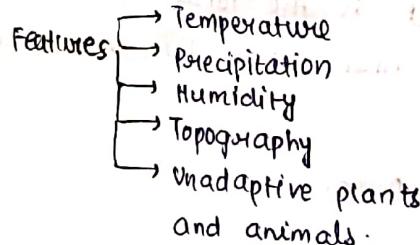


* Biodiversity



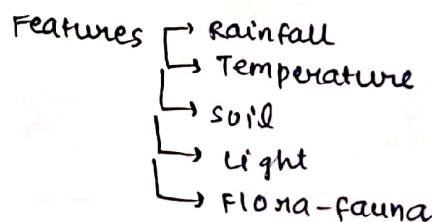
* Grassland Ecosystem :-

↓
Temperate grassland
Tropical grassland
Desert grassland.



* Desert Ecosystem :-

Tropical Desert (Driest & hottest)
Temperate Desert
Cold Desert



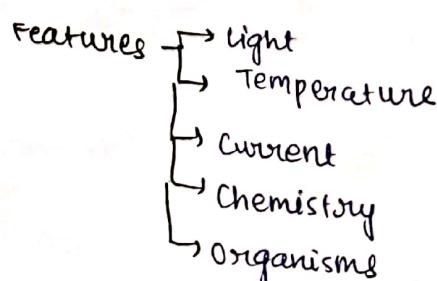
* Aquatic Ecosystem :-

Ocean

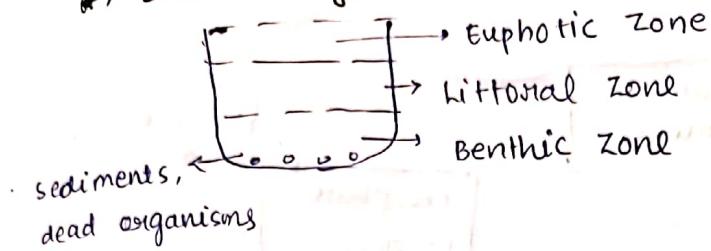
lotic (river - Free flowing)

lentic (still - pond, lake)

