Today's Goal

- ENVIRONMENTAL CHEMISTRY

ENVIRONMENTAL CHEMISTRY

The branch of science which deals with the chemical phenomena occurring in the environment is called as environmental chemistry.

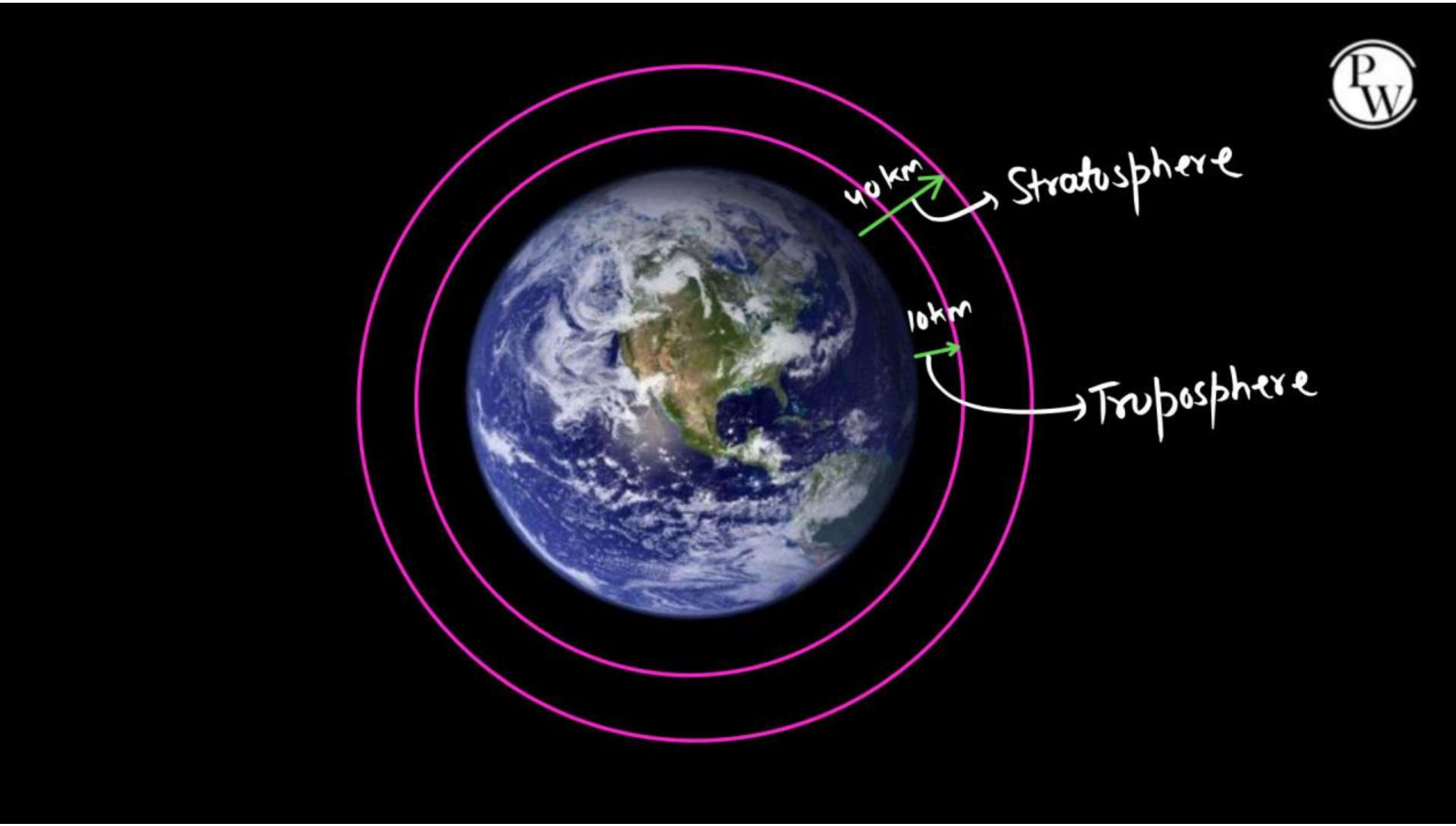
INTRODUCTION

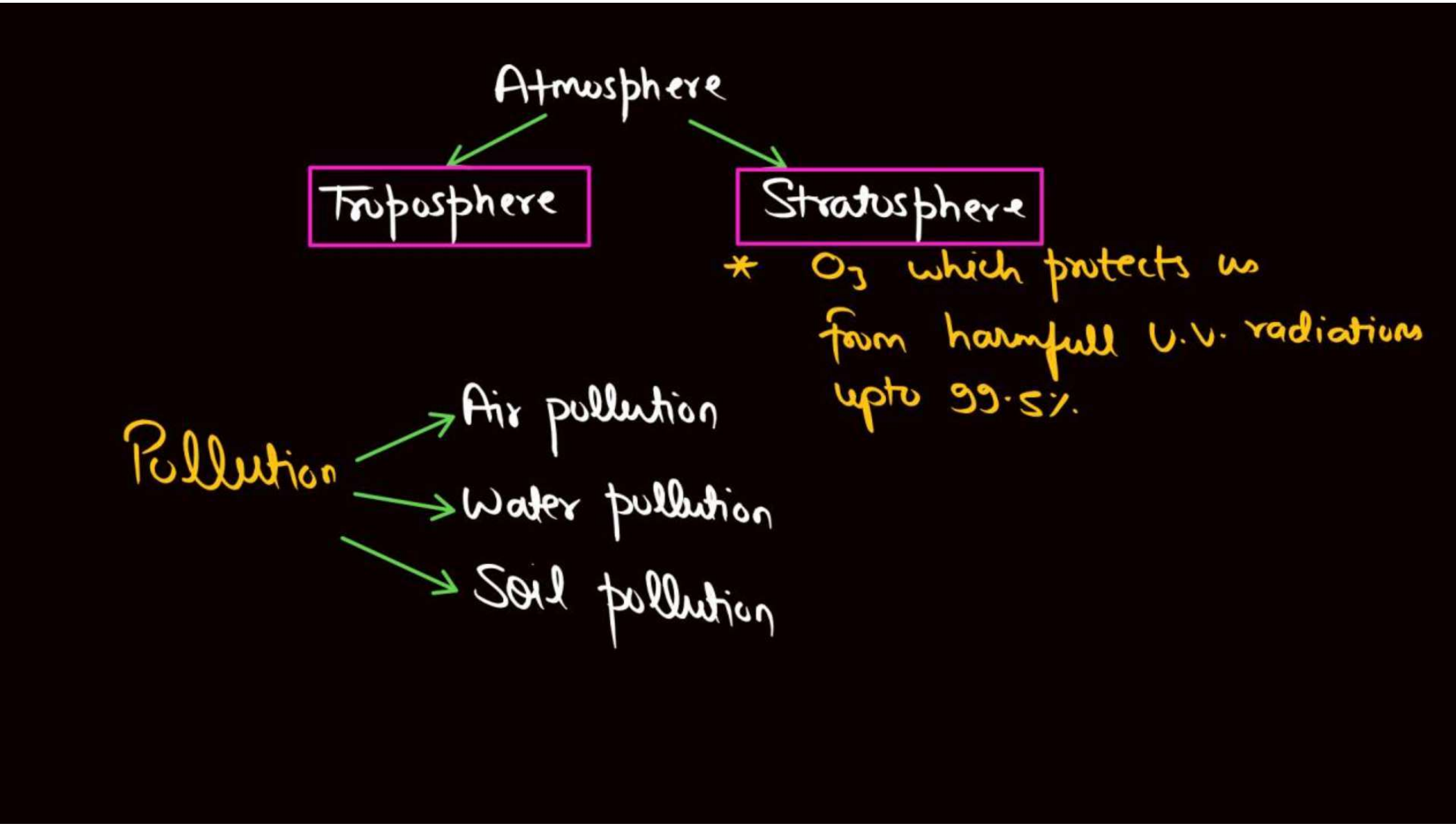
The environment means surroundings.

