Pollution of Air and Water

Sources of Air Pollution

Air is everywhere around us and we all need clean air for breathing. But did you know that as a result of the addition of some substances to air, it is increasingly becoming toxic for living organisms?

The contamination of air with unwanted substances, which have harmful effects on both plants and animals, is known as **air pollution**.

The substances that cause the contamination of air are called **air pollutants**. Let us explore these sources of air pollution in detail.

Sources of air pollution

There are two sources of air pollution:

- Natural sources
- Man-made sources

Natural sources

You may have seen on television that during the summer season some forests catch fire. These fires are caused when, as a result of high temperatures, dead plant materials such as barks, twigs, and leaves, which are lying on the forest floor, start burning. These fires emit large amounts of smoke into the atmosphere, thereby polluting the air.

The other natural source of air pollution is volcanoes. Volcanoes emit large amounts of harmful gases and dust particles into the atmosphere, thus contributing to air pollution.

Did you know that the Pacific Ring of Fire is an area of high volcanic activity encircling the basin of the Pacific Ocean?

Man-made sources

Although natural sources contribute to air pollution, did you know that human activities contribute the most towards air pollution? Human activities that cause air pollution include emissions from power plants, automobile exhausts, and factories; burning of fossil fuels and firewood, etc.

Let us now explore various air pollutants and their sources.

Carbon monoxide

Carbon monoxide is a toxic, colourless gas. It is produced by the incomplete burning of fossil fuels. It is mainly produced by vehicles.

Smog

Smog is formed by the combination of smoke and fog. It is a highly noxious mixture of pollutants that affects the health of living organisms. Smog is a common winter phenomenon in a large number of modern day cities such as Delhi.

Oxides of sulphur and nitrogen

Sulphur dioxide and nitrogen dioxide are major oxides of sulphur and nitrogen that act as pollutants. These are released from petroleum refineries and also from power plants that use coal as a fuel.

Chlorofluorocarbons

Chlorofluorocarbons are also known as CFCs. They are used in refrigerators, air conditioners, and aerosol sprays. They cause damage to the ozone layer in the atmosphere.

Suspended Particulate Matter (SPM)

These are tiny particles that are produced on the burning of coal and petroleum. They are also released during industrial processes such as mining and making of steel.

Indian cities such as Delhi, Kolkata, and Kanpur top the list of cities in the world with the highest air pollution levels.

Effects of air pollution

- Increase in the amount of carbon dioxide level can cause increase in global temperature. This is known as "**Green House Effect".** This increase in temperature leads to the melting of polar ice caps and glaciers which increase the water level in seas and oceans.
- **Global warming -** The phenomena of rise in overall temperature of the Earth because of the rise in CO_2 is known as global warming. CO_2 has a tendency to absorb sun's heat and not let them escape. Thus, it increases the earth's temperature.
- Inhalation of certain gases like carbon monoxide (CO) can cause various respiratory diseases like Asthma and lung cancer.
- Sulphur dioxide causes irritation to the eyes and if combines with water vapour present in air, it forms an acid which comes on earth surface with the rain water. This type of rain is called acid rain. Acid rain affects the growth of the plants. It has also damaged "Taj Mahal"
- There is increase in the depletion of ozone layer due to the constant increase in the air pollution.

Do You Know?

Gases like Carbon dioxide, Methane, Chlorofluorocarbon and Nitrous oxide are known as Green House Gases.

Prevention of Air Pollution:

Air pollution can be prevented by adopting various methods like using non-conventional energy sources instead of conventional sources, increasing the efficiency of engines to control the smoke coming out of the vehicles, making factory chimneys at high altitude or using electrostatic precipitators. Air pollution can be reduced by recycling the plastic and rubber and by planting more and more trees.
Government has introduced **Euro/Bharat norm** (applicable to all vehicles) on the level of vehicular emission. Under this, strict controls are to be maintained in large cities, to cut down sulphur and nitrogen oxides from automobiles exhausts.

Effects of Air Pollution on Living Organisms

Do you know that air pollution has significant health effects on all living organisms including human beings? Let us explore further.

Various air pollutants cause diseases that range from skin cancers to respiratory disorders. Let us examine in detail the effect that each pollutant has on living organisms.

Carbon monoxide

Carbon monoxide is a pollutant that is released as a result of the incomplete burning of fuels such as diesel and petrol. **What effect does carbon monoxide have on the health of humans**?

