UNIT - 1

* **Environment:**

French : 'Environ' : surrounding

It consists both biotic and abiotic components.

- **Ecosystem** : Greek → 'Eco': Home ; 'logy' : study

Interaction between the biotic and abiotic components is called as ecosystem.

-

Abiotic	Air : atmosphere	Here it is conceptualised to different zones.
	Water : hydrosphere	
	Soil / Rock : lithosphere	
Biotic	Life : biosphere	

- **Hydrological cycle** : (water cycle)

It has five components:

a. Precipitation : Rainfall
b. Infiltration
c. surface - runoff
d. Evaporation } Evapotranspiration
e. Transpiration
↳ from the surface of soil and leaves of the plants

mechanism : precipitation

escape of silica / salt particle attracts water droplets to form hygroscopic nuclei. As the mass of this particle increases precipitation occurs. Forms of precipitation rain, snow, fog, mist, dew etc.

~~Once~~ The water ~~table~~ from the precipitation is absorbed by the soil and seeps to the ground water this is called infiltration.

Once the water table level rises and reaches the surface and no more water can be taken in the water flows on the surface, this is called surface run off.

Overland flow : over the surface and flows into the water bodies.

Interflow : in the soil layer, comparitively slower than overland flow.

Baseflow : ground water table, speed of flow is the slowest.

Lakes

lentic lake : water doesn't flow.

lotic lake : water flows

Pond ecosystem

phyto plankton : synthesize their own food

zoo plankton : feed on phyto plankton

small fishes / large fishes : consumer.

Benthic organisms : exist in deep zones of water feeds on decaying matter.

phytoplankton : producer : Autotroph (phototroph) micro flora
- phototroph
- chemotroph

It flows on the surface.

zooplankton : floating microfaura.

saprophyle : decomposers. they recycle the nutrients

- Ecosystem:

a. terrestrial (land)
   - Desert
   - Grassland
   - Wet land

b. Aquatic
   - Fresh water
   - Marine

PRODUCER ⟷ CONSUMER
- Primary
- Secondary
- Tertiary

Primary consumer : Herbivores : directly depend on producer

Secondary consumer : Carnivores / Omnivores : depend on producer

or primary consumer.
Tertiary consumer : Microorganisms : depend on producer, primary consumer and secondary consumer.

Ecological Pyramids

Which ecological pyramid is always upright and why?
Pyramids of energy showing the rate of energy flow or productivity at successive trophic levels are always upright.
It is always upright because there is a gradual decrease in energy at successive trophic levels.
The energy flow in the ecosystem is always unidirectional. all others are bidirectional.

Food Chain

The interdependance of the components of an ecosystem - Foodchain
Many food chains interlock together to form food web.

- Atmosphere :
  a. Troposphere : Top most layer of troposphere : tropopause (flights)
  b. Stratosphere : Ozone layer is present in the stratosphere.
  c. Mesosphere
  d. Ionosphere / Thermosphere : Radiates heat and radio signal to space.
  e. Exosphere

Troposphere : 600km : 14°C to -56°C
Ozone : UV protection : DOBSON UNIT is used to measure the thickness of the ozone.
Stratosphere : -56°C to -2°C
Mesosphere : -2°C to 90°C
Ionosphere / Thermosphere : 600°C to 900°C
Exosphere : High temperature. (1800°C)

Troposhere, Stratosphere, Mesosphere, Ionosphere } Greenhouse effect : due to increase in CO_2 the solar radiation is trapped as heat and no radiation back to space takes place due to excess of CO_2.

Impact of Human Activites on Environment:

- Traditional / Modern Agriculture
- Industrialization
- Urbanization

} Growth of population

Impact due to agriculture

positive impact : export, high yield, improvement in economy

negative impacts : Fertilizers, pesticides, fungicides

Fertilizers → N, P, K → leads to better yield

On adding more than require, the soil loses its fertility this can be over come by mixed cropping

The excess fertilizers flow into the water sources due to runoff, increase in the nutrients in the water sources leads to growth of aquatic plants such as water hyacinth and duck weed on the surface of the water. Due to this the sunlight does not penetrate leading to damage of aquatic life. And no exchang of oxygen takes place for photosynthesis or respiration of the aquatic life this phenomenon is called as Eutrofication: It can happen even due to release of domestic waste (sewage) and industrical waste (Tanaries, Pharmaceutical etc. industrical wastes).

Biomagnification / Bioaccumulation: It is the increasing concentration of a substance, such as a toxic chemical in the tissues of tolerant organisms at successively higher levels in food

Over Irrigation: Due to high amount of fertilizers the solubility of the soil increases which makes the plant to respire through the roots difficult. This phenomenon is called water logging. Once the water reduces, the fertilizers are covered around the roots as salts. This increases the salinity of the soil causing salinity hazard.

A substance is hazardous based on whether they poses one or all properties listed below

- toxicity
- reactivity
- ignitivity
- corrosivity

b:

Impact due to industrilisation and urbanisation

The pollution of water, soil and air are defined as the bey-product of economical development in industry and city life. due to the waste products it produces.

Industrialization makes use of resources as raw materials from the land, water, wood, fossil fuels etc which effects the environment since demand for all these goes up and more quantities are extracted.

Urbanisation: Industrialization needs people to work so people move from rural or agricultural areas to industrialised cities that are concentrated. A higher population puts added pressure on the local environment.

Long term beneficial impact

Industrialisation and urbanisation adds to the wealth of society and makes a greater quantity and quality of goods available at lower cost, thus uplifting the lives of many. If managed properly with ill effects kept limited this will allow humanity to have the resources to better manage the environment while having a ~~blood~~ high standard of living.

* BIODIVERSITY - HOTSPOTS:

Hotspots are the regions where biodiversity is facing disturbance due to humans, climate change, natural calamities etc.

Hotspots are identified based on the following criteria

1. Endemic species must be highest in nature. (atleast 1500 population).
2. Endangered species must be high atleast 1500 in population
3. Extinct species

= India:
- Indo Burman Region (2)
- Eastern Himalaya (1)
- Western Ghats. (3) (Srilanka - South Asian hot spot)

= South Asia:
- Indo Burman Region
- Eastern Himalaya
- western Ghats and Srilanka
- Sundaland.

= ~~All over the world~~

= North and Central America
- California Floristic Province
- Meso-America
- North American coastal plains.
- Madrean Pine-Oaks woodlands.

= The Carribian:
- The whole carribian Island

= South America:
- Atlantic Forest
- Cerrado
- Chilean Winter Rainfall - Valdivian Forest.
- Tropical Andes
- Tumbes - choco - Magtaland

= Europe:
- Meditaranian Basin

= Africa:
- Cape Floristic Region
- coastal Forests of Eastern Africa
- Eastern Afro Montane
- Guinean Forests of West Africa
- Horn of Africa
- Madagaskar and India Ocean Islands.
- Maputaland - Pondo land Albany
- Succulent Karoo

= Central Asia:
- Mountains of central Asia

= South-east Asia and Asia Pacific
- East Melanesion Islands
- New Caledonia
- New Zealand
- Philipines.
- Polynesia - micronesia
- Eastern Australian temperate forest - South west Australia.
- Sundaland and Nicobar Islands of India
- Wallacea

= East Asia
- Japan
- Mountains of south west China

= West Asia
- Irano - Anatolian
- Caucasus

There are 35 biodiversity hotspots identified all around the world.

