The term *"environment"* etymologically means *"surroundings"* Air, Atmosphere, Water, Hydrosphere and land Lithosphere are the components of environment. A fine balance of interdependence occurs between life forms and environment. This balance is disturbed by the addition of certain substances by man in his quest to improve the quality of his life. *This very human act of contaminating the environment and disturbing the ecological balance can be called* ***"Environmental pollution"***.

The contamination of the environment by the addition of undesirable substances produced by human activities which cause damage to the living organisms is called *"environmental pollution"*.

The undesirable substance that is added is called *"pollutant"*.

Causes for Environmental Pollution

Many factors are responsible to cause pollution such as ;

1. According to **write** (1970), human greed and ignorance have allowed our culture to develop an ecological crisis like pollution.
2. According to **Southwick** (1976), human population explosion is the main cause of pollution.
3. According to **Michael** (1984), pollution is the release in excess of permitable limits of foreign substances with in the environment.

Thus, factors such as human population explosion, rapid industrialization, unplanned urbanisation, deforestation etc. are responsible for the environmental pollution. The pollution has invaded all the three components of the environment. Thus we have air pollution water

pollution and soil pollution. In addition to these, there are few more new forms of pollution such as marine pollution, noise pollution, thermal pollution, Radioactive pollution.

AIR POLLUTION

Air or atmosphere is a mixture of gases existing as a thin layer around the earth. The contamination of air by the addition of un wanted gases or solid waste (particulate matter) into the atmosphere is air pollution. The human activities are releasing the pollutants (fn : pollutants are by products or waste products, which when released into environment causes pollution) into the atmosphere resulting in the contamination of air.

Broadly the sources of air pollution are classified into two types : **Natural** and **Anthropogenic**.

The natural sources of air pollution includes the volcanoes, forest fire, pollen and spores of bacteria, fungi.

The human activities leading to air pollution are termed as anthropogenic. Combustion of fossil fuel in automobiles and coal industries, mining, various types of industries etc. are responsible for adding the unwanted gas or particulate matter into the environment leading to its pollution.

Sources of Air Pollution

Complete, combustion of burning of fossil fuels and domestic combustion, thermal power stations and volcanic eruptions releases carbon dioxide into the atmosphere.

Incomplete combustion of petrol and petroleum products used predominantely in automobiles, factories, coal mines, forest fires, furnaces, burning cigarettes produce carbon monoxide.

Nitrogen oxide is produced by the incomplete combustion of petroleum products in automobiles, diesel driven vehicles, power plants etc.

Emission of burning fuel in furnaces and industries produces sulphur oxides. Evaporation of petrol / diesel from the carburettors as components of vehicular exhausts hydro carbons such as Benzene, Benzypyrene and methane are produced.

Coolants of refrigerators, propellent gases of deodorants, insecticides are sources of chlorofluro carbons.

Soot obtained from in complete burning of hydro carbons, smoke obtained from burning of fossil fuel and wood, fly ash, dust obtained from various industries, spores and pollen grain are the source of particulate matter. When this particulate matter is less than 10μm in size they suspend in air. These are called suspend particular matter (SPM)

List of Pollutants and Their Source

Pollutants	Source
1. Oxides of carbon a) carbon dioxide	complete combustion of fossil fuels, domestic combustion thermal power stations and volcanic cruptions.
b) Carbon monoxide	Incomplete combustion of petrol and petroleum products-Automobiles, coal mines, forest fires, industries.
2. Nitrogen oxides thermal power plants.	Incomplete combustion of petrol in automobiles, diesel driven vehicles,
3. Sulphur oxide	Sulphur emission from burning fuel, furnaces, industries.
4. Hydro carbons	Evaporation from fuel dumps, automobile exhausts, refineries, incomplete combustion of fossil fuels, agricultural burning.
5. Chlrofluoro Carbons (CFC)	In complete burning of hydrocarbons, coolants of refrigerators, propellants of deodarants, insecticides
6. Particulate Matter (Particulate matter less than 10μm in size is called suspended particulate. (SPM.)	Soot-incomplete burning of hydrocarbon, smoke - burning of fossil fuel & wood flyash, dust from various industries, spores & pollen grain