ATMOSPHERE

Function of the atmosphere :

- It contain all the gases which are essential for the life on the earth.
- It is a carrier of water vapour which are needed for all life.
- Ozone (O_3) is present in stratosphere which is responsible for absorption of 99.5% of harmful U.V. radiations.
- It maintain heat balance of the earth by absorbing infrared radiation, coming from the sun and re-emit from the earth.


40 km
Stratosphere
10km
Troposphere


Atmosphere
Troposphere
Stratosphere
* O_3 which protects us from harmfull U.V. radiations upto 99.5%.
Pollution
Air pollution
Water pollution
Soil pollution

ENVIRONMENTAL POLLUTION & ENVIRONMENTAL POLLUTANT

The addition of any undesirable material to air, water and soil by a natural source (or due to human activity) which affects the quality of environment is called as environmental pollution.

The undesirable material which is added to the environmental is called as pollutant.

Causes of pollution :

- Fast growth.
- Rapid urbanisation.
- Excessive trialisation.
- Use of pesticides in agriculture.

TYPES OF POLLUTANTS

Bio Degradable and Non Bio Degradable Pollutants

(A) Bio degradable pollutants :- The materials (such as cow dungs) which are easily decomposed by the micro-organism. These are not harmful, but in the excess in environment, they do not undergo degradation completely and thus become pollutant. Eg. Discarded vegetables

(B) Non bio degradable pollutants :- The material (such as Hg, Al, DDT) which do not undergo degradation (or degrade very slowly) but their presence even in very small amount in the environment is very harmful.

They may react with other compounds present in the environment and produce more toxic compound.

Eg. Plastic materials, DDT, heavy metal, many chemicals, nuclear wastes etc.

TYPES OF POLLUTION

Depending on the Part of the Environment Polluted

(A) Air pollution
(B) Water pollution
(C) Soil pollution (or land pollution)

(A) **Air pollution** : It is defined as the undesirable materials into the atmosphere either due to natural phenomena (or due to human activity on the earth). Which affect the quality of the air and also affect the life on the Earth.

MAJOR SOURCE OF AIR POLLUTION :

(i) Natural sources :

Ex. due to CO, H_2S, SO_2, Forest fire → Burning of Hydrocarbon

(ii) **Man made air pollution or source due to human activity :**

C, CO, CO_2, NO, NO_2, NO_3, SO_2, CH_4

sources :

Ex. Burning of fossil fuels which produce some poisonous gases as CO, CO_2, CH_4, oxide of nitrogen.

Combustion of gasoline in the automobiles : The automobiles emit the CO, oxide of nitrogen (NO, NO_2)

Deforestation : Due to this % of CO_2 is increased and % of O_2 is decreased.

Fast industrialisation : The smoke of carbon and CO, CO_2, SO_2, H_2S, NO, NO_2 are coming out from the industries. The industries are responsible for 20% of total air pollution.

Agriculture activities : The pesticides are added in the soil. They give a foul smell and affect the health of animals and human being.

Wars : The nuclear weapons are used in war which emit the radiation.

Air pollutants :

(A) **CO as pollutant** : It is mainly realsed by automobile exhaust due to incomplete combustion of carbon. It binds to hemoglobin to form carboxyhemoglobin, which is about 300 times more stable than the oxygen-hemoglobin complex. In blood, if the concentration of carboxyhemoglobin reaches 3-4 percent then oxygen carrying capacity is greatly reduced.

$$C + \frac{1}{2}O_2 \longrightarrow CO$$

Sink of CO : A large amount of CO are added in the atm. But the level of CO does not rise too much as CO is converted in CO_2 by the micro organism which is present in the soil. The micro organism (bacteria) act as sink for CO.

Harmful effect of CO :

(i) The CO is poisonous because it combine with haemoglobin of R.B.C. about 300 times easily than O_2, to form carboxy haemoglobin.

(ii) Oxygen deficient results into headache, weak eyesight, nervouness and cardiovascular disorder.

(iii) In pregnant women who have the habit of smoking the increased CO level in blood may induce premature birth, spontaneous abortions and deformed babies.

(B) **Hydro carbon** : Hydrocarbons are carcinogenic, i.e., they cause cancer. They harm plants by causing ageing, breakdown of tissues and shedding of leaves, flowers and twigs.

(a) **Natural sources :**

(i) Due to decomposition of organic matter in soil.

$$2HCHO \xrightarrow{\text{Bacteria}} CH_4 + CO_2$$

(b) **Man made sources :**

(i) Due to burning of stationary fuel. (ii) Evaporation of organic solvent.

(C) **Sulphur compounds** : Produced by burning of fossil fuel. The most common species, sulphur dioxide, is a gas that is poisonous to both animals and plants. Ex :→ SO_2

Harmful effect of Sulphur compounds :

(i) Even a low concentration of sulphur dioxide causes respiratory diseases e.g., asthma, bronchitis, emphysema in human beings.