wetland



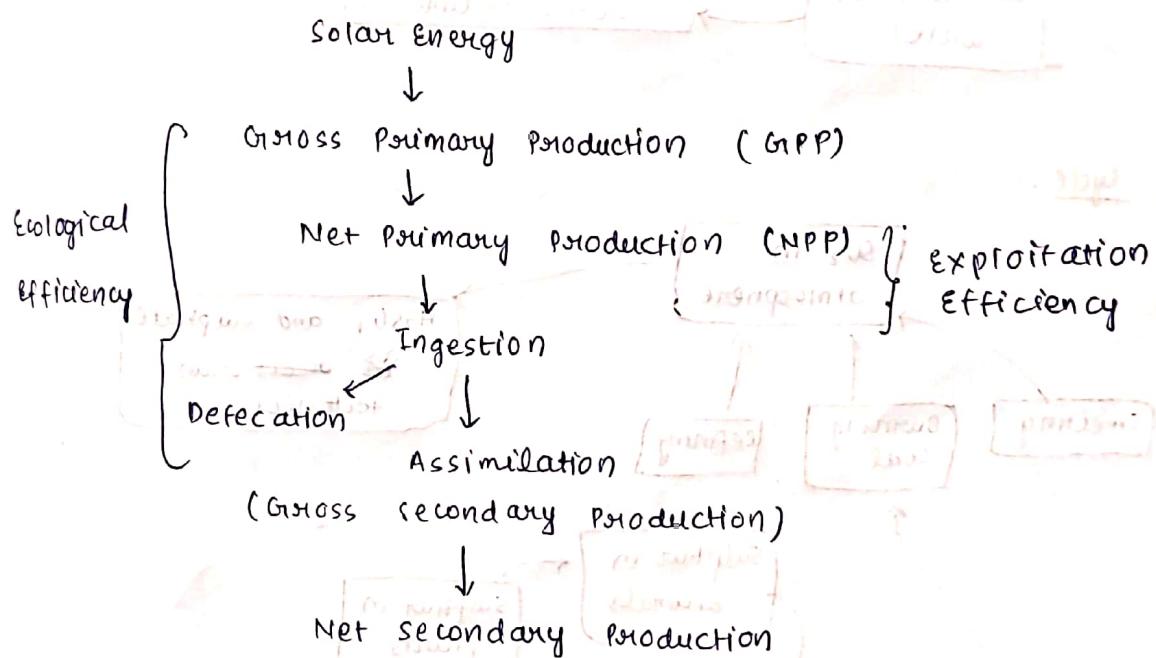
* Lake Ecosystem - Zones



* Energy Flow



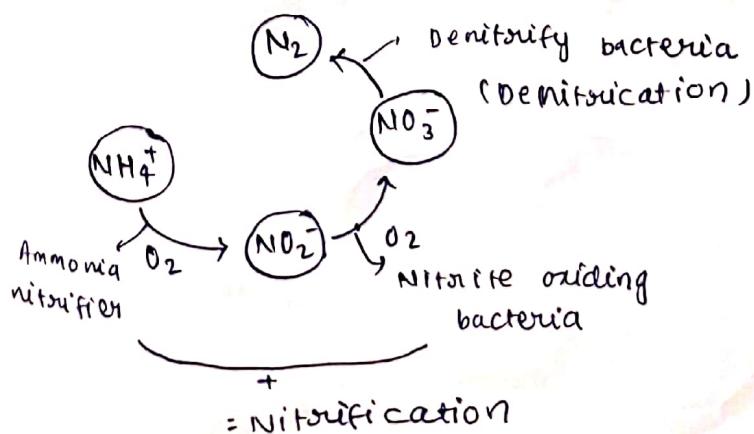
* Energy and Material Flow through Ecosystem



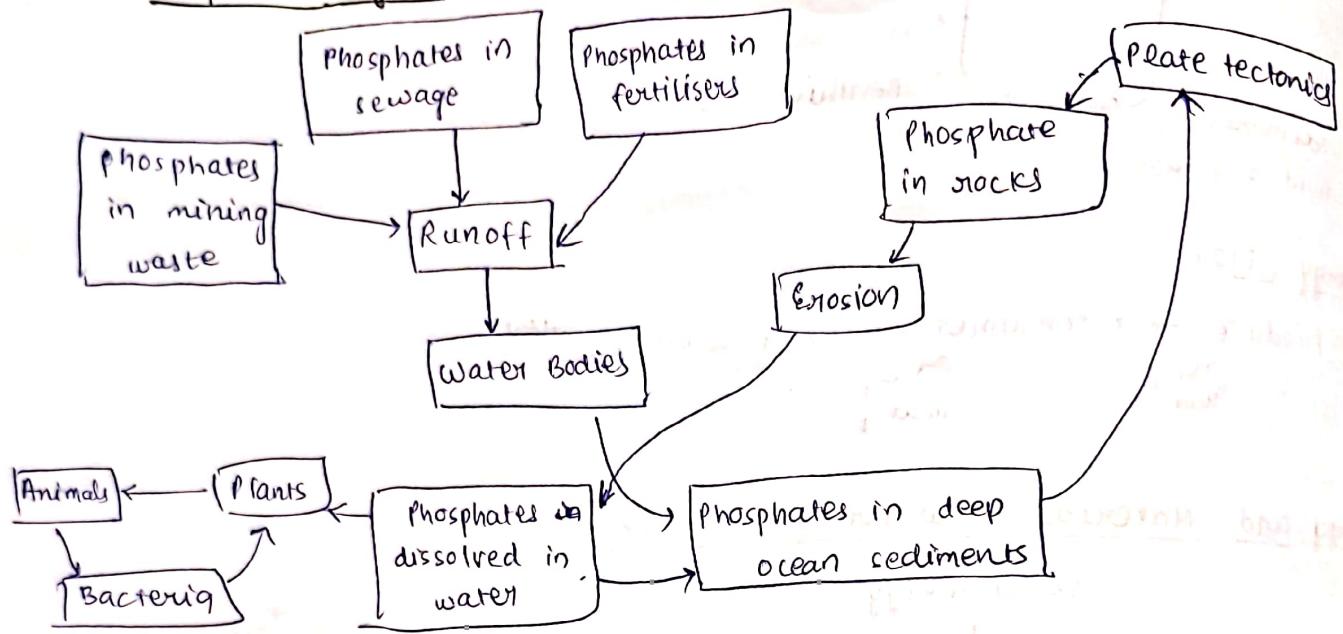
* Ecological Efficiency

Efficiency with which the energy is flowing at each trophic level.