Effects of Air Pollution

Air pollution has long lasting effects both on organisms and environment. This effect may be due to *primary pollutants* (fn : pollutants obtained from a specific source) or *secondary pollutants* (fn : pollutants formed as result of interaction between primary air pollutants)

Effects of Primary Air Pollutants

1. Carbon dioxide is opaque to infrared waves. So it prevents the loss of heat from the earth. Therefore it has warming effect (Green house effect) leading to steady rise in the temperature of earth. This rise of temperature of earth due to increase of carbon dioxide is causing the polar ice caps to melt. This melting has made level of sea rise by about 12cm. Excess of carbon dioxide produces head ache & nausea in humans.
2. Carbon monoxide has strong affinity for haemoglobin : It combines with *haemoglobin* (fn. red pigment present in the blood containing iron) reducing oxygen carrying ability of blood and produces giddiness and headache. It also causes decreased vision, cardiovascular disorder in humans. In plants, premature ageing, leaf curling and leaf drop are observed. It contributes to Global warming.
3. Respiratory damages, eye irritation, bronchitis, asthma etc. are observed in human when sulphur dioxide above 1 ppm is present. In plants, destruction of chlorophyll (chlorosis) is observed. Increased concentration of sulphur dioxide is responsible for discolouration and deterioration of ancient monuments. The threat to Taj Mahal at Agra can be cited here. This was pointed out by the **National Environmental and Engineering Research Institute** (NEERI). The Government owned Oil Refinery, 4 Kms. away from Taj Mahal spews 24 tonnes of Sulphur dioxide daily affecting the monument.
4. Chlorofluoro carbons, hydrochlorofluoro carbons and related poly chlorinated biphenyls damage liver. Central nervous system is impaired. Change in pigmentation is observed.

5. Nitrogen oxides cause eye irritation, respiratory troubles. Damage to lungs liver and kidneys are observed. Nitrogen oxide is responsible for the production of acid rain, photochemical smog.
6. Hydrocarbons are carcinogenic. The hydrocarbons produce bronchial constriction, asthma, irritation to eyes and mucous membrane.

Effects of Secondary Pollutants

7. Production of **smog** (fn : the term was coined by **Des Voeux**) is another outcome of air pollution. It is caused by chemical reaction between different pollutants such as smoke, dust particles, water vapour, hydrogen sulphide and sulphur dioxide. In other words smog is a combination of **smoke** and **fog**. Upper respiratory tract infections, irritation to eye, nose & throat, bronchitis and pneumonia occur in humans. Headaches, nausea and allergic reactions are seen to occur. On exposure to long term exposure to smog, lung cancer, heart disease, damage to brain occur.
8. Production of **photochemical smog**. It formed by the photo chemical reaction between nitrogen oxides and hydrocarbons producing secondary pollutants such as ozone, peroxyacylnitrates (PAN) etc. This can cause headache, eye, nose and throat infections. Coughing and wheezing are seen. Damage to plants are also observed.

Bhopal Tragedy

Bhopal, India is the site of greatest industrial disaster in history. On the night of **December 23, 1984**, a dangerous chemical **Methyl Isocyanate (MIC)** leaked into the atmosphere from the **Union Carbide Factory.** About 4,000 people were killed in their sleep and an estimated 4,00,000 people remain injured or affected to this day.

Control Measures

Air pollution can be prevented by controlling the emission of particulate matter by using **Electro Static Precipitators (ESP), fabric filters, wet scrubbers** and **cyclone separaters.**

By using the fuel free of lead, automobile emissions can be reduced. Catalytic converters, efficient four stroke engines and use of liquified petroleum gas can go long way in preventing the pollution of air by automobiles.