(ii) Causes irritation to the eyes, resulting in tears and redness.

(iii) High concentration of SO_2 leads to stiffness of flower buds which eventually fall off from plants. Sulphur dioxide Uncatalysed oxidation of sulphur dioxide is slow. However, the presence of particulate matter in polluted air catalyses the oxidation of sulphur dioxide to sulphur trioxide.

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ ✓

$O_3 \rightarrow O_2 + [O]$ → nascent oxygen

The reaction can also be promoted by ozone and hydrogen peroxide.

$SO_2(g) + O_3(g) \rightarrow SO_3(g) + O_2(g)$

$SO_2(g) + H_2O_2(l) \rightarrow H_2SO_4(aq)$

$H_2O_2 \rightarrow H_2O + [O]$

$SO_2 + H_2O + O \longrightarrow SO_3 + H_2O \rightarrow H_2SO_4$

(D) **Nitrogen compound** : At high altitudes when lightning strikes, O_2 and N_2 combine to form oxides of nitrogen. NO_2 is oxidised to nitrate ion, NO_3 which is washed into soil, where it serves as a fertilizer. In an automobile engine, (at high temperature) when fossil fuel is burnt, dinitrogen and dioxygen combine to yield significant quantities of nitric oxide (NO) and nitrogen dioxide (NO_2) as given below:

$$N_2(g) + O_2(g) \xrightarrow{1483K} 2NO(g)$$

NO reacts instantly with oxygen to give NO_2

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

Rate of production of NO2 is faster when nitric oxide reacts with ozone in the stratosphere.

$$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$$

$O_3 \rightarrow O_2 + [O]$

$NO_2 + O$

HARMFUL EFFECTS OF NITROGEN COMPOUNDS

(i) The irritant red haze in the traffic and congested places is due to oxides of nitrogen.

(ii) Higher concentrations of NO_2 damage the leaves of plants and retard the rate of photosynthesis.

(iii) Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children.

(iv) It is toxic to living tissues also. It is also harmful to various textile fibres and metals.

(E) **Carbon dioxide** : Normally it forms about 0.03 per cent by volume of the atmosphere. If the amount of carbon dioxide crosses the delicate proportion of 0.03 percent, the natural greenhouse balance may get disturbed. Carbon dioxide is the major contributor to global warming.

STRATOSPHERIC POLLUTION

Depletion of Ozone Layer

Due to human activity 2 compounds NO and CFC are responsible for depletion of O_3 layer.

NO, CF_2Cl_2

(a) **NO (Nitric oxide) :**

$$NO + O_3 \longrightarrow NO_2 + O_2 \quad (\rightarrow O_2 + O)$$

$$NO_2 + O \longrightarrow NO + O_2$$

The NO react with O_3 so decrease the amount of O_3 and forms NO_2 which react with oxygen atoms available in the stratosphere and producing back NO.

Thus no NO is consumed but O_3 gets depleted.

(b) **Chlorofluoro carbons (CFC) or freons :**

The freons decomposes in the presence of U.V. radiation coming from the Sun.

$$CF_2Cl_2 \xrightarrow{h\nu} \dot{C}F_2Cl + \dot{C}l$$

$$CFCl_3 \xrightarrow{h\nu} \dot{C}l + \dot{C}FCl_2$$

The reactive chlorine atoms then destroy the ozone layer through the following sequence of reaction.

Which are repeated because chlorine atom are regenerated in the second reaction :

Reaction. $Cl^{\bullet} + O_3 \longrightarrow ClO^{\bullet} + O_2$

$$ClO^{\bullet} + O \longrightarrow Cl^{\bullet} + O_2$$

The one molecule CFC can destroy more than one thousand O_3 molecules in the stratosphere.

(c) **Effect of depletion of O_3 layer** : Due to depletion of O_3 layer, U.V. radiation fall on the Earth.

- The U.V. radiation, damage the cornea and lens of the eyes.
- The U.V. radiation affect the plant proteins so reduce the chlorophyll.
- The U.V. radiation, up set the heat balance of the Earth.

Ozone hole: It was found that a unique set of conditions was responsible for the ozone hole. In summer season, nitrogen dioxide and methane react with chlorine monoxide (reaction a) and chlorine atoms (reaction b) forming chlorine sinks, preventing much ozone depletion, whereas in winter, special type of clouds called polar stratospheric clouds are formed over Antarctica. These polar stratospheric clouds provide surface on which chlorine nitrate formed (reaction a) gets hydrolysed to form hypochlorous acid (reaction c). It also reacts with hydrogen chloride produced as per (reaction b) to give molecular chlorine.

$$\dot{Cl}O + \dot{N}O_2(g) \rightarrow ClONO_2(g) \quad \text{(a)}$$

$$\dot{Cl}(g) + CH_4(g) \rightarrow \dot{C}H_3(g) + HCl(g) \quad \text{(b)}$$

$$ClONO_2(g) + H_2O(g) \rightarrow HOCl(g) + HNO_3(g) \quad \text{(c)}$$

$$ClONO_2(g) + HCl(g) \rightarrow Cl_2(g) + HNO_3(g) \quad \text{(d)}$$

Acid Rain : The rain containig H_2SO_4, HNO_3 (and small amount of HCl) which are formed from the oxide of S and N_2 present in the air is called as acid rain. Normally rain water has a pH of 5.6 due to the presence of H^+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$$H_2O(l) + CO_2(g) \rightleftharpoons H_2CO_3(aq)$$

$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

When the pH of the rain water drops below 5.6, it is called acid rain.

Formation of acid rain : The oxide of nitrogen undergo oxidation reaction. The reaction with the water vapour present in the atm to form HNO_3.

$O_2 + O$

$N_2 + O_2 \xrightarrow{1483K} NO\,(g)$

Step (I) :

$$NO + O_3 \xrightarrow[h\nu]{} NO_2 + O_2$$

$$NO_2 + O_3 \xrightarrow[h\nu]{} NO_3 + O_2$$

$$NO_2 + NO_3 \xrightarrow[h\nu]{} N_2O_5$$ → is not air pollutant

$$N_2O_5 + H_2O \xrightarrow[h\nu]{} 2HNO_3$$

HNO_3 come down with rain to Earth.

The SO_3 react with water vapour and form H_2SO_4.