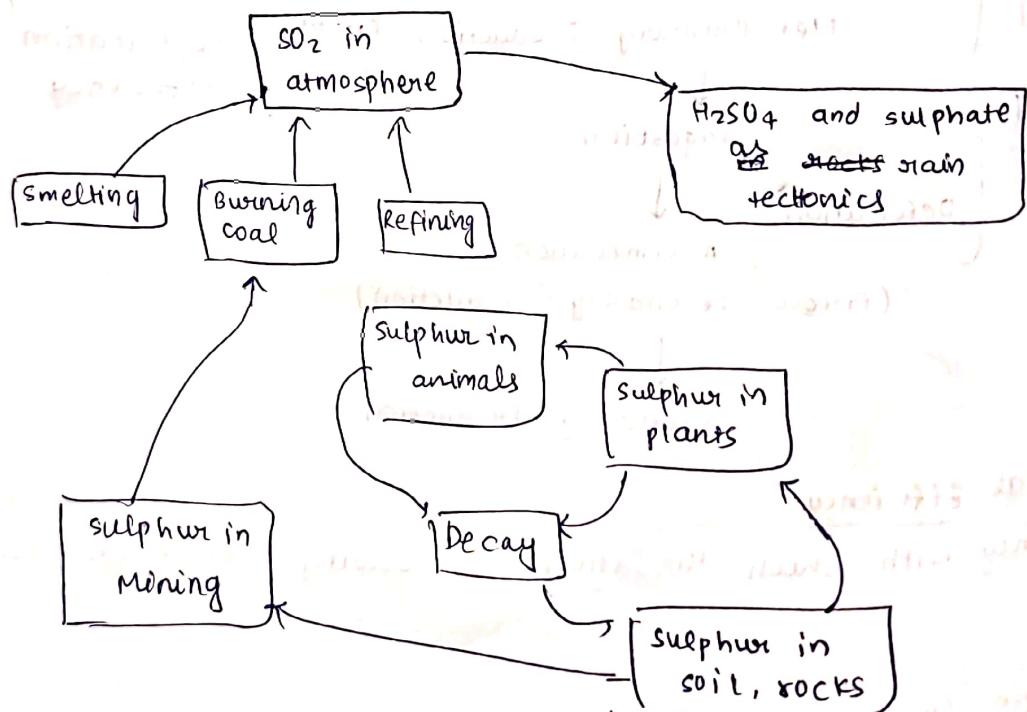
* Nitrogen Cycle



* Phosphorous Cycle :-



* Sulphur Cycle :-

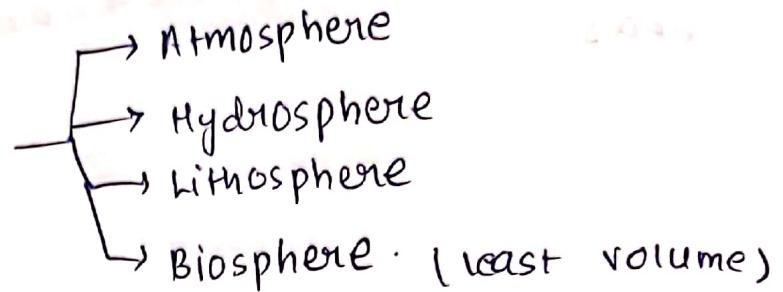


* Ecological Footprint :-

It is the measure of land required to grow our food, process our organic wastes and sequester our CO₂ and provide our material needs.

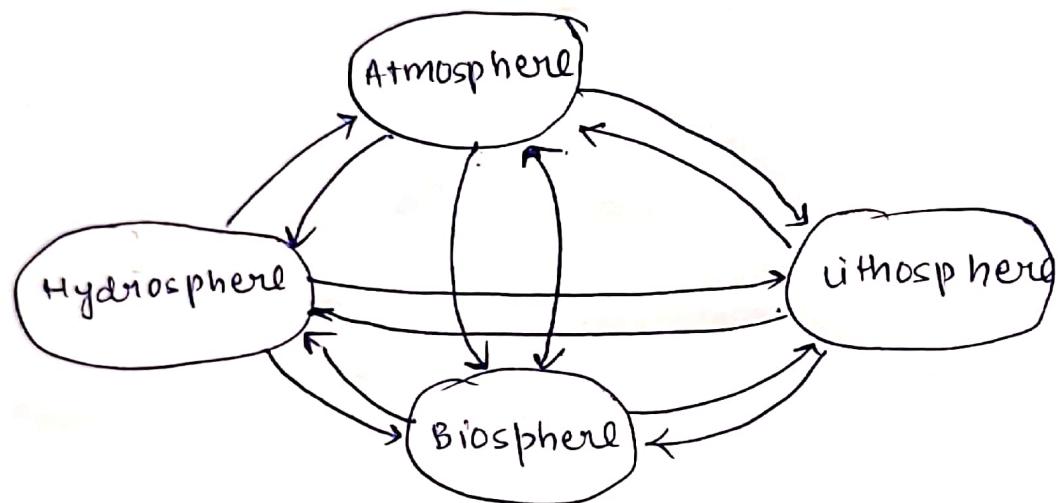
* components of environment.

↳ chemicals on earth are distributed among four major components



Soil layer is called pedosphere.

Humans - part of biosphere.



Impact of Technology on Environment

Technology refers to application of scientific knowledge for practical purpose.

- Types
 - Air pollution control equipment
 - Sewage treatment
 - Soil pollution
 - Noise pollution

Air pollution control equipment

removes volatile organic compound (VOC) and Hazardous Air Pollutants (HAPs)
Clean Air Act (CAA) implemented by EPA (Environmental Protection Agency)

Goals:

- Decrease release of harmful gases.
- Conserve natural resources
- Decrease health-threats

How It Works : (1/3)