Carbon monoxide combines with haemoglobin, which is present in the red blood cells, and decreases the oxygen-carrying capacity of blood.

Sulphur dioxide

Sulphur dioxide is a pollutant that is produced during the combustion of fuels such as coal. It causes many respiratory problems such as cough and throat irritation when inhaled in small amounts. Continuous exposure to sulphur dioxide may cause permanent damage to the lungs.

Nitrogen dioxide

Exposure to nitrogen dioxide causes damage to the lungs apart from other respiratory disorders.

Smog

Do you know what smog is? Some of you may have seen a thick fog-like layer in the atmosphere during the winter months. This is smog. **Do you know how it is formed?** Smog is formed when smoke mixes with fog. **But how does smog affect the health of living organisms?**

Smog is made up of many air pollutants such as the oxides of nitrogen. It causes breathing difficulties such as asthma, cough, and wheezing among children.

Do You Know:

The great smog of 1952 in London caused the darkening of streets and killed approximately 4,000 people in just four days.

Chlorofluorocarbons (CFCs)

Chlorofluorocarbons are responsible for damaging the ozone layer and have led to the formation of the ozone hole in the atmosphere. A rapidly depleting ozone layer allows the harmful UV radiations of the Sun to reach the Earth, which is responsible for an increase in the cases of skin cancers.

Suspended particles

Suspended particles are tiny particles that are produced because of the burning of fossil fuels. They trigger many respiratory diseases such as asthma and sneezing when inhaled.

The hair present in the nostrils prevent the suspended dust particles from entering our lungs. However, some dust particles are so small that they cannot be trapped in the nostrils and they enter the respiratory system.

Do you know that pollution has an equal damaging effects on plants?
Yes, pollution causes various klinds of changes in plants like unrequired closure of stomata, slower rates of photosynthesis and retarded growth of plants.

Effect of Air Pollution on Non-Living Objects

All of us have seen the Taj Mahal, either in reality or in pictures. **Did you know that the Taj Mahal is in danger because of rising air pollution levels?** Taking the Taj Mahal as a case study, let us explore how air pollution affects non-living objects such as buildings and monuments.

The industries present around the Taj Mahal, especially the Mathura oil refinery, are primarily responsible for the damage caused to the monument. Do you know how?

Acid rains are very harmful. Do you know why? These rains cause widespread damage to several materials and property, especially to monuments, which undergo heavy corrosion as a result of these rains.

Acid rains have corroded the marble of the Taj Mahal, a phenomenon also known as "Marble-cancer".

Do you know that the Mathura oil refinery also releases large amounts of suspended particulate matter? This particulate matter is responsible for the yellowing of the marble of the Taj Mahal.

When you compare the colour of the Taj Mahal in present photographs with those taken about 50 years back, **do you notice any change?**

Do you know that acid rains reduce the availability of nutrients to plants and result in a decrease in their rate of growth?

What are we doing to protect the Taj Mahal or other monuments from the harmful effects of air pollution? Let us find out.

The Supreme Court of India has taken many steps in the direction of protecting the Taj Mahal from pollution.

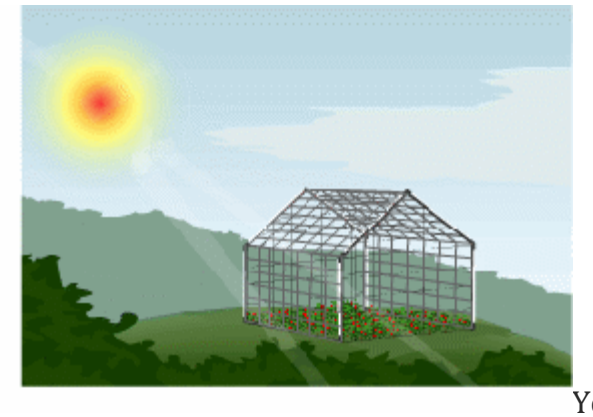
It has directed the industries around the Taj Mahal to use cleaner fuels such as LPG (Liquefied Petroleum Gas) and CNG (Compressed Natural Gas).

In addition, all vehicles have been ordered to switch-over to unleaded petrol.

Greenhouse Effect and Global Warming

Greenhouse Effect

What is a greenhouse?