In India several species are being endemic and the number and percentage of these species in the world are given below.

(in India)

GROUP	NUMBER	PERCENTAGE OF WORLD
Mammals	350	7.6%
Birds	1224	12.6%
Amphibians	194	4.4%
Reptiles	408	6.2%
Fishes	2546	11.7%
Flowering plants	15000	6%

Wildlife of India

= Fauna:

- Asiatic Lion
- The Bengal Tiger
- Indian White-Rumped Vulture
- Golden Langur
- India Rhinosorus. (one of 45 threatened species of the world in eastern himalayas)
- Lion tailed Macaque (Flagship species of the western ghats)

NOTE: Western ghats also shows similarity (faunal similarity) with the Madagascar region especially in reptiles and amphibians

- Snakes
- The Purple Frog
- Srilankan Lizard

In western ghats 6000 vascular plants belonging to over 2500 genera out of which 3000 are endemic.

Cardomon and Black Pepper is only grown in the Western ghats.

The highest concentration of species is found in the Agasthiyamalai hills in extreme south of Western Ghats. This region also harbours 450 bird species, 140 mammalian, 260 reptiles and 150 amphibians (60% is endemic).
The vegetation in the hotspot is extended over ₹190000 sq kms.

Eastern Himalaya

The region includes Bhutan, Northeastern India, Southern - Central - Eastern Nepal which also includes Himalayan Mountain region (two highest peaks - Mount Everest and K2). There are 163 globally threatened species indudy one horned rhinoceros, wild Asian Water Buffalo, 45 mammals, 50 birds, 17 reptiles, 12 amphibians, 3 invertibrate 36 plant species.

* Relict Dragon Fly is an endangered specirs found in this region. One genus is present in India and the other is present in Japan.

Indo Burma

The region includes Eastern Bangladesh to Malasia. northeastern India, south of Bramhaputra river, Mayanmar, southern part of China Yunon Province, Lao's People's Democratic Republic, Cambodia, Vietnam and Thailand.

* Fresh water turtules, and
1300 birds including white eared hwon, grey crowned crocias, orange necked partridge
13,500 plant species out of which half of it is endemic Eg: ginger.

Sundaland - It includes Thailand, Malaysia, Singapore, Brunei and Indonesia and India represented by Nicobar island. This has been identified as biosphere reserve

in 2013 by United Nations. These islands have a rich terrestrial and marine ecosystem that includes mangroves, coral reefs and sea grass beds.

In marine ecosystem it has whales, dolphins, turtles, crocodile, prawns, corals, lobsters and sea shells.

Imp Dates

- The author of book 'Silent Spring' is Rachel Carson.
- DDT was invented by Paul Hermann Miller in the year 1939. DDT is more soluble in fat than in water. It is considered to be POP's (persistant Organic Pollutant). which causes bioaccumulation process.
- Stock home convention was held in the year 2000.
- Minamata (caused by methyl mercury) 1950. - Japan
- Chernobyl Nuclear Disaster: April 26, 1986
- Bhopal Gas Tragedy - December 3, 1984.
- World Food Summit - 1996, Rome
- Vienna Convention - 1985 - Austria
- Montreal Protocol - 1987
- Saving the Ozone layer Conference - March 1989, London
- Revision of Montreal Protocol - May 1989, Helsinki
- World Environment Day - 5 June
- World Nature Day - 3 October
- World Population Day - 11 July
- World Forest Day - 21st March.
- World Water Day - 22 March
- World Health Day - 7 April
- National Science Day - 28 Feb
- Earth Day - 22 April.
- Anti tobacco day - 31 May
- World Food Day - 6 October
- Wildlife Week - 1st - 7th October
- National Environmental Awareness month - 19th Nov - 18 Dec

- United Nation's Day - 24 October
- Ozone Day - 16th September
- World Habitat Day - 6 October

UNIT-2

★ CARBON CYCLE:

Carbon sink: Carbon is taken ins by the water bodies (oceans) into deeper zones due to turbulant action and is formed into fossil fuels after a long time. Oceans act as large sink of carbon.

Carbon sequestration: Artifically capturing the carbon to convert it into fossil fuels. (in deep zones of oceans).

Carbon is also taken up by plants in the form of CO_2 for photosynthesis.

Carbon is given out by vehicular emission, volcanic erruption, natural calamities etc.

Sources of carbon:

- Vehicular Emissions (CO)
- Respiration (CO_2)
- Natural calamity (Earth Quake, Volcanic Erruptions, Forest fire cyclone etc)
- Combustion.

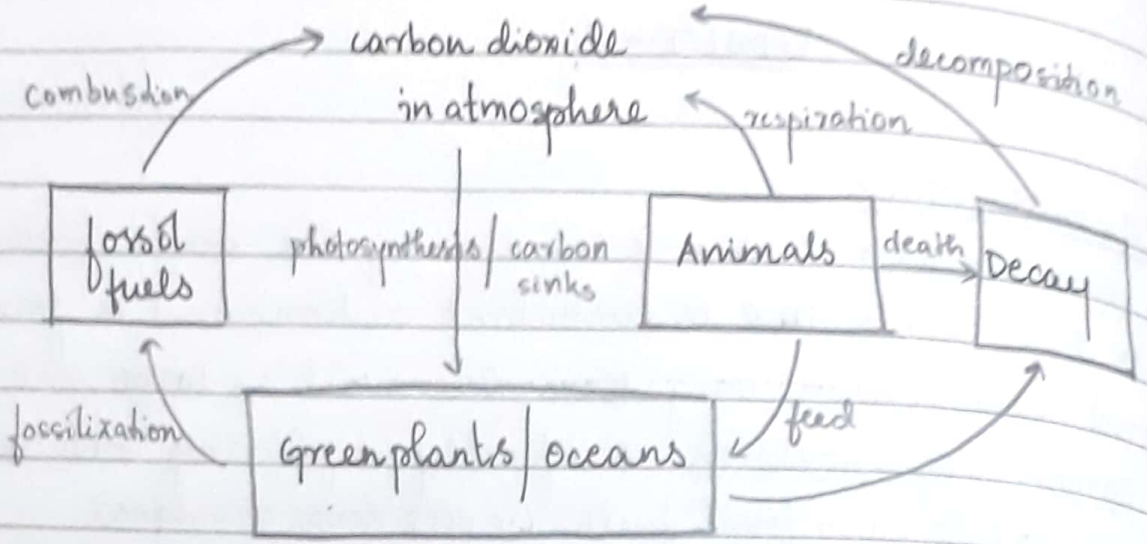
Carbon Sinks:

- Vegetation (Green plants) : coal
- Wet lands
- Ocean (any surface water source) : petroleum