Step (II) :

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

$SO_2 + O_3 \longrightarrow SO_3 + O_2$ (S: +4 → +6)

$SO_2 + H_2O_2 \longrightarrow SO_3 + O_2$

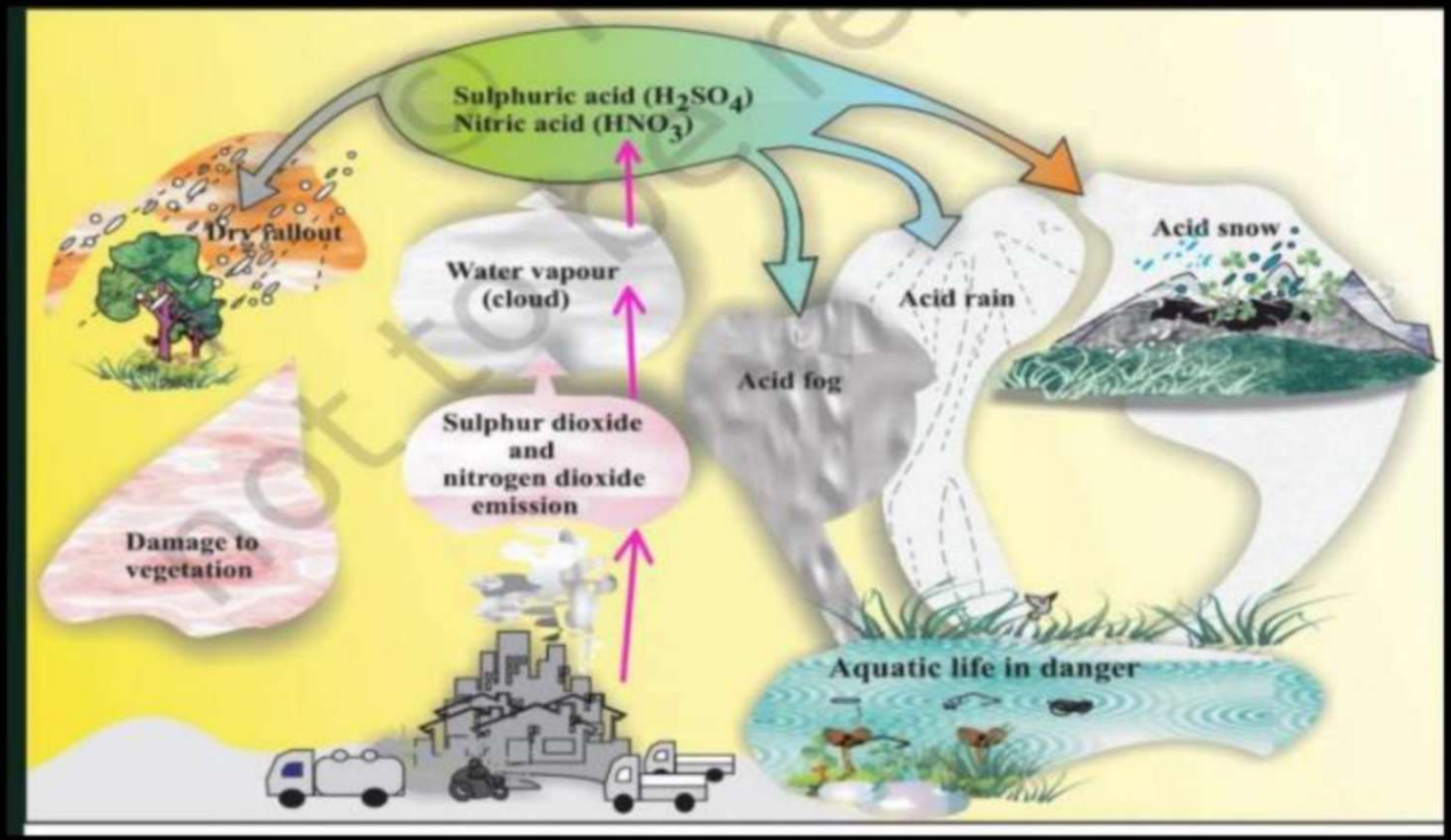
↳ $H_2O + O$

Ammonium salts are also formed and can be seen as an atmospheric haze (aerosol of fine particles). Aerosol particles of oxides or ammonium salts in rain drops result in wet-deposition. SO_2 is also absorbed directly on both solid and liquid ground surfaces and is thus deposited as dry-deposition.

