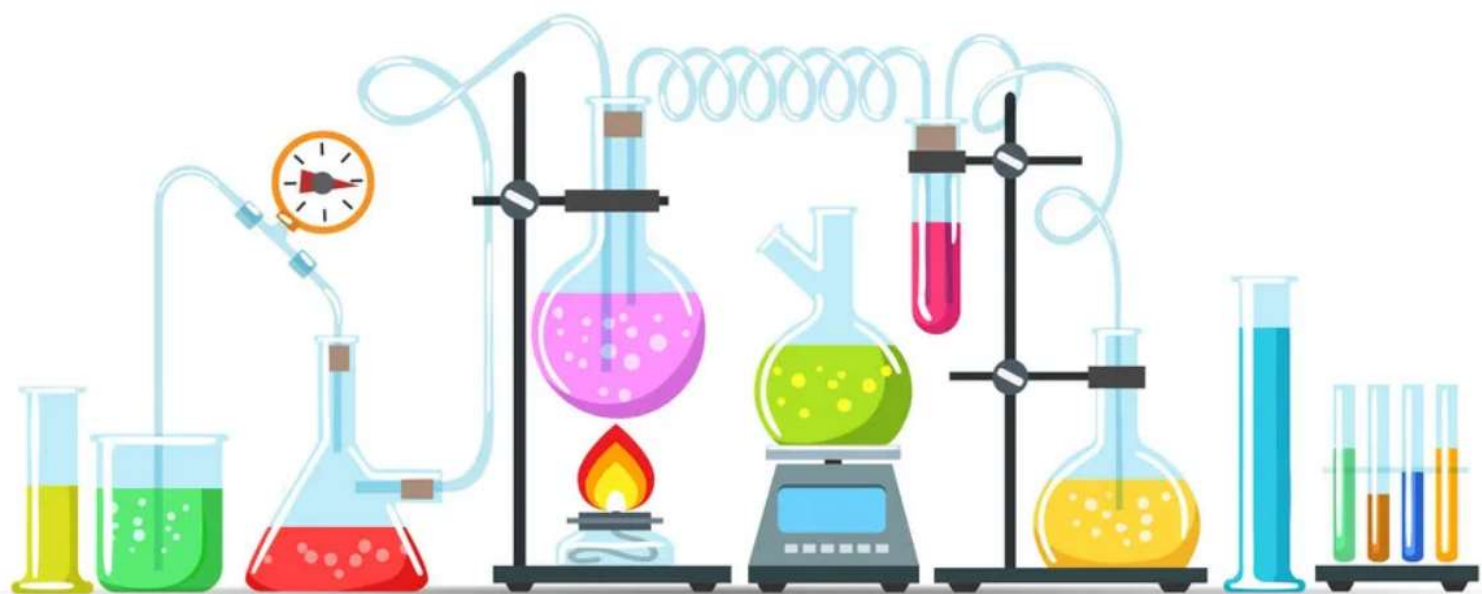


# CHEMISTRY



# ENVIRONMENTAL CHEMISTRY

## Introduction

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Interrelation of biological, social, economical, physical and chemical studies with our surrounding is called environmental studies. Environmental pollution is the greatest health hazard all over the world. Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

An undesirable change in physical, chemical or biological characteristics of air, water and land that is harmful to human life and other living organisms, living conditions, cultural assets, industrial progress and harms our resources is called pollution.

## Environmental Pollution

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Undesirable changes that have harmful effects on plants, animals and human beings in our surrounding is called environmental pollution.

### Pollutant

The substance which causes pollution and is harmful for environment is called pollutant. Pollutants are of two types:

#### 1. Biodegradable

Those substances which are degraded rapidly by natural process or artificial methods are called biodegradable pollutants. Ex- discarded vegetables.

#### 2. Non-biodegradable

Those substances which degrade at very slow rate or does not degrade by natural biological process, for example, DDT, arsenic salts of heavy metals, radioactive materials and plastics are non-biodegradable pollutants.

## Atmospheric Pollution

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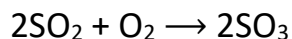
Lowest layer of atmosphere is troposphere which have dust, water vapour and clouds, it contains dust, water vapour and clouds while stratosphere contains ozone. Atmospheric pollution includes both troposphere and stratosphere pollution.

### Tropospheric Pollution

Tropospheric pollution occurs due to the presence of undesirable solid or gaseous particles in the air.

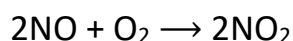
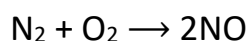
## 1. Gaseous air pollutants:

- i. **Oxides of Sulphur:** Oxides of sulphur are produced when sulphur containing fossil fuel is burnt. The most common species, sulphur dioxide, is a gas that is poisonous to both animals and plants. It has been reported that even a low concentration of sulphur dioxide causes respiratory diseases e.g., asthma, bronchitis, emphysema in human beings. Sulphur dioxide causes irritation to the eyes, resulting in tears and redness.