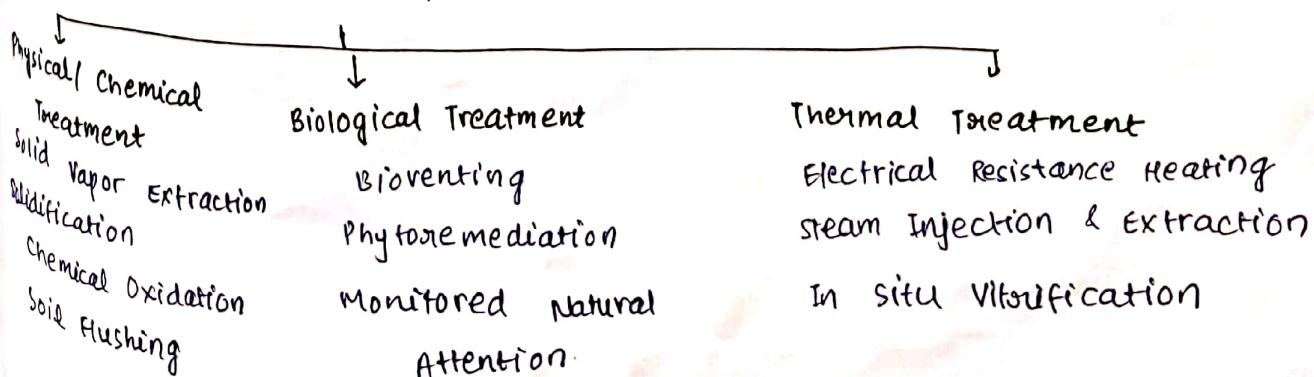
- Chemical modification
- Contaminant destruction
- Hazard removal.

Types :

- Continuous Emission Monitoring Systems (CEMS)
- Parametric Monitoring
- Emission control system
- Oxidiser.

e.g. Scrubbers, Air filters, Mist collectors, Biofilters, etc.

Treatment Technologies for contaminated soil



* Wastewater Treatment :-

Physical Operation	Chemical Process	Biological Process
Flow measurement	Precipitation	Aerobic action
Mixing	Neutralisation	Anaerobic action
Flocculation	Adsorption	Aerobic-Anaerobic combination
Sedimentation	Disinfection	
Floatation	Ion exchange	
Filtration	Electrodialysis	
Drying		
Distillation		
Centrifuging		
Freezing		
Reverse osmosis		

Environmental degradation

Environmental degradation is a result of socio-economical, technological and institutional activities.

Causes:

1. Urbanisation
2. Population Explosion
3. Intensification of Agriculture
4. Increase in energy use
5. Increase in transportation.
6. High quantity of exhaust gas.
7. Secondary pollutants
8. Chemical effluents
9. High no. of industries
10. Unplanned land use policies.

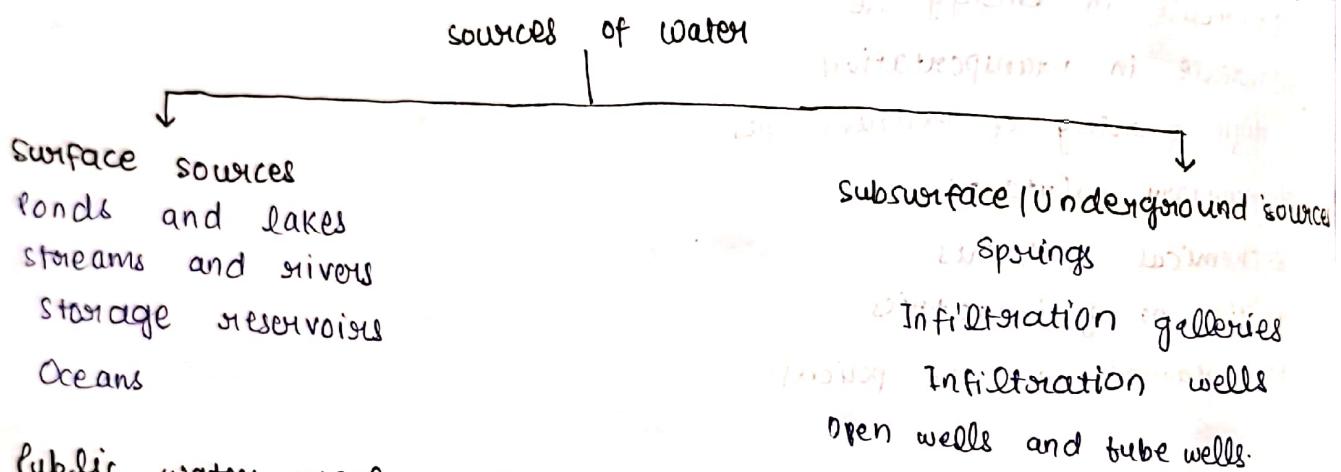
Study of Drinking water TreatmentWater Purification :-

Water Purification is the process of removing undesirable chemicals, biological contaminants, suspended solids, and gases from water.