HARMFUL EFFECT OF ACID-RAIN

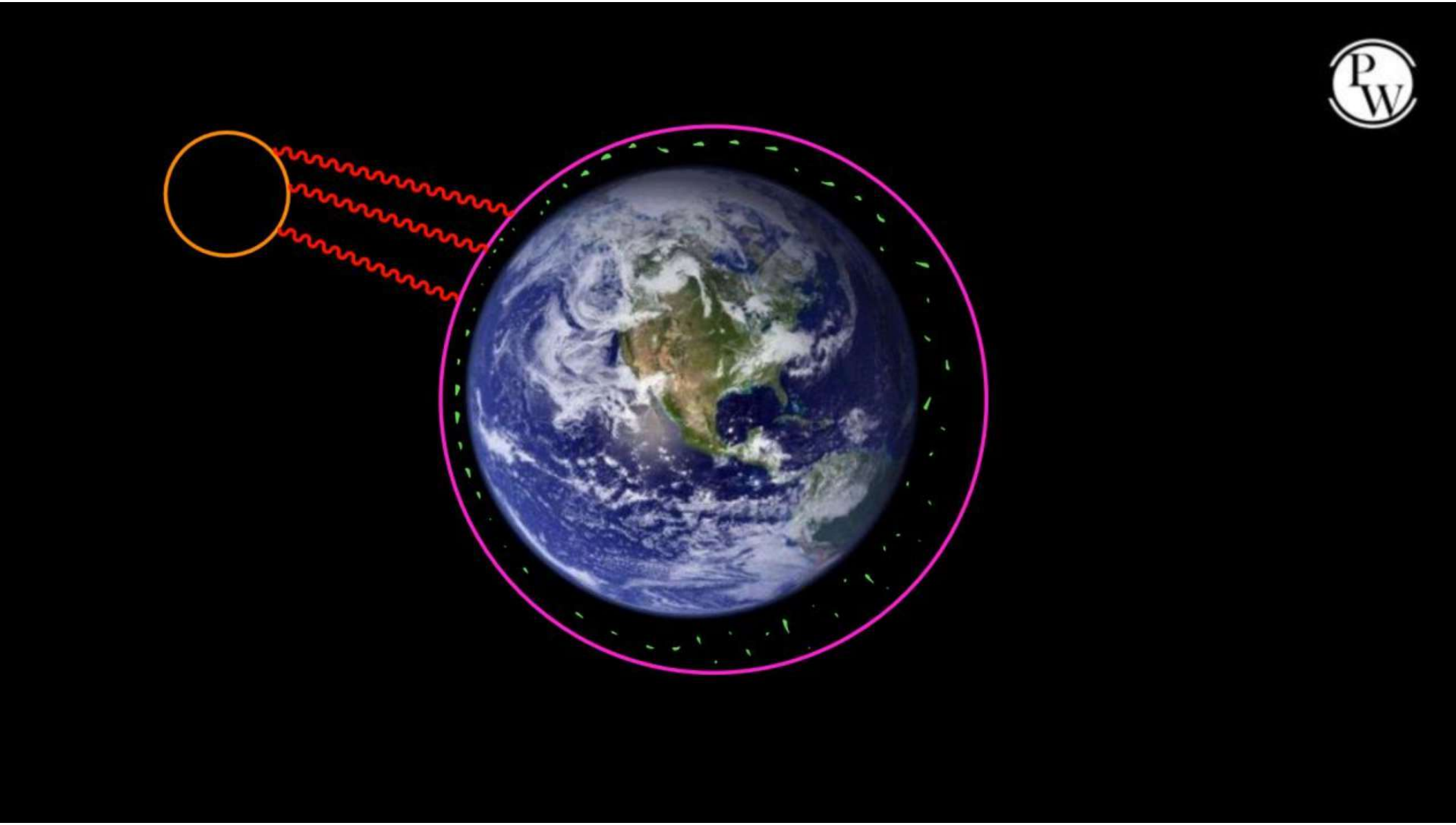
- It causes respiratory ailments in human beings and animals.
- It corrodes water pipe. So heavy metal (like Fe, Pb, Cu) are mixed with water which have toxic effect.
- The acid rain increase the acidity of the lake. Which is harmful to aquatic ecosystem.
- It is harmful for agriculture, trees, plants as it dissolves and washes away nutrients needed for their growth and also damages buildings.

Taj Mahal and Acid Rain : Taj Mahal is reported to be affected by SO2 and other air pollutants released by oil refinery of Mathura. Acid rain reacts with marble, $CaCO_3$ of Taj Mahal ($CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$) causing damage to this wonderful monument that has attracted people from around the world.


Sulphuric acid (H_2SO_4)
Nitric acid (HNO_3)
Dry fallout
Water vapour (cloud)
Acid rain
Acid snow
Acid fog
Sulphur dioxide and nitrogen dioxide emission
Damage to vegetation
Aquatic life in danger

Green House Effect : The warming of earth due to remission of sun's energy absorbed by the earth. The remission of earth's energy is absorbed by CO_2 molecules and H_2O vapour present near the earth's surface and then its radiation back to the earth, is called as green house effect. So the temp. of the earth is increased is called as global warming.

Important Green House Gases : Methane, water vapour, nitrous oxide, CFCs, ozone and CO_2.



PARTICULATES IN ATMOSPHERIC POLLUTION

Smoke is composed of particulate matter. Particulates are the tiny solid or liquid particles suspended in air. These particles are usually individually invisible to the naked eye. Collectively, however, small particles often form a haze that restricts visibility.

Particulates in the atmosphere may be viable or non-viable :-

(i) **Viable particulates** - These are the minute living organisms that are dispersed in atmosphere.

Eg. bacteria, fungi, moulds, algae etc.

(ii) **Non-viable** - These are formed either by the breakdown of larger materials or by the condensation of minute particles and droplets. There are four types of non-viable particulates in the atmosphere : mists, smoke, fumes and dust.

(a) Mists are produced by particles of spray liquids and the condensation of vapours in air. Examples are portions of herbicides and insecticides that miss their targets and travel through the air to form mists.

(b) Smoke denotes very small soot particles produced by burning and combustion of organic matter. Oil smoke, tobacco smoke and carbon smoke are typical examples of this type of particulate emission.

(c) Fumes are condenses vapours : fumes of metals are the well-known particulates of this type. Examples of this category also include metallurgical fumes and alkali fumes.

(d) Dust consists of the particles produced during crushing, grinding and attribution of solid materials. Non- viable dust particulates in the atmosphere consist of ground limestone, sand tailings from floatation, pulverized coal, cement, fly ash and silica dust.

The effect of particulate pollutants are largely dependent on the particle size. Airborne particles such as dust, fumes, mist etc., are dangerous for human health. Particulate pollutants bigger than 5 microns are likely to lodge in the nasal passage, whereas particles of about 10 micron enter into lungs easily. Lead used to be a major air pollutant emitted by vehicles. Leaded petrol used to be the primary source of air-borne lead emission in Indian cities. Lead interferes with the development and maturation of red blood cells.

SMOGS → Smoke + Fog

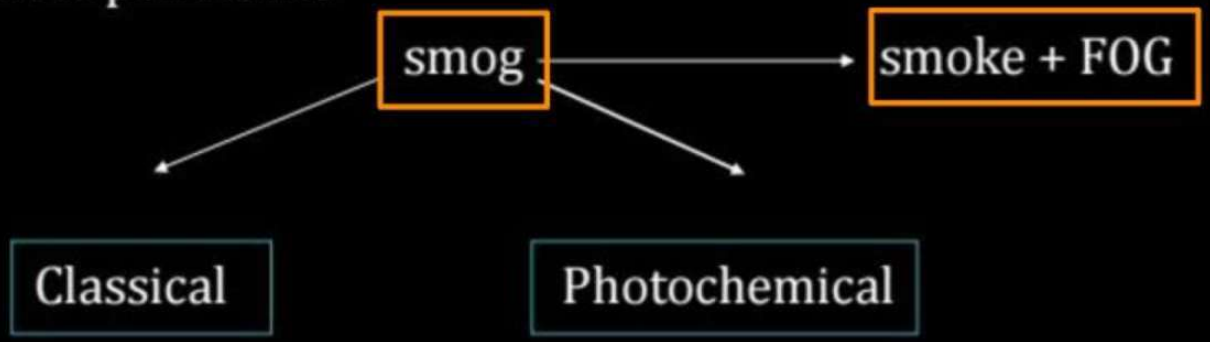
Smogs which describe the "smoke-fog" like condition, are the best-known examples of air pollution that occurs in many cities throughout the world.