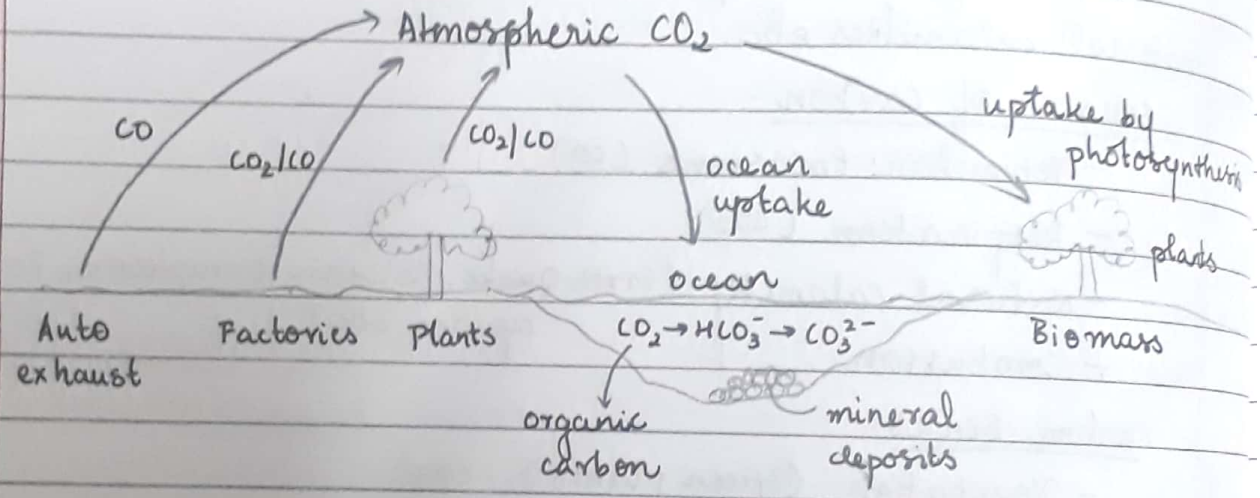
Carbon Trading: 11Y countries: have come together to reduce the carbon emission year by year (KYOTO PROTOCOL)

zero discharge concept: no pollutant is released outside any industries

since respiration and natural calamities as source of can not be change. To reduce the carbon content we focus on the emissions by human activities.



CARBON CYCLE



SOURCES AND SINKS OF CARBON

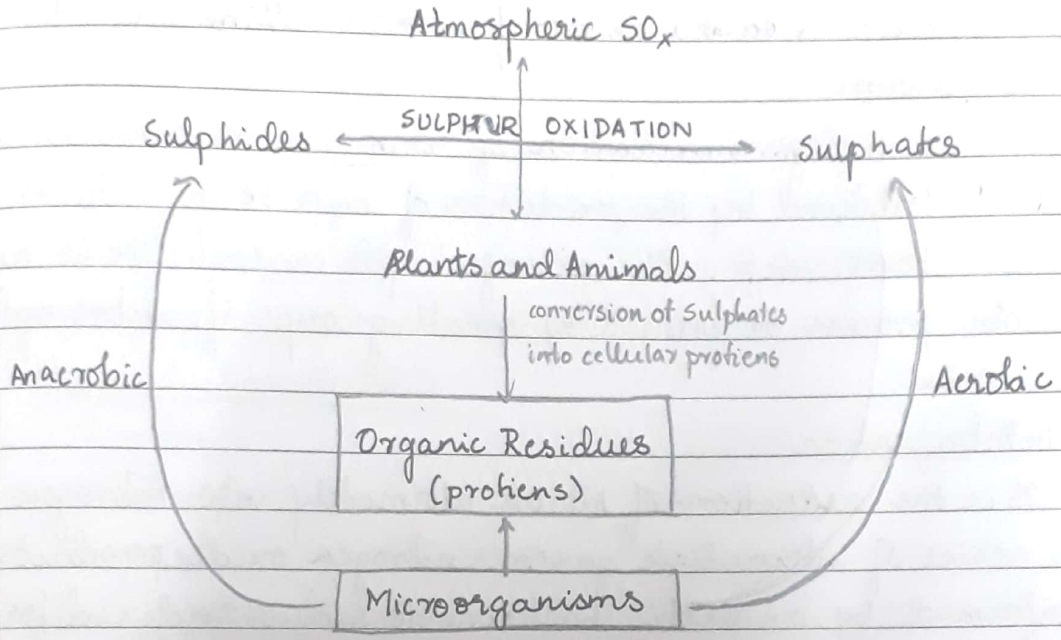
★ SULPHUR CYCLE:

Plants require sulphur to produce amino acids and proteins.

Sulphur diode with water causes acid rain. This effects some of the precions stone monuments (Taj Mahal). stone leprasy Agra: 1990-2000: small scale industries releasing SO_2 to the atmosphere where shut down.

Sulphitation: Sugar mills: Sulphitation process maintains the pH and also done for the main purpose of whitening of sugar crystal. In this process SO_2 is added with the sugar cane juice.

wastes for sugar mills.
Bugas: used for paper production
Molasses: alcohol



SULPHUR CYCLE

* NITROGEN CYCLE:

The nitrogen cycle is the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial and marine ecosystems.

Important processes in the nitrogen cycle include fixation, ammonification, nitrification and denitrification.

Nitrogen Fixation.

The conversion of N_2 into nitrates (NO_3^-) and nitrites (NO_2^-) is nitrogen fixation. Atmospheric nitrogen must be fixed into a suitable form to be taken up by plants. It is fixed by lightening strikes but most fixation is done by free-living or symbiotic bacteria called as diazotrophs. They have nitrogenase enzyme that combines gaseous nitrogen with hydrogen to produce ammonia which is converted by the bacteria into other organic compounds. Rhizobium (nitrogen fixing bacteria) usually live in the root nodules of legumes.