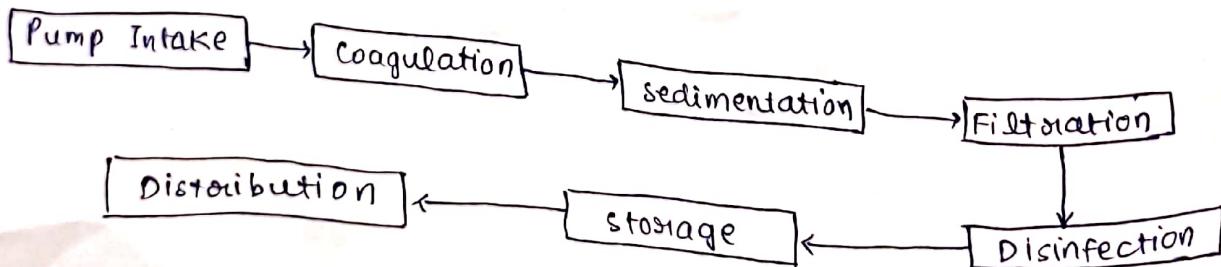
Contaminants are removed by :

Unit Operation : contaminant removed by the physical forces

Unit Process : contaminant removal by the chemical and biological processes

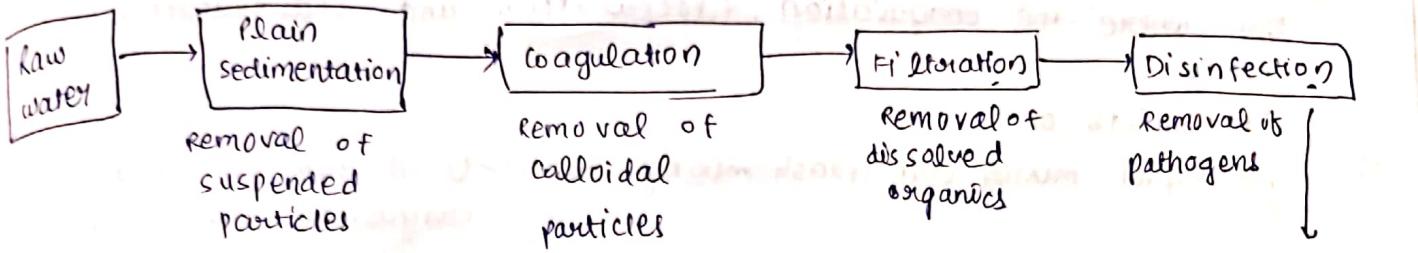
Public water supply methods:-

- Screening
- Plain sedimentation
- Filtration
- Disinfection
- Aeration
- Softening

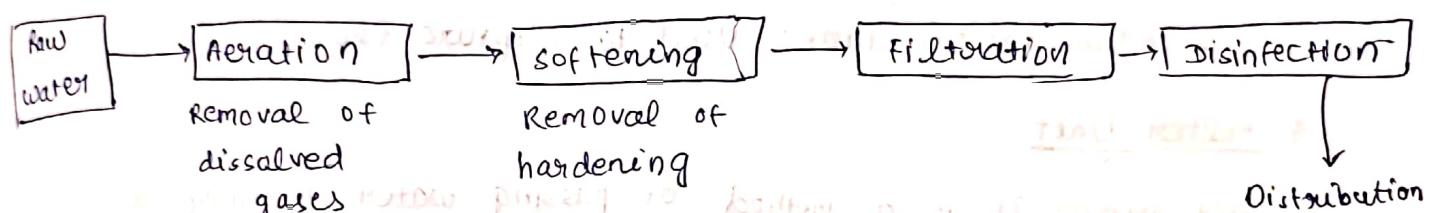
* Water Treatment Process :-

Common coagulants → Ferric sulphate, Aluminium sulfate, Ferric chloride.

Surface Water Treatment :-



Ground Water Treatment :-



Components of Water Treatment Plant:-

1. Screening :

To protect the main units of a treatment plant and to aid in their efficient operation.

Waste screens are steel bars placed 5-15 cm apart to exclude large materials.

2. Bar screen

3. Sedimentation Tank:-

(a) Plain sedimentation

To remove suspended particles

Method of removing particles by controlling the turbulence and flow velocity.

(i) horizontal flow rectangular settling tanks

(ii) radial flow circular settling tanks.

(b) sedimentation aided with coagulation

Accelerated sedimentation process.

Capture colloidal particles which is escaped during the plain sedimentation.

Clariflocculators:

Unit where the coagulation, flocculation and sedimentation takes place.

It consists of:

(a) Rapid mixing unit (flash mixing unit) :- Used for blending coagulant uniformly with water.

(b) Flocculator (slow mixing unit) :- They are used to produce floc

(c) sedimentation tank :- Used to capture floc.

4. Filter Unit

Filtration:- It is a method of passing water through a stationary bed of granular media.

Media

→ Anthracite coal

→ silica sand

→ Garnet (green sand)

Filters on the basis

of rates of
filtration

→ Slow sand filter

→ Rapid sand filter

→ Pressure sand filter

5. Disinfection Unit:-

Disinfection :-

Disinfection is a method of destroying the disease causing bacteria called pathogens from water.