You may have seen **transparent structures made of plastic or glass that house small plants**. These transparent structures are called greenhouses. A greenhouse allows sunlight to enter, but prevents the heat from escaping. This results in an increase in the temperature inside the greenhouse.

Greenhouses help maintain climatic conditions such as temperature and humidity at the levels that are conducive for the optimum growth of plants. Specially designed greenhouses keep tropical plants warm during the winters in colder climates. Apart from this, greenhouses also provide protection to plants against factors that are adverse to their growth, for example, pests and strong winds.

Greenhouse effect

Greenhouse effect is an atmospheric phenomenon named after the heat-trapping transparent structures. Sunlight passes through Earth's atmosphere to warm Earth's surface, but the heat radiated back from the warmed surface is absorbed by certain gases present in the atmosphere. This trapping of heat increases Earth's temperature, much the same way as the temperature inside a greenhouse rises. This is called greenhouse effect and the gases responsible for this phenomenon are called **greenhouse gases**.

Greenhouse Effect: Causes

The amount of greenhouse gases in the atmosphere has been on the rise for centuries. This has in turn increased Earth's average temperature and resulted in the phenomenon known as **global warming**.

Some of the factors responsible for this increase in greenhouse gases in the atmosphere.

- **Deforestation**: The cutting down of trees on a large scale negatively affects the amount of carbon dioxide getting converted into oxygen. This increases the concentration of carbon dioxide in the atmosphere.
- **Burning of fossil fuels**: The burning of fossil fuels such as coal and petroleum releases greenhouse gases such as carbon dioxide and methane into the atmosphere.
- **Industrial emissions**: Gases released by various industries also contribute to the rise in the amount of greenhouse gases in the atmosphere.

Initiatives to Reduce Air Pollution and Global Warming

Air pollution and global warming pose a serious threat to the Earth. What initiatives can we take to reduce these problems? Let us look at some of the initiatives that are already underway, and those that can be taken to help combat air pollution.

The government of Delhi has taken several initiatives to reduce the levels of air pollution in the city. Delhi was ranked among the most polluted cities of the world till a few years ago. The air in the city was heavily laden with fumes and poisonous gases from automobiles. On the intervention of the Supreme Court, a decision was taken to introduce CNG (Compressed Natural Gas) as a fuel to run the public transport system of Delhi. In addition, the use of unleaded petrol was made compulsory. The results of these initiatives reflected in the quality of air. The air in Delhi now is much cleaner as compared to the past.

Thus, the use of CNG and unleaded petrol are a few of the measures that can be taken to reduce air pollution. **Do you know of other measures to help combat air pollution?**

One measure of preventing air pollution and global warming involves the **switching over from traditional fuels to alternative, cleaner fuels** such as solar energy, wind energy, and hydropower energy. Unlike fossil fuels, these alternative sources of energy do not cause pollution and can be tapped from nature, where these are available in abundance.

The burning of dry leaves causes a lot of pollution. Therefore, instead of burning them, one can bury these leaves in a compost pit. The leaf compost thus obtained can be used as manure for plants.

Did you know that trees help in reducing the levels of sulphur dioxide, nitrogen dioxide, and dust particles in the atmosphere?

Planting of trees is another measure that can be taken to reduce air pollution. Plants use carbon dioxide during photosynthesis. Thus, planting more trees will increase the

utilization of carbon dioxide from the atmosphere. This will reduce the carbon dioxide concentration in the atmosphere and will help in reducing the growing effects of global warming. In India, *Van Mahotsav* is celebrated every year during the rainy season in the months of July and August. During this period, large scale plantation of trees is carried out.

Spread awareness!

Explain the importance of trees to your friends and motivate them to plant trees and nurture the already existing trees in their locality.

Interesting Fact:

An "Anti-cracker campaign" has been started by the Delhi government to motivate school students to avoid burning crackers on the occasion of Diwali. This initiative has started showing positive results. The quality of air in Delhi on the night after Diwali has improved significantly in comparison to previous years**.**

Water Pollution

The addition of harmful substances to water, as a result of which its physical, chemical, and biological properties get altered, is called ***water pollution****. The substances that pollute water are called water pollutants.* Sewage, toxic chemicals, silt etc. are examples of water pollutants.

What effect does water pollution have on living organisms? Let us explore the effects of various water pollutants on living organisms.