Ammonification

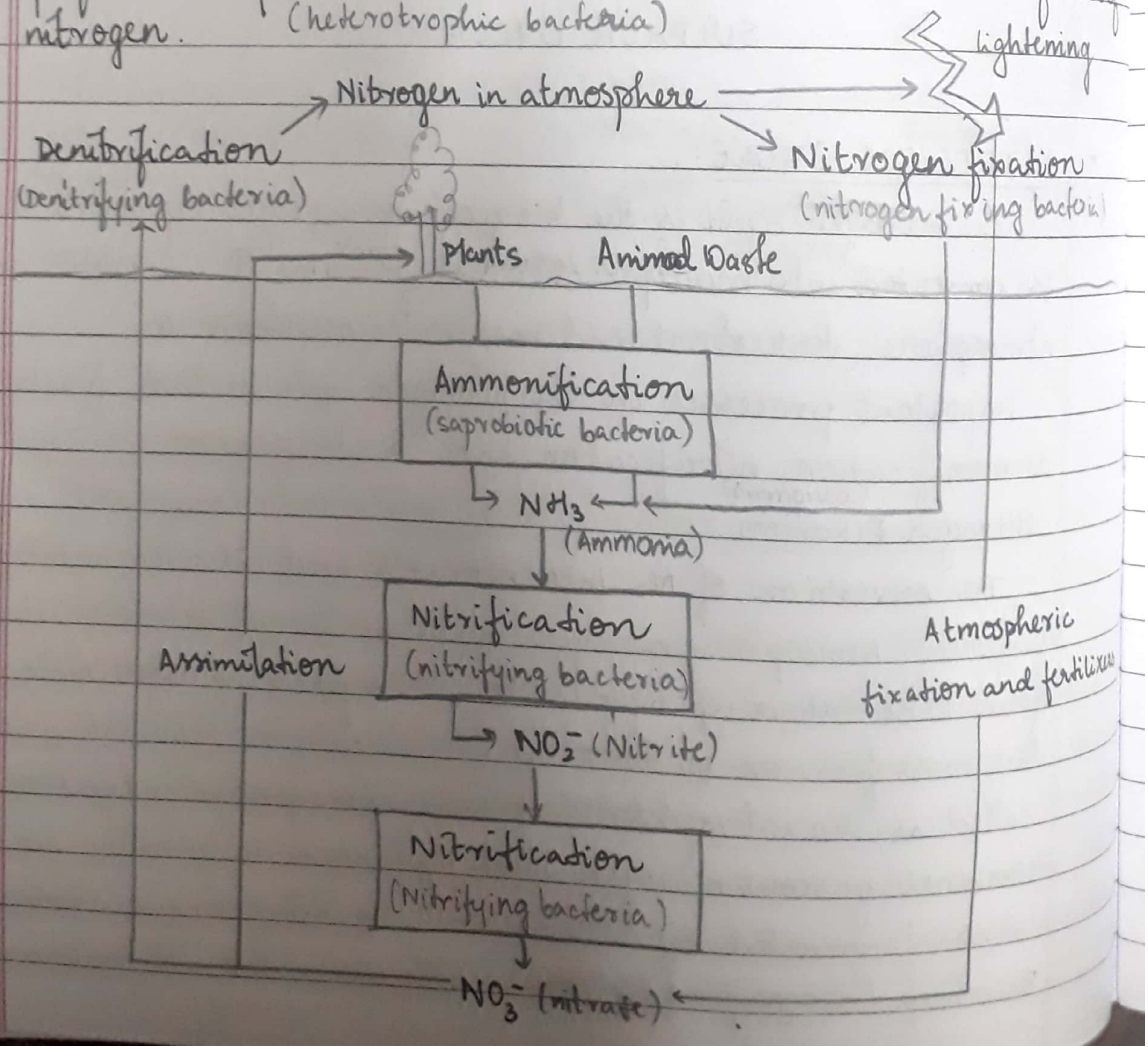
When a plant or animal dies or an animal expels waste, the initial form of nitrogen is organic. Bacteria or fungi convert the organic nitrogen within the remains back into ammonium. This process is called ammonification or mineralization.

Nitrification

It is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of nitrite to nitrate. It is an important step in the nitrogen cycle in soil. It is an aerobic process performed by small groups of autotrophic bacteria.

Denitrification

It is the reduction of nitrate ultimately into nitrogen through a series of intermediate gaseous nitrogen oxide products. It is performed by anaerobic bacteria to reduce oxidized forms of nitrogen. (heterotrophic bacteria)



UNIT - 3

* Intake structures
  - Wet intake structure: inside the water bodies
  - Dry intake structure: banks of the water bodies.

  These intake structures pump the water into treatment plants
* Portable water: free from pathogens.
* Palatable water: gives taste to palette. It may be polluted/contaminated
* Wholesome water: contains all minerals.
* Physical characteristics
  - color
  - odour
  - taste
* Chemical characteristics.
  - pH (6.5 to 8.5)
  - DO (dissolved oxygen) (decreases with increase in temp).
    at 0°C. 14.23 mg/l
    normal temp 7.5 to 8.0 mg/l
  - Fluoride: 1 to 1.5 mg/l
    If more than that skelital fluorosis and if less: dental fluorosis
  - Chloride: not more than 250 mg/l
    If more than that it causes corrosion
  - Hardness: bitter taste (not more than 500 mg/l) in terms of $CaCO_3$
    (presence of ~~carbonates and~~ magnesium and calcium salts)
    Water softening using zeolites.
    Hardness of water is due to leaching action. and also due to excess alkalinity.
  - Heavy metal (0.0003 mg/l) should not exceed this limit.
    (Lead, Cromium, Cadmium, Nickel and Boron)
    Even if chromium is toxic it can be recovered to 100%.

* Biological characteristics:

Even if one of the characteristics is present no suitable for the
- Echoli : present only as indicator of physcol contamination
(due to domestic waste) it cannot be removed by

* Desirable characteristics of portable water:

	Physical Chemical / Biological	Desirable or Permissible limits	Effects
Physical:			
1.	Colour	5mg/L to 25mg/L	physical characteristics does not cause any and can be easily
2.	Odour	Unobjectionable	
3.	Turbidity	5 - 10mg/L	
	Turbidity meter:	NEPHELO TURBIDITY METER : NTU (50-500)	
		JACKSON'S TURBIDITY METER : JTU	
	Turbidity in water is defined as the presence of colloidal particles in water.		
Chemical:			
4.	pH	6.5 to 8.5	Effects the mucus membrane, causes corrosion.
5.	Total hardness	300 - 600mg/L	Scale formations
6.	Iron	<0.321 mg/L	change in the colour and taste, leads to growth of iron bacteria

7.	Nitrates	not more than 45 mg/L	METHAMOGLOBENEMIA (Blue baby syndrome)
8.	Chlorides	< 250 mg/L	(Refer water treatment process)
9.	Fluoride	1 to 1.5 mg/L	Less than the limit (<1 mg/L) it causes dental fluorosis. more than 1.5 mg/L it causes skeletal fluorosis.
10.	Residual chlorine (present in water due to treatment of water) (To prevent further contamination of water after treatment)	0.2 (minimum) 0.5 during epidemics (super chlorination)	
11.	BOD Biochemical Oxygen Demand.	Nil	
12.	DO Dissolved Oxygen	More that 4 mg/L	
13.	Ecoli (It indicates the fecal contamination of water)	Nil	

- Wholesome water

Water which is free from excessive amounts of organic matter, minerals and toxic substances. Wholesome water does not cause any disease.

- Portable water

It is wholesome water where in all the parameters are with in the desirable limits.

- Palatable water

The water which is free from excessive temperature, turbidity, taste, colour and odour and it is well aerated

- Polluted water

Water that contains any forgien matter in it (solid/liquid/gaseous) which may affect the beneficial usage of that water. The agents of pollution may be infectious or noninfectious and toxic / nontoxic.

- Contaminated water

Water which is contaminated by infectious agent (pathogens) or toxic matter which affects the health of the community and make water unfit for beneficial uses.