Physical Methods

→ Boiling method

→ UV light treatment

Chemical Methods

→ Treatment with excess lime

→ Treatment with metal ions

→ Treatment with ozone

→ Treatment with chlorine

6. Distribution system :-

Distribution of treated water is done pipe water distribution system.

It consists of :

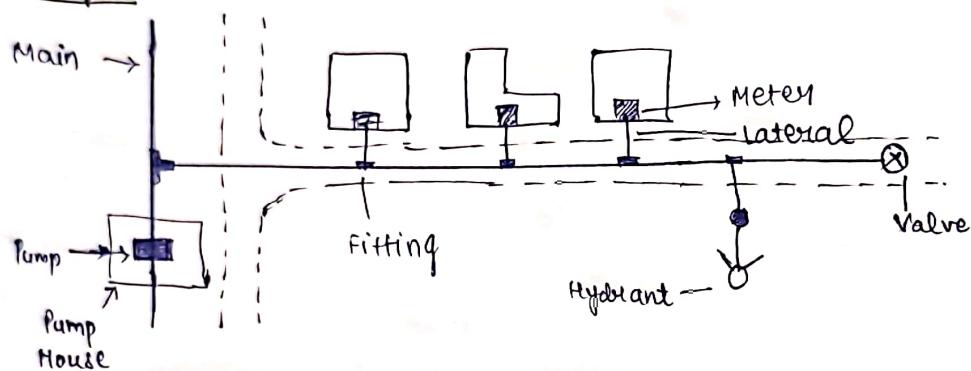
1. Network of pipes
2. Pumps
3. Distribution reservoirs
4. Valves
5. Water meters.

Water supply / Distribution system

* Requirements of Good distribution system:-

1. Water quality should not get deteriorated.
2. Sufficient pressure
3. Fire fighting
4. No consumer would be without water supply.
5. It should be fairly water tight.

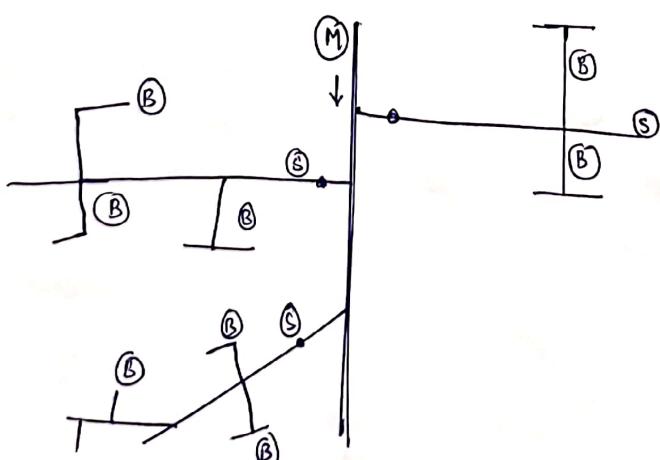
* Layout :-



* Classification of Network :-

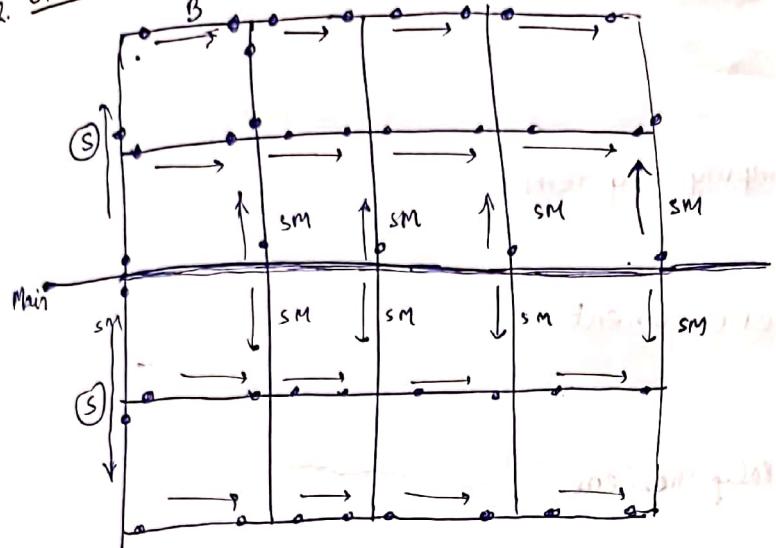
1. Dead end system
2. Radial system
3. Grid system
4. Ring system