Using coal with low sulphur content will reduce the sulphur dioxide contamination of air.

Use of smoke filters and increasing the height of smoke chimneys can reduce the industrial contamination of air.

In India, both State and Central Govt. have passed several legislative measures to prevent and control different types of air pollution :

1. Bengal Smoke and Nuisance Act, 1905;
2. The Motor Vehicle Act, 1938;
3. The Gujarat Smoke Nuisance Act, 1953;
4. The Air (Prevention and Control of Pollution Act), 1981;
5. The Environment (protection) Act, 1986 ;
6. The Motor Vehicles Act, 1988 - This Act came into force from 1.7.1989.

GREEN HOUSE EFFECT, GLOBAL WARMING

Phenomenon of increase in temperature of earth by allowing solar radiation to pass in but preventing long wave heat radiation to pass out due to increased levels of green house gases is called ***'green house effect'***. It was discovered by **Joseph Fourier**.

To describe this phenomenon, the term "green house" is used as the green house gases act like the glass of a glass house to trap heat and maintain higher interior temperature.

The gases involved in producing green house effects are called green house gases.

These green house gases mainly carbon dioxide allow the solar radiation to reach earth. This energy is used for processes such as:

- heating of ground surface,
- plant photosynthesis,
- evaporation of water,
- melting and of ice and snow.

Heating of the ground by sun light makes the earths surface radiator of energy in long wave band. This emission of energy from the earth is generally directed to the space. But instead of reaching the space, these long wave infra red radiation is absorbed by naturally occurring greenhouse gases mainly carbon dioxide. The absorption of this energy adds additional heat energy to Earth's atmosphere.

In fact, this greenhouse effect is a natural phenomenon without which earth would not be warm enough for humans to live. But when the levels of green house gases increases, the green house effect becomes stronger. As a result, earth's climate will become warmer - This is referred to as *'Global Warming'*

Effects of Global Warming

1. Global warming has resulted in the melting of Arctic's Polarice Cap. It is declining at the rate of 9 percent per decade. This melting is resulting in the raise of the sea levels. Submersion of large areas can occur.
2. Warmer earth could cause disruption of habitats such as ***coral reefs*** and ***alphine meadows*** resulting in the extinction of many plant and animal species.

Measures to be Taken to Control Global Warming

Though India is not required to adopt any green house gas reduction targets, as a commitment under the ***United Nations Framework Convention on Climate Change***, it has to be ready with :

1. invention of sinks and sources of green house gas emission.
2. Predict the cumulative effect or impact of national and international green house gas emission to plan for temperature and sea level rise.
3. Devise land use plans for the coastal areas likely to be affected.
4. Devise water and land management strategies especially in agriculture sector

WATER POLLUTION

Water is the major constituent of hydrosphere. Survival of all type of life forms are dependent on water as major constituent of protoplast is water. 2/3 of earth's surface is covered with water. Out of this only about 3% of water is potable. *Unscrupulous industrial growth* and *increasing human population* are the root causes for water pollution. The term *water pollution* refers to *contamination of water by toxic pollutants that may either eliminate some living organisms or all forms of life.*

Pollution of water occurs from three main sources :

- **Industrial effluents**
- **Domestic sewage and**
- **Agricultural waste**

(i) Industrial effluents : Chemical waste released by industrial units into the water bodies are called industrial effluents. Every possible type of industry releases its wastes into the water and pollutes it. These effluents contain acids, alkalies, fluorides, phenols, metals like mercury, lead, cadmium, zinc etc and many other organic and inorganic substances.

(ii) Domestic Sewage : Waste water containing human and animal excreta, food residues, organic waste from tannaries & canning industry and discharges from commercial establishments connected to public swage system is called domestic sewage.

(iii) Agricultural Waste : In agriculture, chemicals are used as fertilizers and as pesticides. Many of the pesticides are non biodegradable i.e. they persist in environment harming organisms and affecting human health. Run-off from the agricultural fields contains these chemicals leading to the contanination of water bodies. Besides these, thermal pollution can cause water pollution.