* Water borne diseases: (spread through water)
  - Cholera: Vibrio Cholerae
  - Typhoid: Salmonella Typhae / Typhy
  - Amoebiosis: Entameoba Hystolytica
  - Polio:

Vector borne diseases
  - Malaria: plasmodium Vector: mosquito
  - Plague (Eradicated from India)

* Mineral Resources of India:

India has a large number of economically useful minerals. They constitute 1/4th of world's known resources. India imports oil, copper, zinc, steel and lead. It plays a major role in the global market to supply ores of iron, manganese, aluminium, titanium, diamond and mica.

	ORE	PLACE
1.	Iron	Orissa, Bihar border (2/3rd of iron ore present in India is found in Bihar), Madhya Pradesh, Karnataka (Heamadite ore), Maharashtra and Goa.
2.	Coal (largest producer of coal in the world - India) Bituminus: Lignite Ore:	Jharia & Bokaro in Bihar Raniganj in West Bengal Neyveli in Tamil Nadu
3.	Manganese (second largest producer in the world - India) Note: First largest Producer - Russia.	Orissa, Bihar border and Madhya Pradesh.
4.	Bauxite.	Bihar, Kashmir, Tamil Nadu, Kerala, Uttar Pradesh, Uttarakand, Karnataka, Maharashtra.
5.	Mica (largest producer of mica in the world - India) 45% of mica produced in the world is in India.	Bihar, Andhra Pradesh, Rajasthan

6	Gypsum	Tamil Nadu and Rajasthan.
7.	Gold	Ramagiri in Andhra Pradesh. Kolar and Hatti gold mines in Karnataka.
8.	Diamond	Panna diamond belt is the only area in the country which has large deposits of diamond It passes through panna, chatarpur and sadna in Madhya Pradesh and some parts of Utlar Pradesh
9.	Petroleum	Assam (largest producer), Gujarat, Mumbai.

★ i. OPEC - organisation of Petroleum Exporting countries.
ii. OTEC - Ocean Thermal Energy Conversion.
iii. TOMS - Total Ozone Mapping spectrometer
iv. ODP - Ozone Repletion Potential.
v. GHG - Green House Gases.
vi. GWP - Global Warming Potential
vii. EIA - Environmental Impact Assessment
viii. CPCB - Central Pollution control Board
ix. NAAQM - National Ambient Air Quality Monitoring

IMP ★ International conversions and Protocols:

i. Ramsar Convension (Iran) - 1971 - On wetland and water foul habitat.
ii. Vinna Convention - 1985 - Ozone depletion
iii. Basel Convention - Switzerland - 1989 - Control of transboundary

movement of hazardous waste (India hasn't signed)

iv. Earth Summit - 1992 - Rio - Climate change.
Agenda 21 was adopted to attain sustainable development.

v. Stockholm convention - on persistant organic pollutants - 1998-2000

vi. Montreal Protocol - 1987 - Ammended in the year 1991 and 1992
Protection of oxone layer, CFC's and halogens to be phased out of the world by 2000.

vii. Kyto Protocol - 1994 - Green house gases.

viii. Cartegena Protocol - 1996 - Biodiversity

* **Water Induced Diseases:**

1. Malaria - protozoa developed in mosquitors and passed on to human beings.
2. Chemicals in fertilizers, pesticides and industrial wastes - carcinogenic: causes cancer
3. Methamoglobanemia / Blue Baby syndrome: presence of excess nitrate in water: >45 mg/L (as per BIS: Buro of Indian Stds).
4. DDT, Heptachlor - carcinogenic, neurological disorders.
5. Heavy metal (Cd, Cr[VI]): High infant mortality rate, endamic diarrhoea.
6. Mercury - Crippling of bones
7. Minamata disease: 1952-1960 in Japan: Methyl mercury.
8. Lead - damage to kidney, liver and brain.
9. Arsenic - lung cancer, mental disorder, damage to kidneys.

* **Fluorosis:**

Fluorosis effects bones, teeth, tissues and other organs leading to death after prolonged illness. The permissible limit of fluoride in water should always be 1mg/L - 1.5mg/L. as per WHO standards and BIS standards.

less than 1mg/L it causes dental fluorosis, if more than 1.5mg/L it causes skeletal fluorosis.

- Dental fluorosis: discolouration of teeth
- Skeletal fluorosis: stiffening of joints, bow legs, knock joint pain and back pain
- Fluoridation: Adding fluoride compounds for fluoride defecent water.
- Defluoridation = Removal of excess fluoride from water
  - NAL GONDA TECHNIQUE: Developed by Nehri. National Environmental Engineering Research Institute in Nagpur (NEERI)

* Water Treatment Plant:

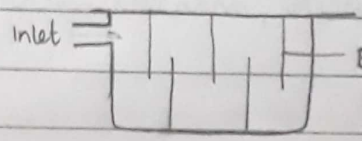
Surface water sources: ponds, lake, stream, river, sea, canal
Sub-surface water sources: ground water table, springs.
Intake structures: pumps water from the source after physical screening.

→ Screening: Bar screens (large in size) – debris, floating matter.

Physical Treatment

→ AERATION (To increase the DO > 4mg/L)
  - Surface → jet of water: exchange of gases: oxygen
  - Diffused → pipe of air with perforation is induced
  - Cascade → water flows over series of steps

→ Sedimentation: water is made to stand for 2-3 days.



It is used to reduce the water velocity after aeration inturn reducing turbulance of water. Hence water fills up and detension / retention for 2-3 days makes particles to settle through gravity

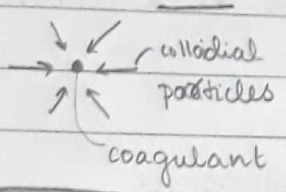
The settled sludge is removed. Then the water is sent into the next chamber along with the suspended solids / colloidal solids. Here a coagulant is added into the water along with rotating shaft.

→ COAGULATION and FLOCCULATION

Addition of coagulant into water treatment unit is called coagulation.

The colloidal particles adhere to the surface of the coagulant to form flocs and settle down.

FLOC:

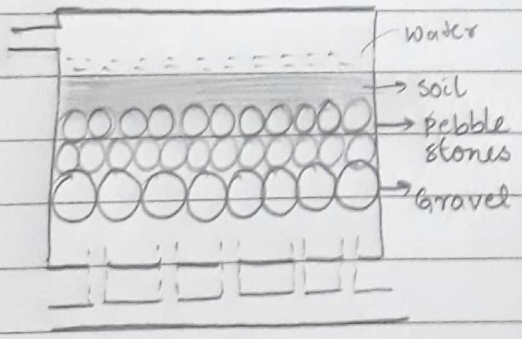


JAR TEST APPARATUS (in laboratory) - checks for optimum dosage of coagulants.