Water pollutants:

There are three main categories of water pollutants:

Biological pollutants: Biological pollutants make the water unfit for consumption and are responsible for causing various kinds of diseases, for example, algae, bacteria, fungi, etc.

Inorganic pollutants: These include suspended particles like dust, sand, soil etc.

Organic pollutants: These include weedicides, pesticides, fertilizers, sewage etc.

Do you know that water pollution can occur either through natural reasons or man made reasons?
Natural reasons of water pollution include the presence of aquatic weeds, decomposing matter, mud/sludge, algae or nematodes. Presence of these components in water bodies makes them unfit for human consumption.

Man made reasons of water pollution include industrial wastes, pesticides etc. Lets study them in detail.

Industrial waste

In the absence of proper treatment facilities for industrial wastes, most of these wastes are directly dumped into the rivers. The industrial wastes from oil refineries, chemical factories, sugar mills, and fertilizer plants carry toxic substances such as arsenic, lead, mercury, and fluoride. These substances cause toxicity in plants and animals.

They also pollute the soil by increasing its acidity, decreasing its fertility, and affecting the growth of worms which are beneficial for the soil.

Pesticides and fertilizers

We know that fertilizers and pesticides are the farmer's friends as they help in killing the pests and weeds and increasing the fertility of the soil. **However, do you know that they also have a significant negative impact on the water bodies?** The chemicals that are contained in these pesticides and fertilizers get dissolved in the water and eventually get washed away to the water bodies. They also seep into the ground and pollute the ground water.

On entering the water bodies, these pesticides and fertilizers increase the nutrient content of the soil as they contain various nutrients. This accelerates the growth of algae in the water bodies. You may have observed that some water bodies appear green in colour. This is because of the excessive growth of algae in water. **Does this excessive algal growth have any effect on the living organisms present in the water body?** The answer is a yes.

When these algae die, they are decomposed by the action of micro-organisms that are present in water. Consequently, the number of these micro-organisms in water bodies increases. Since they consume a large quantity of oxygen that is present in the water, it leads to a decrease in the levels of oxygen. The absence of oxygen eventually leads to the death of the living organisms.

Sewage

Sewage is waste water that contains faecal matter, urine, food wastes, detergents, and other solid substances. Sewage contains many disease-causing pathogens such as bacteria, fungi, viruses, and parasites. When drinking water gets contaminated with sewage water, these harmful organisms enter the bodies of the living organisms and cause several diseases. Some of the diseases caused by the drinking of contaminated water and the names of the respective causal organisms are listed in the given table.

Name of the disease	Causal organism
Cholera	Bacteria
Typhoid	Bacteria
Diarrhoea	Bacteria
Hepatitis	Virus
Amoebic dysentery	Protozoan

Several bacteria are present in the faeces of mammals. If the water is contaminated with faeces, then these bacteria function as indicator organisms for the quality of water i.e., the number of these faecal bacteria indicates the extent to which the water is contaminated by faecal matter.

Release of Superheated Water

The release of superheated water from some industries and nuclear power plants causes thermal pollution of the water bodies.

It results in the increase in temperature of ambient water that reduces dissolved oxygen content of water bodies. The abrupt change in the temperature of water body can kill the fish and other organisms adapted to particular temperature range.

Release of Waste and Oil from Refineries

The wastes and oil released from the refineries mainly in the seas and oceans cause marine pollution. The released oil penetrates into the plumage of birds and fur of mammals. This reduces their insulating ability and makes them more vulnerable to temperature fluctuations.

Methods of preventing water pollution

- Industrial waste must be chemically treated to remove harmful substances before dumping into the water bodies
- Disposal of human and animal excreta into water should be avoided
- Sewage water must be treated before releasing into the rivers
- Dumping of dead bodies, carcasses and other wastes into the water must be stopped

- Aquatic animals like tortoise and some special types of fishes help in purifying water, therefore they are termed as natural purifier of water

Some Interesting Facts:

- According to the Central Pollution Control Board, about 3,684 million litres of sewage is produced in Delhi in a single day.

- *Escherichia coli* bacterium, which is present in the faeces of humans and other living organisms, is used as an indicator organism for water contaminated with faeces.

Sources Of Water Pollution: A Case Study of River Ganga

What is water pollution?