There are two types of smogs :

(i) Classical smogs - Which occur in cool humid climate and are the result of buildup of sulphur oxides and particulate matter from fuel combustion. Chemically it is a reducing mixture so also called reducing smog.

(ii) Photochemical smogs - Which occur in warm, dry and sunny climate and result from the action of sunlight on the nitrogen oxides and hydrocarbons produced by automobiles and factories. Photochemical smog is an oxidising smog having a high concentration of oxidising agents whereas classical smog is chemically reducing smog with high concentrations of SO_2. Mostly in those cities which have very large populations and high vehicular density.

Particulate pollutants



Classical	Photochemical
1) occurs in cool humid climate	1) occurs in warm, dry & sunny climate
2) Smoke + Fog + SO_2	2) action of sulight on unsaturated H.C and Nitrogen oxides
3) Reducing smog	3) oxidising smog (Hydro Carbons)

Formation of photochemical smog : The chemistry of formation of photochemical smog centres around nitric oxide (NO). At the high temperatures, in the petrol and diesel engines of cars and trucks, N_2 and O_2 react to form a small quantity of NO, which is emitted into troposphere with the exhaust gases. This NO oxidised in air to NO_2 which in turn absorbs energy from sunlight and breaks up into nitric oxide and free oxygen atom.
(Photochemical decomposition)

$$NO_2(g) \xrightarrow{h\nu} NO(g) + O(g)$$

Oxygen atoms are very reactive and can combine with O_2 to form ozone;

$$O(g) + O_2(g) \longrightarrow O_3(g)$$

The O_3 formed in the above reaction reacts rapidly with the NO(g) formed in reaction to regenerate NO_2. NO_2 is brown gas at high levels can contribute to haze.

$$NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$$

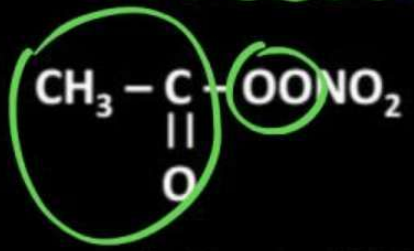
Both NO and O_3 are strong oxidising agents and can react with the unburnt hydrocarbons in the polluted air to produce chemicals such as formaldehyde, acrolein and peroxyacetyl nitrate (PAN) that cause the eyes to water and burn and are harmful to the respiratory system. The brownish haze of photochemical smog is largely attributed to the brown colour of NO_2.

$$3CH_4 + 2O_3 \longrightarrow \underset{\text{Formaldehyde}}{3CH_2 = O} + 3H_2O$$

Acrolein and peroxyacetyl nitrate (PAN) are particularly noxious.

$CH_2 = CHCH = O$

Acrolein



Peroxyacetyl nitrate (PAN)

Effects of Photochemical Smog :-

- The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate (PAN).
- Photochemical smog causes serious health problems.
- Both ozone and PAN act as powerful eye irritants.
- Ozone and nitric oxide irritate the nose and throat and their high concentration causes headache, chest pain, dryness of the throat, cough and difficulty in breathing. Photochemical smog leads to cracking of rubber and extensive damage to plant life. It also causes corrosion of metals, stones, building materials, rubber and painted surfaces.

Control of Photochemical Smog :-

- If we control the primary precursors of photochemical smog, such as NO_2 and hydrocarbons, the secondary precursors such as ozone and PAN, the photochemical smog will automatically be reduced.
- Usually catalytic converters are used in the automobiles, which prevent the release of nitrogen oxide and hydrocarbons to the atmosphere.
- Certain plants e.g., Pinus, Juniparus, Quercus, Pyrus and Vitis can metabolise nitrogen oxide and therefore, their plantation could help in this matter.

WATER POLLUTION

(i) Pathogens :

The most serious water pollutants are the disease causing agents called pathogens.

Pathogens include bacteria and other organisms that enter water from domestic sewage and animal excreta.

Human excreta contain bacteria such as Escherichia coli and Streptococcus faecalis which cause gastrointestinal diseases.

(ii) Organic wastes:

- The other major water pollutant is organic matter such as leaves, grass, trash etc.
- They pollute water as a consequence of run off. Excessive phytoplankton growth within water is also a cause of water pollution.
- These wastes are biodegradable.

(Major Water Pollutants)

Pollutant	Source
Micro-organisms	Domestic sewage
Organic wastes	Domestic sewage, animal excreta and waste, decaying animals and plants, discharge from food processing factories.
Plant nutrients	Chemical fertilizers
Toxic heavy metals	Industries and chemical factories
Sediments	Erosion of soil by agriculture and strip mining
Pesticides	Chemicals used for killing insects, fungi and weeds
Radioactive substances	Mining of uranium containing minerals
Heat	Water used for cooling in industries

IMPORTANCE OF DISSOLVED OXYGEN IN WATER

The large population of bacteria decomposes organic matter present in water. They consume oxygen dissolved in water. The amount of oxygen that water can hold in the solution is limited.

In cold water, dissolved oxygen (DO) can reach a concentration up to 10 ppm (parts per million), whereas oxygen in air is about 200,000 ppm.

If the concentration of dissolved oxygen of water is below 6 ppm, the growth of fish gets inhibited.

$DO \leq 10\ ppm$

$DO > 6\ ppm$

BIOCHEMICAL OXYGEN DEMAND (BOD) AND CHEMICAL OXYGEN DEMAND (COD)

The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called **Biochemical Oxygen Demand (BOD).**

The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically.

Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

Clean water < 5 ppm
Highly polluted > 17 ppm

CHEMICAL OXYGEN DEMAND (COD) :

COD is the oxygen requirement by chemical $K_2Cr_2O_7$ for oxidation of total organic matter (biodegradable + non biodegradable) in water.

Note : COD value is always higher than BOD value.

$$COD > BOD$$

(iii) Chemical Pollutants:

- As we know that water is an excellent solvent, water soluble inorganic chemicals that include heavy metals such as cadmium, mercury, nickel etc constitute an important class of pollutants. All these metals are dangerous to humans because our body cannot excrete them. Over the time, it crosses the tolerance limit. These metals then can damage kidneys, central nervous system, liver etc. Pollutants :- Cd, Hg, Ni
- Acids (like sulphuric acid) from mine drainage and salts from many different sources including raw salt used to melt snow and ice in the colder climates (sodium and calcium chloride) are water soluble chemical pollutants.