→ FILTRATION

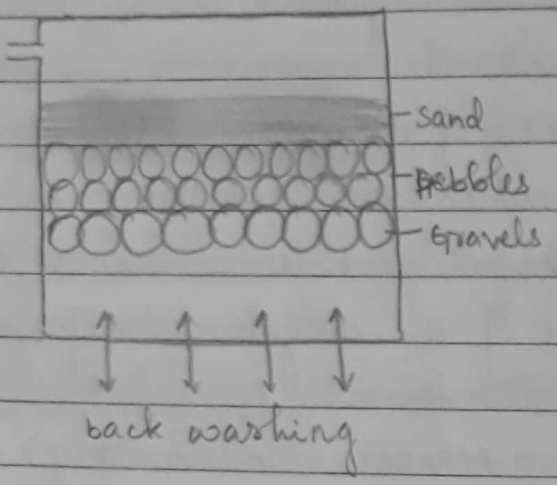
Next filteration is done because some particles are smaller than the range of colloidal particles size. It directly depends on the effective size of the sand.

- Slow sand filter



Here the water is treated for 40 to 50 days. No chemicals are added the treatment is done only due to microorganisms. For the first batch of water the organic matter gets struck in between the particles i.e., voids. Below the microorganisms feed on this forming a layer called slime layer. Now for the next batch of water the slime layer becomes active and the organic matter is fed by the microorganisms and the water flows down. Here the slime layer acts as a filter. Once the slime layer gets detached from the soil then the soil layer is replaced by new batch of sand.

-rapid sand filter



Here the water is treated within ~~the~~ 24 hrs. No retension time is given as there is no activity of microorganisms.
The clogging is removed by applying pressure from below known as back washing.

→ DISINFECTION — To get rid of pathogens.

* Resources:

Resources

Renewable (Non conventional)
- Solar Energy
- Tidal Energy
- Wind Energy
- Biogas
- Ocean thermal Energy

Non renewable (conventional)
- Fossil fuels
  - coal
  - petroleum
- Timber
- Hydroelectric power
- Nuclear energy

Nuclear energy → electrical energy → nuclear power plants → conventional sources → pollution.

UNIT - 4

Environmental Pollution.

Pollution

- Point source : known cause or pollutant and its amount.
- Non point source : unknown pollutant.

(pollutant / source of pollution cannot be estimated

The pollutant coming out of vehicles and industries have a tendency to rise higher in atmosphere when the temperature is high.

The chimneys of industries are called stacks must be above the ground of 20m. The wind movement around the stack is also responsible for dispersion of pollutants. Temperature also plays an important role. Temp α dispersion.

Inversion: Temp ↓ all the pollutants released start settling down.

* Occupational Hazards:

Workers in mines, factories, commertial firms, forestry, agriculture suffer from hazards due to air pollution and noise pollution. According to United Nations the death rate due to occupational hazard will go up to 2 lakh and upto 10 million non fatal injuries globally

- Deadly dust: lung disease called pneumoconiosis. coal mine works suffer from pneumoconiosis along with this they also suffer from tuberculosis.
- Silicosis: caused by dust containing silica or SiO_2. The first case of silicosis in India was recorded in 1949 in Kolar Gold Mines.

Generally workers in mines and industries of ceramics, sand blasting, metal grinding, building construction and steel industries suffer from silicosis.

In Bihar mica mines 33% works suffer from silicosis

In Madhya Pradesh pencil factories, villagers do not survive beyond 40 years of age.

- Asbestosis : Asbestos is used in roofing, insulation, car brake lining etc. It is a versatile material used to resist heat and moisture but asbestos fibre finds ready access to respiratory system. It leads to :

a. pulmonary ~~disease~~ fibrosis (disease related to lung) which leads to death.

b. cancer of air tubes : ~~Cancer of gastro intestinal tract~~

c. cancer of gastro-intestinal tracts

- Byssinosis : Disease related to textile industries cotton emits dust during processing. This disease strikes 10 years after exposure. Symptoms include coughing, breathlessness and ultimately death.

Workers of cotton mills in Ahmedabad, Mumbai, Delhi, Kanpur, Chennai, Madurai and Nagpur suffer from byssinosis.

★ Air pollution

Major pollutants

1. Carbon Monoxide : CO

- colourless, odourless, poisionous gas
- source

★. incomplete combustion of fuels.

- Effects.

★. carboxyhaemoglobin : Haemoglobin has more affinity towards carbon monoxide than to oxygen. The bloods ability to carry oxygen to brain, heart and tissues is reduced and this condition is called carboxyhaemoglobin.

Mild dosages of carbon monoxide leads to head ache and tiredness and high dosages leads to coma and death

2. Oxone : O_3

- Source

★ photochemical smog produced due to reaction of of nitrogen oxides and hydrocarbons in the presence of sunlight. Emissions may be from refineries, vehicles, chemical plants, paints and solvents.

- Effects

★ Harmful in lower temperatures in lower atmosphere. Affects lung tissues and causes respiratory infections.

3. Nitrogen Oxides:

- Source

★ Burning of fossil fuels in vehicles and power plants (thermal power plants).

- Effects

★ photochemical smog, acid rain, respiratory infections.

4. Sulphur dioxide : SO_2

- source

★ Burning of fuel containing sulphur

- Effects.

★ Acid rain, constricts air passages, asthma.

5. Suspended particulate matter: (SPM)

- Source

★ Industries, vehicles, construction, mining.

Health hazard is inversely proportional to the particle size of particulate matter (solid and tiny droplets of liquids) Lesser the particle size more the hazard.

- Effects

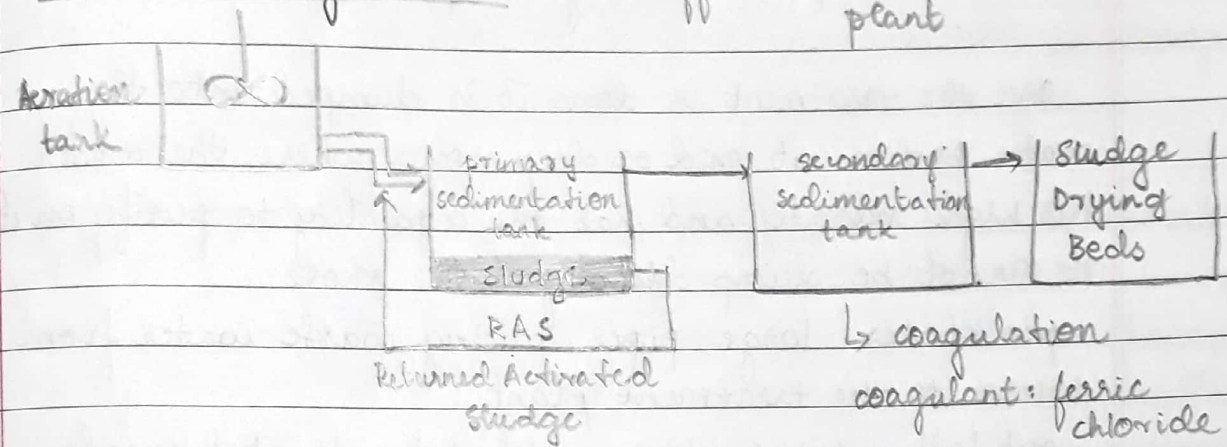
★ Wheezing, asthma, premature death.