1. Dead end system :- (or Tree system)

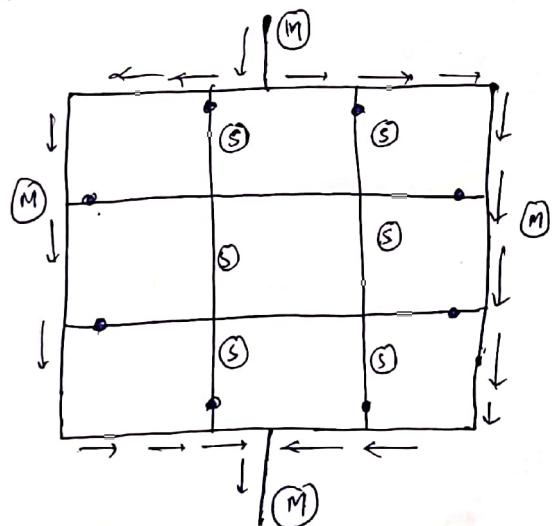


(M) → Main Branch
 (S) → Sub-mains
 (B) → Branch
 • → cut-off valves

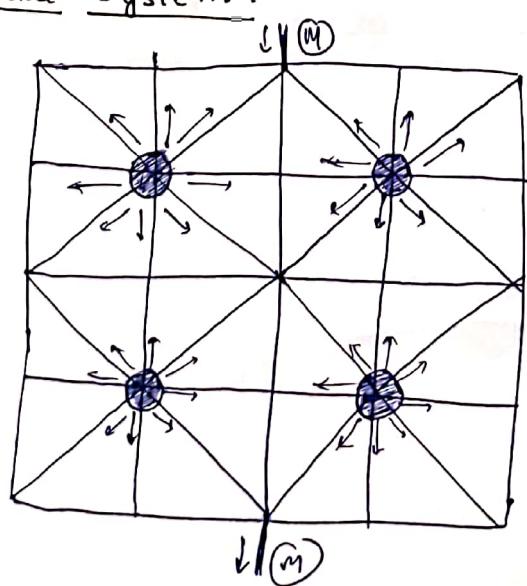
2. Grid system :-



3. Ring system :- (or circular system)



4. Radial system :-



(M) → Main

(S) → Submains

○ → Cutoff valves

● → Distribution Reservoir

Methods of water distribution system:-

1. Gravity system
2. Pumping System
3. Combined gravity and pumping system

Types of tanks

1. RCC Tank → Reinforced concrete cement
2. GI Tank → Galvanized iron
3. HDPE Tank → High density polyethylene

Types of Joints :-

1. End cap joint
2. Tee joint
3. Reducer joint
4. Bent joint
5. Collar joint

Wastewater Treatment

Wastewater treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to water cycle.

BOD → Biological Oxygen Demand

COD → Chemical Oxygen Demand.

Types of Treatment :-

• Mechanical

- Influx (Influent)

- Removal of large objects

- Removal of sand and grit

- Primary sedimentation

• Biological

- Trickling bed filter

- Activated sludge

• Chemical

- Disinfection

Stages of water Treatment :-

① Primary stage

Settling of particles.



FOG (Fat, Oil, Grease)

Sedimentation

Sludge pumped out

② Secondary Treatment

Added Bacteria and protozoa into sewage

Methods

→ Fixed film system

→ suspended film system

→ Lagoon system

↓
Hold wastewater for several months

③ Advanced Treatment

Nitrogen removal



Phosphorous removal

Lead to eutrophication

④ Tertiary Treatment

Remove disease causing organism from wastewater.

- Chlorination

- UV light radiation

- Ozonation

Eutrophication

Eutrophication is the process in which a water body becomes overly enriched with nutrients, leading to the plentiful growth of simple plant life.

Sludge Treatment

- Aerobic treatment
- Anaerobic treatment
- composting

Solid Waste ManagementClassification:

→ Based upon their origin and type:-

1. Residential wastes
2. Commercial wastes
3. Institutional wastes
4. Municipal wastes
5. Industrial wastes
6. Agricultural wastes

→ Based on properties:-

1. Biodegradable
2. Non-biodegradable

→ Based on their effect on Human Health and Environment

1. Hazardous
2. Non-Hazardous

Method of Disposal of Solid Waste:

- Open Dumps
- Landfills
- Anaerobic Digestion
- Composting / Vermicomposting
- Incineration

Composting → Composting is the biological decomposition of organic matter under controlled aerobic conditions.

Incineration → Incineration is the most common thermal treatment process. It is the process of burning waste at a temperature of $1000 \pm 100^{\circ}\text{C}$, in the presence of oxygen.

Four R's of Waste Management:-

- Reduce
- Reuse
- Recycle
- Recover

* IPAT equation:-

Describes the multiplicative contribution of population (P), affluence (A) and technology (T) to environmental impact (I)

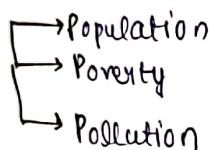
$$\boxed{\text{Impact (I)} = P \times A \times T}$$

P = size of human population

A = the level of consumption by population

T = process used to obtain resources and transform them into useful goods and wastes.

* P₃ syndrome



→ Key factors responsible for environmental degradation

* Sustainable Development :-

Sustainable development is defined as the form of development or progress that meets the needs of the present without compromising the ability of future generations to meet their own need.

Components



Sustainable development

is a development which

meets the needs

of the present

without compromising the ability of future

generations to meet

their own need.