- ii. **Oxides of Nitrogen:** Mainly produced by combustion of fossil fuels at high temperature in automobile engines mainly NO and NO<sub>2</sub>.

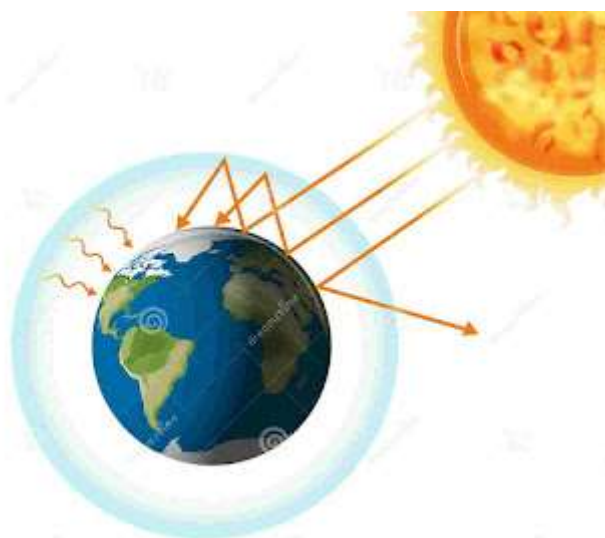
These produce reddish brown haze or brown air NO<sub>2</sub> is more dangerous than NO. These oxides can cause pulmonary oedema, dilation of arteries, eye irritation, heart problems, injury to liver and kidneys and also causes acid rains.



- iii. **Hydrocarbons:** Produced naturally (e.g., marsh gas) as well as due to incomplete combustion. These are carcinogenic and causes irritation of mucous membrane, eyes. They causes ageing, breakdown of tissues, shedding of flower, leaves and twigs in plants.
- iv. **Carbon monoxide:** It is colourless, odourless gas. It is produced by incomplete combustion of fuels, naturally it is produced by oceans or by decaying of organic matter by bacteria. It is poisonous because it combines with hemoglobin to form 300 more times stable carboxyhemoglobin which reduces oxygen-carrying capacity of blood and results into giddiness, headache, decreased vision, cardiovascular malfunction and asphyxia. Cigarette smoke also contains a lot of CO which induces premature birth deformed babies and spontaneous abortions in pregnant women.
- v. **Carbon dioxide:** It is produced naturally by volcanic eruptions, respiration. It is also produced by burning of fossil fuels. Increased level of CO<sub>2</sub> is controlled by green plants during photosynthesis. It is a greenhouse gas and responsible for global warming. It causes headache nausea and asphyxiation.

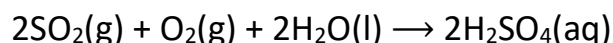
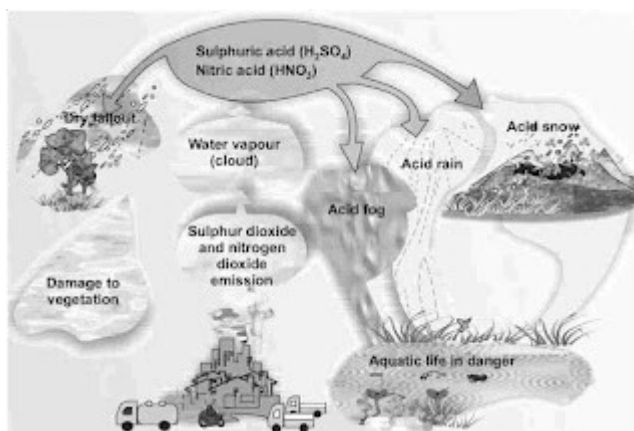
## 2. Greenhouse Effect

This effect was discovered by Fourier and the term was coined by Arrhenius. 75% of solar radiation is absorbed by earth surface and remaining is reflected back. Some of which is absorbed by greenhouse gases such as carbon dioxide, methane, ozone, chlorofluorocarbon compounds (CFCs) and water vapour in the atmosphere which increases temperature of atmosphere is called greenhouse effect.



### 3. Acid Rain

When the pH value of the rain water drops below 5.6, it is known as acid rain. Acid rain is a byproduct of a variety of human activities that emit the oxides of sulphur and nitrogen in the atmosphere.

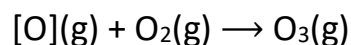


## Stratospheric Pollution

### 1. Ozone Hole

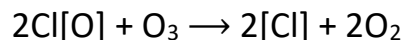
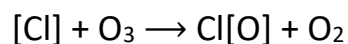
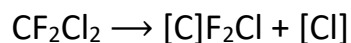
Depletion in the concentration of ozone over a restricted area as over Antarctica is called ozone hole. Stratospheric clouds are formed over Antarctica.