6. Lead : Pb
- Sources
  * lead smelters, lead batteries, points
- Effects
  * It affects blood, brain, nerve and immune system. Leads to mental retardation and high blood pressure.

★ Solid Waste Management :
- Discarded after primary use
- Sources
  1. Municipal solid waste (household waste)
  2. Industrial wast
  3. Demolision and construction
  4. Medical waste
  5. commertial wastes
- Treatment
  1. Incinerators (Hazardous waste : Medical waste)
  2. Landfills (solid waste may mix with ground water)
  3. Pyrolysis (in the absence of O_2 waste is burnt, high pressure)
  4. composting (biodegradable wastes)

★ Waste Water Treatment :
80% of the water used is converted into waste. The treatment plant is designed based on the population of that region.
- Screening : Bar screening
- Aeration : surface aeration : to reduce the BOD.
  Due to exchange of gases, the oxygen absorbed helps the microorganisms to feed on organic waste. Hence DO increases and BOD decreases.
  Diffused aeration can be used but cascade aeration is not used.

- Sedimentation: Grit chambers : hits the baffled walls and reduces the velocity of the waste water. once the settled sludge is removed. the supercridendent water is removed. after a retension of 48-72 hrs.
- Activated Sludge Process (ASP) efficient waste water treatment plant



On using alum the sludge produced is very large, hence to reduce the volume of sludge produced ferric chloride is used.

At sludge dryind beds the sludge is dried and can be later used as manure.

- Trickling Filters

Water is sprinkled on layers of gravel. A slime layer is formed which has microorganisms that feed on the organic matter. Then the water flows through the layers of gravel and flows to the bottoms.

- Clari Flocculations:

Here microorganisms floc the organic matter and treats the waste water. An arm will be rotating at a very slow rate sprinkling water in order to provide contact time for the microorganisms with organic matter. the slime layer feeds on the organic matter and treats the water.

- Rotating discs / arcs

the water flows to half depth on rotation of the discs the micro organisms grows on the disc and exchange of gases also takes place Even in this process sludge is produced.

Once the treatment is done it is dumped into the water bodies at mid or deep zones where the water has high velocity and has the capability to purify on its own it cannot be dump directly at the shore.

pen stokes: large pipes taking waste water from source to the treatment plant.

out fall: large pipes which take treated waste water from treatment plant to surface water sources.

UNIT - 5

Local and Global Environmental Issues.

* **Ozone Depletion:**

Ozone is a procisonous gas made up of molecules having three oxygen atoms. It is the rare gas (just 3 out of 10 million molecules) in the atmosphere. Ozone plays two role in atmosphere
- in the lower atmosphere it acts as greenhouse gas keeping the earth warm.
- it serves a major role in stratosphere where it absorbs UV radiations and shields out UV radiation which is harmful.

Ozone layer is located between 10-50km above the surface. Depletion of ozone layer allows more UV rays to the earth surface. Thus causes increase in skin cancer, eye cataract, weakens immune system, reduces plant yield, damage to ocean ecosystem, reduced fishing yield and adverse effects on animals.

— **Ozone formation:**

Formed under normal conditions due to photochemical reaction between oxygen molecules and solar radiations as per chapman's reaction: $O + O_2 \rightarrow O_3$ and $O + O_3 \rightarrow 2O_2$

When oxygen moleaules absorbs UV radiations ozone is produced Ozone produced immediately disassociates in the presence of UV. Hence an equilibrium exists between rate of ozone formed and ozone destroyed. Thus concentration of ozone is fairly constant in stratosphere. But it is slow, steady decline of above 3% per decade in ozone concentration has been observed during the past few decades - even 10% decrease is observed over polar regions. This phenomenon is called 'ozone hole'.

In 1970's scientists have discovered that when freons (chlorofluorocarbons used as refrigerants and in aerosal sprays) finally breakup in the atmosphere or they release Cl^- radical which are responsible for ozone holes. The Cl^- reacts with an O_3 molecule and takes an oxygen atom to form ClO leaving behind an oxygen atom $ClO + O \rightarrow Cl + O_2$

Thus as net effect : $O_3 + O \rightarrow 2O_2$ Hence the dissociation takes place faster than formation

Each Cl^- atom can destroy upto 1 lakh ozone molecules

Bromium is more efficient than chlorine in destroying ozone molecules but there is much less bromine present in the atmosphere.

Ozone concentration is measured in the stratosphere in Dobson units using an instrument called TOMS : total ozone mapping spectrometer.

Substantialey decrease of upto 70% in ozone concentration has been observed in southern hemisphere over Antartica and first report in the year 1985 (it is said that the ozone hole was of the size of Cuba in 1979 and has grown to the size of North America)

The land area under ozone depleted atmosphere has increased to more than 20 million km^2 in 1990 and has varied between 20-29 million km^2 from 1990 - 2010.

- Consequences of ozone depletion:

Skin cancer, DNA damages

The amount of damage that chemicals like CFC's, halons etc cause to ozone layer is expressed in relative to that of CFC's and it is called as Ozone Depletion Potential (ODP).

The life span of these substances are very long. They may continue to deplete the ozone layer long after their use has been phased out.

Due to global warming there would be greater transfer of ozone from stratosphere to troposphere. Down in the troposphere ozone becomes the effective green house gas. Being larger than oxygen in molecular size, ozon can store more energy in the form of heat. Adding this to troposphere would increase the pace of global warming.

Greenhouse gases:

Carbon dioxide – CO_2 – 55%.

N_4O : 15%.

Ozone : O_3 – varied by lattitude and altitude

CFC's : 25%.

Global warming – Increase in average temperature of earth's surface or atmosphere.

* Initiative against ozone depletion:

- Inter governmental negotiation to phase out ozone depleting substances started in 1981.
- In 1985, 20 nations including, most of the major CFC manufacturers signed, Vienna convention.
  It encourages inter governmental cooperations on research, systematic observation of ozone layer, monitoring of CFC production and exchange of information.
- In May 1985, scientists published the article related to ozone hole, which was confirmed by satilite observation. It is regared as one of the major environmental disaster of 21st century.
- In 1987, Montreal protocol on substances that deplete ozone layer was adopted. 96 chemicals are presently being controlled by Montreal Protocol.
  Montreal protocal is working to a great extent but ozone layer will remain vulnerable for another decade or so.
- Developed countries have reduced their CFC consumption for 0.9 million ODP tonnes to 4000 tonnes.
- Ozone depletion will continue and reach its worst point during the next few years and then gradually ozone layer returns to its normal by around 2050 only if Montreal protocol is fully implemented.

* **Acid Rain:**

Oxides of nitrogen and sulphur dioxide are released to the atmosphere from burning of fossil fuels and industries (power stations and smelters).

Volcanoes and swamps (wetland ecosystems) and carbon dioxide are natural causes of acid rain. These reach high altitudes, travel with wind to 100's of km and finally return to earth in the form of acid rain.

1. Wet form: rain, snow, dew, fog or mist.
2. Dry form: dust particles containing sulphates and nitrates.

Both the forms are equally harmful.