Poly chlorinate biphenyls

- Cleansing agent
- Carcinogenic

EUTROPHICATION

Decrease in Conc^n of oxygen in water due to pollutants

International Standards for Drinking Water

Fluoride:

- For drinking purposes, water should be tested for fluoride ion concentration.
- Its deficiency in drinking water is harmful to and causes diseases such as tooth decay etc.
- Soluble fluoride is often added to drinking water to bring its concentration up to 1 ppm or 1 mg dm^{-3}.

$[F^{\ominus}] \leq 1$ ppm

Las Hard $3Ca_3(904)_2 . Ca(OH)_2 \downarrow F^-$ $3Ca3(PO4)2 . CaF_2$ More Hard $[F^-] \leq 1$ppm

F^- ion concentration above 2 ppm causes brown mottling of teeth. At the same time, excess fluoride (over 10 ppm) causes harmful effect to bones and teeth, as reported from some parts of Rajasthan.

$[F^{\ominus}] > 2$ppm → Brown mottling of teeth

$[F^{\ominus}] > 10$ppm → harmful

Lead :

Drinking water gets contaminated with lead when lead pipes are used for transportation of water. The prescribed upper limit concentration of lead in drinking water is about 50 ppb. Lead can damage kidney, liver, reproductive system etc.

$[Pb] \leq 50$ ppb

Sulphate : $[SO_4^{2-}] < 500$ ppm

Excessive sulphate (>500 ppm) in drinking water causes laxative effect, otherwise at moderate levels it is harmless.

Nitrate : [Nitrate] < 50 ppm

- The maximum limit of nitrate in drinking water is 50 ppm.
- Excess nitrate in drinking water can cause disease such as methemoglobinemia (blue baby' syndrome).

Maximum Prescribed Concentration of Some Metals in Drinking Water.

Metal	Maximum concentration (ppm or mg dm^{-3}
Fe	0.2
Mn	0.05
Al	0.2
Cu	3.0
Zn	5.0
Cd	0.005

(C) **LAND OR SOIL POLLUTION :** Most of the land pollution is caused by pesticides and other chemicals which are added to the soil grow better crops. Often, a pesticide poisons many more organisms than those intended. Some of these poison pass through food chains and eventually reach harmful proportions. Solid wastes are another cause of land pollution.

Pesticides

- Prior to World War II, many naturally occurring chemicals such as nicotine (by planting tobacco plants in the crop field), were used as pest controlling substance for major crops in agricultural practices.

- During World War II, DDT was found to be of great use in the control of malaria and other insect-borne diseases.

- Therefore, after the war, DDT was put to use in agriculture to control the damages caused by insects, rodents, weeds and various crop diseases. However, due to adverse effects, its use has been banned in India.

Organic toxin

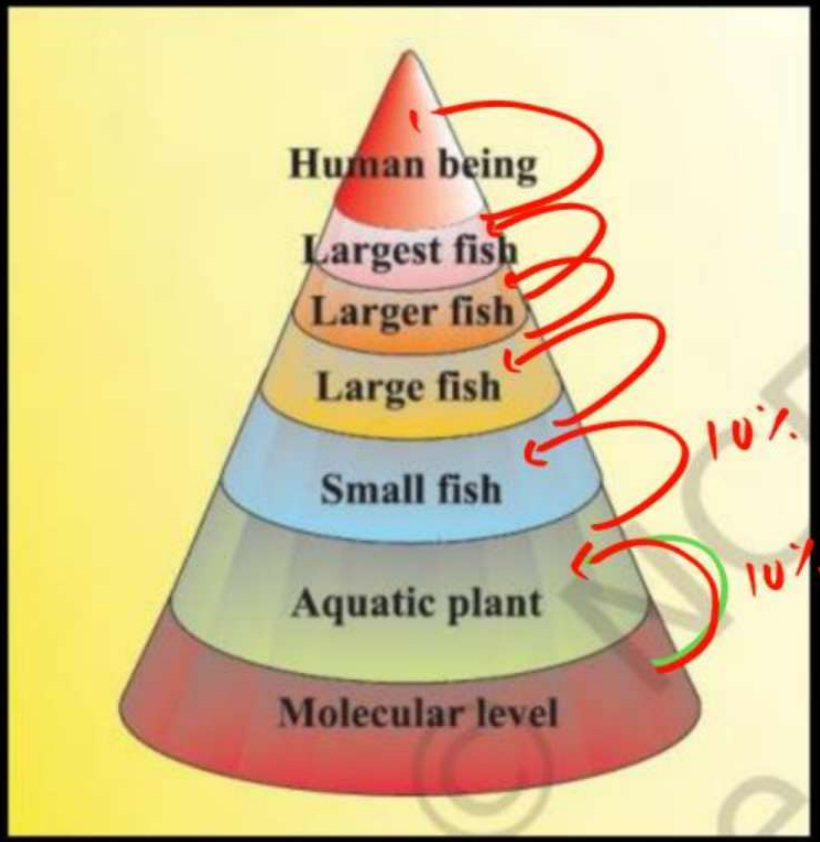
- Aldrin
- Dieldrin
- Water insoluble
- Non biodegradable

Herbicides

$NaClO_3$

Na_3ASO_3

- Most herbicides are toxic to mammals but are not as persistent as organo-chlorides



At each level 10% increement in pollutants.

INDUSTRIAL WASTE

Industrial solid wastes :

(i) Biodegradable - Biodegradable wastes are generated by cotton mills, food processing units, paper mills and textile factories.

(ii) Non-biodegradable - These wastes are generated by thermal power plants which produce fly ash; integrated iron and steel plants which produce blast furnace slag and steel melting slag.

Industries manufacturing aluminium, zinc and copper produce mud and tailings. Fertilizer industries produce gypsum. Hazardous wastes such as inflammables, composite explosives or highly reactive substances are produced by industries dealing in metals, chemicals, drugs, pharmaceuticals, dyes, pesticides, rubber goods etc.

STRATEGY FOR CONTROL OF ENVIRONMENTAL POLLUTION

The management of waste : The production and improper disposal of waste are causes for a great deal of environmental pollution. In addition to the household waste which included sewage and municipal garbage, many toxic industrial wastes from manufacturing processes require treatment and/or safe disposal.