Effects of Water Pollution

The industrial effluents are toxic to animals. The death of marine and fresh water fishes is largely due to industrial pollution. Presence of chemicals released by industries into water makes it unfit for consumption.

The occurrence of a crippling disease, "Minamata disease" in Japan was due to the consumption of mercury poisoned fish/animal. It is a classical example of industrial effluents on organisms.

The sewage is biodegraded by bacteria. This bacterical action decreases the dissolved oxygen present in the water. Thus, oxygen requirement of organisms increases. This is called Biological oxygen **Demand (BOD).** Decreasing level of dissolved oxygen leads to the death of fishes and other animals. BOD is the index of water pollution.

Decomposition products of the sewage or organic waste act as nutrients. This process of conversion of nutrient poor state of water into highly productive or eutrophic form is called **eutrophication.** These nutrients stimulate luxuriant growth of algae. This is called *algal*

bloom. The algal bloom depletes the oxygen content of water leading to the death of aquatic animals.

Pathogenic bacteria in the sewage produces diseases such as typhoid and cholera. Hepatitis, a viral disease is spread by polluted water.

The phenomenon of increase in concentration of non-biodegradable pollutants such as DDT in organisms is known as *biomagnification*. In higher concentration, they cause thinning of egg shell, malfunctioning of sexhormones, hypertension, liver cirrhosis. Biomagnification of DDT lead to the decline in population of several birds. "*Silent Spring*" a novel written by **Rachel Carson** (1962) drew the attention of US govt and then DDT was banned.

Control Measures for Water Pollution

The sewage should be treated in oxidation ponds or waste stabilization ponds. The processed sewage is non toxic and can be used for agricultural purposes.

Use of non-biodegradable pesticides should be discontinued. Naturally occurring herbal products should be used as pesticides.

Discharge of untreated industrial effluents should not be allowed.

NOISE POLLUTION

Noise is *"unwanted sound"*. one man's sound may be another man's noise. So noise may also be defined as *"unwanted sound at a wrong time and at a wrong place"*. **Intrusion of unwanted sounds into our life is noise pollution.**

Noise pollution has many sources. It can be categoriesed into following types :

Road, Air and Railway traffic contributes significantly to noise pollution. Increase in the number of automobiles, airlines and trains is becoming major source of noise pollution. Directly or indirectly more people are exposed to this type of noise pollution.

Industrial activities is leading to noise pollution. People located near the industrial plants are subjected to noise originating from the industrial activities. People working in such industries are specially affected by severe noise pollution.

Household consumer products like refrigerators, mixies, vacuum cleaners, air conditioners etc. by the sound they generate are responsible for noise pollution. Various types of music systems playing loud music, sirens of ambulances, police vehicles, loud speakers in public functions etc. are sources of noise pollution. Noice generated by numans and barking dogs also contribute to the noise pollution.

The loudness of noise is measured in *decibels* (dB). Noise level upto 85 dB can be tolerated by human. Increase in these noise level leads to adverse effects on human health such as ; Hearing loss, Sleeplessness, Headaches, Loss of mental peace etc. Noise pollution can also effect the occupational performace.

To control noise pollution, three methods can be adopted

a) Reduction of noise at source

b) Interruption of path of transmission

c) Measures to protect the receiver

Different Measures Used to Control Noise Pollution are;

Lubrication of the machines, tightening of loose nuts, reducing the vibration of the machines etc. can reduce the noise at the source.

Construction of silence zones around hospitals educational institutions will lessen noise pollution.

Covering the noise producing machines by sound insulating materials or use of sound proof chamber can reduce the noise at source.

Growing trees around all noise producing regions reduces noise as trees and shrubs act as *Green Muffler* i.e. act as sound insulators.

Ear muffs / cotton plugs should be used to reduce the effect of noise in case of occupational exposure to noise.