1 MP

— **Formation of acid rain:**

Unpolluted rain water is slightly acidic due to the presence of carbon dioxide in air.

$$CO_2 + H_2O \longrightarrow H_2CO_3 \text{ (carbonic acid)}$$

The pH of rain water is around 5.6 to 5.4 where as Acid rain has pH less than 5.6.

Acid rain consists of H_2SO_4 (60-70% contribution), HNO_3 (30-40%), HCl (5-15%)

$$S + O_2 \longrightarrow SO_2 \quad ; \quad 2SO_2 + O_2 \longrightarrow 2SO_3$$

$$SO_2 + H_2O \rightarrow H_2SO_3 \quad ; \quad SO_3 + H_2O \rightarrow H_2SO_4$$

$$2NO + O_2 \longrightarrow 2NO_2 \quad ; \quad 4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

Ammonia is also responsible for acid rain. Ammonia from fertilizers and animal waste form clouds, thereby making conversion of SO_2 and NO_2 to acids faster.

These acids react with NH_3 forming sulphates and nitrates which fall on the earth as particulate matter (dry form of acid rain).

Acid rain situation is severe in India and China which have substantial coal deposits. India releases maximum pollutants to air after china.

Acid rain problem has increased manifold during last 200 years.

- Effects of acid rain:

The alkaline chemicals present in rocks, soil, lakes and streams regularly neutralise the acidity of rain water. But when the precipitation is highly acidic, natures ability to neutralise the acid becomes inadequate.

1. Effects on soil:

a. Acid rain dissolves and washes away nutrients needed by plants.

b. Dissolves toxic substances like Aluminium and mercury thereby polluting the water. Plants which absorb this get affected. Alkaline soils are able to neutralise acid rains to great extends.

2. Effects on trees:

a. As nutrients are removed from soil by acid rain the plant growth is retarded.

b. Acid rain attacks the waxy coating of leaves forming brown dead spots. This reduces the ability of the plant to undergo photosynthesis reactions. These plants become vulnerable to insect attacks and weather changes.

c. Trees at higher altitudes touch the acid rain clouds. This is the reason for:

- decline of spruce forest in Appalachian of USA.
- half of the trees in blackforest of Germany are damaged due to acid rain

* **Global Warming:**

greenhouse gases → Green house effect → Global warming
→ ozone depletion → melting of polar ice caps → Rise in sea level (covering available land)
(rise in temperature)
→ climate change → extinction of species (flora and fauna).

causes:
- use of CFC's
- vehicular emission / industrial emission
- Agriculture
- Power generation

Control Measures:
- Zero discharge concept

KYOTO PROTOCOL: to reduce the carbon emission.

NE Water Technology

carbon sequestration.

EIA: Environmental Impact Assessment

EIS: Environmental Impact statement

REIS: Rapid Environment Impact statement

UNIT - 6

* **Environmental Legislation:**

United Nation's conference on human environment uses the first step taken by the united nation in the protection of environment. This conference was held at Stockholm on 5th June 1972, then onwards 5th June is celebrated as World Environment Day.

Declaration of the conference

1. Man has the right to freedom, equality and adequate conditions to live in an environment of quality that permits a life of dignity and welbeing.
2. It is the solemn responsibility of man to protect and improve the environment for the benefit of present and future

generation.

— An international conference on environment education was held in New Delhi in Dec 1982. This conference stresses the need of formal and informal environmental educational right from childhood.

★ Environmental Protection laws in India:

— India was the first country to make provisions for environment in constitution through 42nd ammendment in the year 1976 through articles 48(A) and 51(A)g.

Article 48(A)

The state shall endavor to protect and improve the environment and safe gaard forest and wild life in the country.

Article 51(A)g:

It shall be the fundamental duty of every citizen in India to protect and improve the natural environment and to have compassion for all living creatures.

Other than these constitutional provisions there are some more provisions for protection of environment in Indian Penal code (IPC) and various municipal acts.

The various acts passed by Indian government are as follows:

1. Wild life (Protection) Act: 1972 (after stockholn)

To preserve biodiversity and protect wildlife. This act ensures the declaration of the national parks, wildlife sanctuaries etc., constitution and function of central zoo authority, prohibition of hunting and penalties for the violation of provisions in the act.

2. Water (prevention and control pollution) Act - 1974

For maintaining, restoring the wholesomeness of the water. This act empowers the state board for protection and control of water pollution.

The salient features are:

1. The authority can collect cess amount based on the amount of water consumed by industry.
2. 25% rebate on cess for industries that consume water within the prescribed quantity and also comply with effluent standards.

Effluent standards are prescribed in this Act.

3. Forest (conservation) Act - 1980

This act is enforced all over India except Jammu and Kashmir. This was ammended in the year 1988.

The purpose of this act is to regulate indiscriminate conversion of forest land for non-forestry uses and to maintain and balance between development of the country and conservation of natural resources.

CAMPA: Compensiatory Afforestration Management and Planning Authority is constituted at the national level to monitor the compensator afforestration in the country.

4. Air (Prevention and control of Pollution) Act: 1981

The objective of this act is to prevent, control and reduce air pollution including noise pollution and to establish boards at state and union territory level. Under this act no person can establish or operate any industrial plant without the concern of SPCB (state Pollution Control Board).

5. Environment (protection) Act - 1986

This act was enacted after Bhopal gas tragedy in the year 1984 under article 253 of constitution of India. This act includes pollutants and hazardous substances also.

Several set of rules pertaining to management of hazardous waste, chemical, microorganism etc., have been notified under this act.

Those industries which handle hazardous waste should submit Environmental Audit Report to SPCB before 30th September every year.

Ammendment was made in the year 1994 for EIA

★ Pollution control Board :

CPCB: central Pollution control Board : Sept 1974 (as per water Act 1974). It is a statutory board. Technical advisor to government on matters concerning prevention and control of pollution.

Functions:

- To promote cleanliness of water bodies by prevention, control and abatement of water pollution.
- To improve air quality by prevention, control and abatement of water pollution.
- CPCB has developed standards for effluents and it has also established National Ambient Air Quality Monitoring (NAAQM) to determine the current air quality and trends.
- KSPCB established in the year 1974: Asst Environmental Engineer / officer of KSPCB inspects every industry periodically for ease in monitoring the waste load
  1. Red : highly polluted
  2. Orange : medium polluted
  3. Green : less polluted

It should also be seen as per environmental management criteria the industries have to be in power with IS std. i.e., IS : 14000 ; IS : 18000 series.

* Environmental Impact Assessment:

EIA is an activity designed to identify and predict the impact of legislative proposals, policies, programs, projects and operational procedures on bio-geo-physical environment and health and wellbeing of human beings.

- Steps in EIA process:

1. Project screening
2. Scoping
3. Identifying alternatives
4. Description of the project
5. Establishing environmental base line
6. Impact identification
7. Impact prediction
8. Evolution
9. Mitigation
10. Public Participation (Principle 10 of Rio convention - Environmental theory)

Environmental Impact Statement:

1. Decision making
2. Monitoring and auditing
3. Preparation of EIS.