The addition of harmful substances to water which changes its physical, chemical and biological properties is called ***water pollution****.*

The substances that pollute water are called water pollutants. Sewage, toxic chemicals, silt etc. are examples of water pollutants.

What are the sources of water pollution? How do water pollutants such as sewage, toxic chemicals, and silt enter water? Let us explore the answers to these questions by taking the river Ganga as an example.

All of you are aware that Ganga is one of the most important holy rivers of India. It supports the lives of millions of people living in the northern plains. **However, do you know that it has now become one of the most polluted rivers in India?** According to a study by the WWF, Ganga is one of the ten most endangered rivers in the world.

The river Ganga is practically dead at many places. This is because the pollution levels in the river are so high that it cannot support any life form. The portion of the river that flows through the city of Kanpur is a stretch that is completely dead.

What has led to such a condition of the river Ganga? The factors that have contributed to the increase in the pollution levels of the river are

- Dumping of large quantities of garbage into the river

- Releasing of untreated sewage water into the river

- Throwing of dead bodies into the river

- Washing, bathing, and defecating near the shores of the river

- Throwing flowers and idols of gods and goddesses into the river
- Dumping non-biodegradable substances such as polythene bags into the river

These are common factors that are responsible for polluting the rivers of our country. In addition, factories that are located near a river, throw their industrial wastes and toxic chemicals into the river. This makes the water of the river unfit for use by living organisms.

In order to address all the above mentioned problems, the **Ganga Action Plan** was launched in the year 1985 with the purpose of reviving the river. However, unplanned urbanisation and industrialization have already damaged the river beyond repair.

An Interesting Fact:

- The pollution in the river Ganga is harming the dolphins present in the river and their numbers are seen to be gradually declining.

Conservation and Purification of Water

Water is a precious resource and we need to conserve it. **How can the conservation and purification of water be carried out?** Let us explore the various methods that can be adopted to save water.

Water can be conserved by following the simple principle of reduce, reuse, and recycle. This can be practiced easily at homes. Some examples are

- Reusing the waste water from the kitchen (water that has been used to wash vegetables etc.) to water the plants in the garden
- Turning the tap off while brushing or shaving
- Checking for leaky taps and fixing them up
- Rain water harvesting
- Using improved farming and irrigation techniques
- Preventing pollution of water
- Conserving and replenishing ground water
- Proper removal of silt from water bodies
- Preventing cutting of trees
- Recycling and reusing water

Thus, we can reduce the total amount of water consumed by us by recycling and reusing most of the waste water for other purposes.

What about the waste water that is released from industries? Can it be recycled and reused too? The waste water from industries first needs to be treated in sewage treatment plants. This water can then be used for growing plants and other industrial purposes.

Some Interesting Facts:

- Leaking taps can lead to the wastage of thousands of litres of water in a single day.
- Drip irrigation is a method of irrigation that helps in the maximum conservation and utilization of water.

Purification of water

Do you know what potable water is? *Potable water is the water that is safe for drinking.* Although the water may look clean on mere observation, it may contain disease-carrying micro-organisms. In order to prevent the occurrence of diseases, this water has to be cleaned and only then can it be used safely for drinking. **What are some of the methods that can be used to purify water?** The methods for obtaining potable water can be divided into two groups: physical methods and chemical methods. Let us discuss them in detail.

Physical methods

- **Sedimentation**: It is a process in which suspended particles are allowed to settle down in water.
- **Filtration:** It is one of the common methods used for removing impurities from water. A simple filter paper can be used to obtain clean water. Candle type filter that is commonly used in households is also based on the principle of filtration.
- **Boiling:** Boiling the water helps in killing the germs present in water.

Chemical Methods

- **Chlorination:** Adding chlorine to water is one of the most commonly used methods of purifying water. Chlorine, when used in the prescribed amount, kills the germs present in water and makes it safe for consumption. You may have observed that tap water sometimes appears milky. **Do you know why?** This is because it contains chlorine.
- **Ozonisation**: It is a process of treatment of water with ozone. Due to great oxidation power, ozone acts as a powerful disinfectant.
- Adding bleaching powder also helps in purifying water.

Water Purifiers:

Water is purified at homes using a domestic water purifier. They have microporous filters and activated charcoal along with a source of UV radiations.
Insoluble impurities, such as sand, etc. are removed by the filters and microbes are killed by UV radiations. Organic impurities and undesirable odour are removed by activated charcoal.