Molecular oxygen splits into free oxygen atoms by UV radiations which combine with molecular oxygen to form ozone.



As ozone is thermodynamically unstable hence, there exists dynamic equilibrium between its decomposition and formation. Ultraviolet radiations dissociate chlorofluorocarbon to give chlorine-free radical, which combines with ozone to form

chlorine monoxide radical which combines with free oxygen to form more chlorine-free radicals.



### Effects of Depletion of The Ozone Layer:

Bad ozone is formed in troposphere that harms plants and animals while good ozone is formed in stratosphere which acts as shield. UV rays can enter in earth's atmosphere.

- It is harmful as can cause skin cancer.
- It increases transpiration hence decreases soil moisture.
- It damages paints and fibres, causing them to fade faster.

## Water Pollution

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Any unwanted change which deteriorate quality of water and make it unfit for drinking is called water pollution. Pollution of water originates from human activities.

### Causes of Water Pollution

1. Organic matter such as leaves, grass, trash etc. as well as excessive phytoplankton growth in water causes water pollution as this matter is decomposed through microbial activity is known as putrescibility which requires oxygen. Degree of impurity of water due to organic matter is measured in terms of Biochemical Oxygen Demand (BOD).
2. **Pathogens:** Disease-causing agents are called pathogens e.g., viruses, bacteria, protozoa, helminthes, algae etc. Human excreta contains E.coli and Streptococcus faecalis bacteria which cause gastrointestinal diseases.
3. **Chemical pollutants:** These are of two types, inorganic and organic.
4. Inorganic pollutants constitute acids, salts, heavy metals such as Cd, Hg, Ni etc. Heavy metals can damage central nervous system, liver and kidneys.
5. Organic pollutants constitute, pesticides, petroleum pollutants, PCBs, detergents, fertilizers etc. PCBs (Polychlorinated Biphenyls) are carcinogenic and phosphatic fertilizers increase algae growth. Acidic water is harmful for aquatic life as well as for drinking.

## Soil Pollution

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It is unfavourable alteration of soil by addition or removal of substances and factors which

decrease soil productivity, quality of plants and ground water is called soil pollution. Mainly caused by chemicals added into soil as pesticides, herbicides and fertilizers for better productivity.

### Causes of Soil Pollution

1. **Pesticides:** These are actually synthetic toxic chemicals with ecological repercussions. These are used in killing pathogens, pests and in inhibiting unwanted growth in agriculture, horticulture, forestry and water.
2. **Fertilizers:** Excessive use of fertilizers decreases natural microflora hence deteriorate soil. Therefore, now a days organic farming is encouraged which involves organic pesticides, biofertilizers and disease resistant varieties.
3. **Industrial wastes:** These are both solid and liquid and are dumped over the soil. These contain toxic chemicals like mercury, copper, zinc, lead, cadmium, cyanides, acid, alkalies etc.

### Strategies to Control Environmental Pollution

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Two sources of environment pollutant are household waste and industrial waste. Following method can be used to control them.

1. **Recycling:** Waste are recycled into manufacturing of new material. For example, scrap iron, broken glass, clothes can be made from recycled plastic waste and soon becomes available in market. We can also recover energy from burning combustible waste.
2. **Digestion:** Waste material can be degraded by anaerobic micro-organisms in absence of air. It can be used to produce electricity. First biodegradable and non-biodegradable waste are separated then biodegradable wastes are mixed with water and cultured by bacterial species which produce methane.
3. **Dumping:** Sewage sludge acts as fertilizer because it contains nitrogen and phosphorus hence, it is dumped in land areas which increases soil fertility.

### Green Chemistry

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Green chemistry is a way of thinking and is about utilizing the existing knowledge and principles of chemistry and other sciences to reduce the adverse impact on environment. Utilization of existing knowledge base for reducing the chemical hazards along with the development activities are the foundation of green chemistry.

### Summary-

1. Environmental pollution causes undesirable changes in our surrounding that have harmful effect on plants, animals and human beings.
2. Atmospheric pollution is studied as tropospheric pollution and stratospheric pollution.
3. Smog and global warming take place due to tropospheric pollution.
4. Stratospheric pollution causes depletion of ozone layer.
5. Water pollution is caused by pathogens, organic wastes and chemical pollutants.
6. Soil pollution is caused by insecticides, pesticides and herbicides.
7. Industrial waste is of two type, biodegradable and non-biodegradable.
8. Green chemistry is a way of thinking and is about to utilize the existing knowledge and principles of chemistry and other sciences to reduce the adverse impact on environment.



# MIND MAP : LEARNING MADE SIMPLE CHAPTER - 14