Recycling : When materials are recycled, there are several benefits, apart from saving on the cost of raw materials, waste disposal costs are reduced. Examples of recycling by industry are :

1. the collection and recycling of glass (in bottle banks);
2. the use of scrap metal in the manufacture of steel;
3. the recovery of energy from burning combustible waste.

Thus recycling converts waste into wealth.

Green Fuel : Fuel obtained from plastic waste has high octane rating. It contains no lead and is known as "green fuel".

Biogas : A pilot plant has been set up, where after removing ferrous metals, plastic, glass, paper etc. from garbage, it is mixed with water. It is then cultured with bacterial species for producing methane, commonly known as biogas. The remaining product is used as manure and biogas is used to produce electricity.

Digestion : Anaerobic digestion occurs when microganisms degrade wastes in the absence of oxygen. It may be used to treat sewage sludge, but the process can also be used to degrade a variety of toxic organic wastes.
Carbon dioxide and methane, which may be used as a fuel, are the products. The overall process is the conversion of the organic material into carbon dioxide and methane i.e.

Dumping : Ocean dumping of sewage sludge has been widely practiced in the seas around the worked. However, the parctice of application to sludge the land is increasing. The sludge contains nitrogen and phosphorus which make it useful as a fertilizer. Urban areas produce sludge with high toxic metal content, so the amount of such sludge dumped in this way must be carefully controlled.

Incineration : Incineration converts organic materials to CO_2 and H_2O. It may serve to destroy household waste, chemical waste and biological waste (e.g. from hospitals). A high temperature is required usually in excess of 1000°C, and a plentiful supply of oxygen. Exhause gases must be filtered. The process greatly reduced the volume of waste-an inorganic ash is left behing, which is disposed of as landfill.

STRATEGIES TO CONTROL ENVIRONMENTAL POLLUTION

Waste management

GREEN CHEMISTRY

- exploitation of soil and excessive use of fertilizers and pesticides have resulted in the deterioration of soil, water and air.
- The solution of this problem does not lie in stopping the process of development that has been set in; but to discover methods, which would help in the reduction of deterioration of the environment.
- Green chemistry is a way of thinking and is about utilising the existing knowledge and principles of chemistry and other sciences to reduce the adverse impact on environment.
- Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment.

Green Chemistry in day-to-day Life

(i) Dry Cleaning of Clothes

- Tetra chloroethene ($Cl_2C=CCl_2$) was earlier used as solvent for dry cleaning. The compound contaminates the ground water and is also a suspected carcinogen.
- Replacement of halogenated solvent by liquid CO_2 will result in less harm to ground water.
- These days hydrogen peroxide (H_2O_2) is used for the purpose of bleaching clothes in the process of laundary, which gives better results and makes use of lesser amount of water.

(ii) Bleaching of Paper

Chlorine gas was used earlier for bleaching paper. These days, hydrogen peroxide (H_2O_2)

(iii) Synthesis of Chemicals

Ethanal (CH_2CHO) is now commercially prepared by one step oxidation of ethene in the presence of ionic catalyst in aqueous medium with a yield of 90%.

(iv) 'Green Solution' to Clean Turbid Water

- Powder of kernel of tamarind seeds has been found to be an effective material to make municipal and industrial waste water clean.
- It is non-toxic, biodegradable and cost effective material.
- This powder is usually discarded as agricultural waste.
- The present practice is to use alum to treat such water.
- It has been found that alum increases toxic ions in treated water and can cause diseases.

Q. Among the following, the one that is not a greenhouse gas is :

(a) Sulphur dioxide (b) Nitrous oxide

(C) Methane (d) Ozone *(NEET 2019)*

Q. Which of the following is not correct about carbon monoxide ?

(a) It forms carboxyhaemoglobin

(b) It reduces oxygen carrying ability of blood

(c) The carboxyhaemoglobin (haemoglobin bound to CO) is less stable than oxyhaemoglobin

(d) It is produced due to incomplete combustion *(NEET 2020)*

Q. Which of the following is a sink for CO ?

(a) Microorganisms present in the soil

(b) Oceans

(c) Plants

(d) Haemoglobin

(NEET 2017)

Q. Which one of the following is not a common component of photochemical smog ?

(a) Ozone
(b) Acrolein
(c) Peroxyacetyl nitrate
(d) Chlorofluorocarbons

NO, O_3, Acrolein, formaldehyde, PAN

Q. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity ?

(a) N_2O_5 (b) NO_2

(c) N_2O (d) NO (NEET 2018)

Q. Which one of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere ?

(a) Polyhalogens
(b) Ferrocene
(c) Fullerences
(d) Freons (2004)

Q. About 20 km above the earth, there is an ozone layer. Which one of the following statements about ozone and ozone layer is true ?

(A) It is beneficial to us as it stops U.V. radiation.
(b) Conversion of O_3 to O_2 is an endothermic reaction.
(c) Ozone is a triatomic linear molecule.
(d) It is harmful as it stops useful radiation.

Q. Which one of the following statements regarding photochemical smog is not correct ?

(a) Carbon monoxide does not play any role in photochemical smog formation.
(b) Photochemical smog is an oxidising agent in character.
(c) Photochemical smog is formed through photochemical reaction involving solar energy.
(d) Photochemical smog does not cause irritation in eyes and throat.

(2012)

Q. Which one of the following statements is not true?

(a) Clean water would have a BOD value of 5 ppm.

(b) Fluoride deficiency in drinking water is harmful. Soluble fluoride is often used to bring its concentration upto 1 ppm.

(c) When the pH of rain water is higher than 6.5, it is called acid rain.

(d) Dissolved Oxygen (DO) in cold water can reach a concentration upto 10 ppm.

pH < 5.6
Acid Rain

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(a) Clean water would have a BOD value of 5 ppm.

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(c) When the pH of rain water is higher than 6.5, it is called acid rain.

(d) Dissolved Oxygen (DO) in cold water can reach a concentration upto 10 ppm.

(Karnataka NEET 2013)

Q. Which one of the following statement is not true?

(a) pH of drinking water should be between 5.5-9.5.

(b) Concentration of DO below 6 ppm is good for the growth of fish.

(c) Clean water would have a BOD value of less than 5 ppm.

(d) Oxides of sulphur, nitrogen and carbon, are the most widespread air pollutant. *(2011)*