It is a development which

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of the present

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Chapter-2

Environmental Pollution

PPT - 2-1

Sources of water

Ocean - 96.5 %

Other saline - 0.9 %

Freshwater - 2.5 %

Surface - 1.2 %
Ground water - 30.1 %
Glaciers - 68.7 %

Atmosphere - 3 %
Rivers - 0.49 %
Soil moisture - 3.8 %
Lakes - 20.9 %
Ground ice - 69 %

Rate of demand \rightarrow $l_p cd \rightarrow$ litres per capita per day

Group	l _p cd
Domestic	135
Industrial & Commercial	70
Public	10
Losses and thefts	55
Total	270 lpcd

* water demand

1. Arithmetic Increase Method

$$P_n = P_0 + n\bar{x}$$

2. Geometric Increase Method

$$P_n = P_0 \left(1 + \frac{g}{100}\right)^n$$

3. Incremental Increase Method.

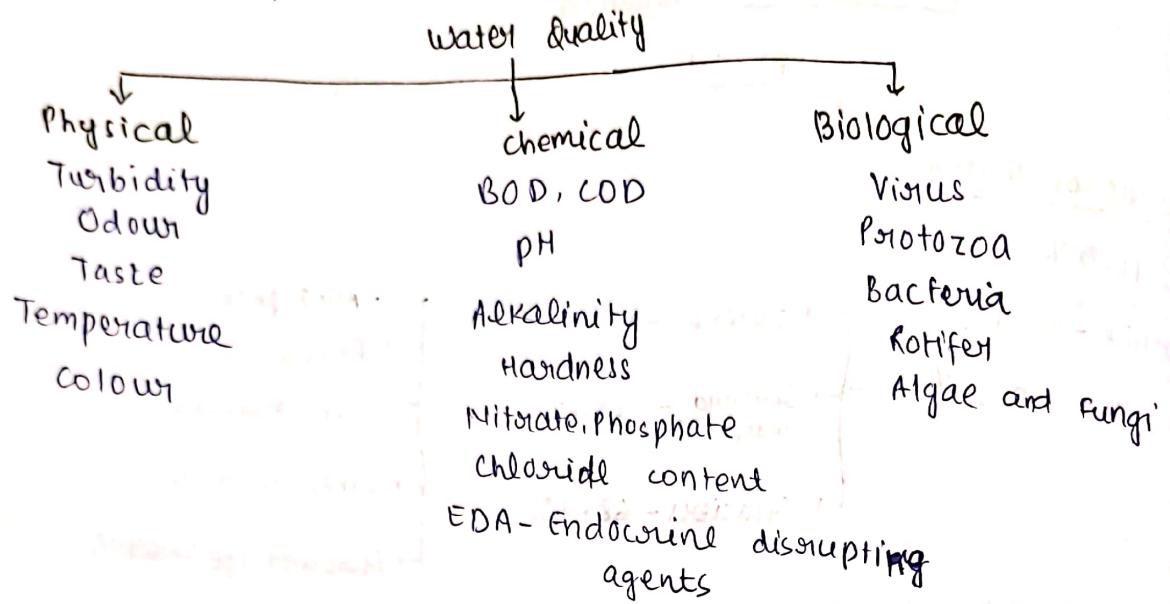
$$P_n = P_0 + n\bar{x} + \frac{n(n+1)}{2} \bar{y}$$

4. Decreasing rate method

5. Simple Graphical Method - Logistic curve

6. Comparative graphical method.

* Water Quality Parameters:



$$\text{Conductivity} = 2.5 \times 10^{-5}$$

Water
Fresh water
Brackish water
Saline water

(TDS)

TDS

< 1500 mg/L

upto 5000 mg/L

> 5000 mg/L

TDS → Total dissolved solid

TSS → Total suspended solid

Hardness

- Temporary HCO_3^- , CO_3^{2-}
- Permanent Cl^- , SO_4^{2-} , NO_3^-

removed by simple boiling

Removed by softening techniques like ion exchange

* Alkalinity → Temporary hardness
Hardness - Alkalinity → Permanent Hardness.

Major contaminants

- Endocrine Disrupting chemicals (EDCs)
- Polybrominated biphenyl ethers (PBBEs)
- Perfluorocarboxylates (PFCAs)
- Antibiotic resistant pathogens (ARP)
- Nanoparticles

- 5 VOCs
- Vinyl chloride
 - Tetrachloroethylene
 - Trichloroethylene
 - 1,2 dichloroethane
 - carbon tetrachloride

80% of all disease is transmitted through contaminated water (WHO)

10% of extra money can save 80%, ~~same~~ money in health sector.

Bacterial Disease	Viral	Protozoa
Typhoid	Hepatitis-A,B	Amoebic
cholera	Dengue	Dysentery
Dysentery	COVID-19	

Pathogens → Viruses, Bacteria, Fungi, Algae, Protozoa, Helminthes