

Air Pollution

Air pollution is defined as the introduction of pollutants, organic molecules, or other unsafe materials into Earth's atmosphere. This can be in the form of excessive gases like carbon dioxide and other vapours that cannot be effectively removed through natural cycles, such as the carbon cycle or the nitrogen cycle.

What are Air Pollutants?

Pollutants are the substances which cause pollution; air pollution is caused by air pollutants.

Types of Air Pollutants

Primary Pollutants

The pollutants that directly cause air pollution are known as primary pollutants.

Secondary Pollutants

The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants.

Classification of Pollutants

Particulate Pollutants	Gaseous Pollutants	
<ol style="list-style-type: none"> 1. Lead 2. Fly Ash 3. Metallic Oxides 4. Nanoparticles 	<ol style="list-style-type: none"> 1. Carbon monoxide (CO) 2. Carbon dioxide (CO₂) 3. Chlorofluorocarbons (CFCs) 4. Ozone (O₃) 5. Nitrogen oxide (NO_x) 6. Sulphur dioxide (SO₂) 	<ul style="list-style-type: none"> • Volatile organic compounds (VOCs) • Benzene • Ethylene • Biological pollutants • Asbestos • Radon

Particulate Pollutants

The particles that pollute the air by being suspended can be defined as particulate pollutants.

These particles are results of some anthropogenic processes like vehicles, industries, construction sites/activities, etc. or natural sources like pollen, volcanic eruptions, natural gaseous precursors, etc.

- Their size ranges from 0.001 to 500 micrometres (µm) in diameter.

Heavy Particulate Matter

Suspended Particulate Matter

Nanoparticulate Matter

- More than 10 μm
 - Settles down after a point
 - Less than 10 μm
 - Floats and moves freely with air currents
 - Less than 0.02 μm
 - Very light and harmful
 - Form aerosols
- Particulate pollutants can do vast damage to the human respiratory system.
 - PM 2.5 particles (2.5 μm or less) are declared as one of the most harmful particulate pollutants by the [Central Pollution Control Board \(CPCB\)](#). They are so tiny that they can be detected only with the help of an electron microscope.
 - These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory problems, irritation, inflammations and pneumoconiosis (a disease of the lungs caused due to the inhalation of dust.
 - It is characterised by inflammation, coughing, and fibrosis – excess deposition of fibrous tissue).

Lead

- Lead is one of the most hazardous heavy metals.
- Lead can cause serious damage to the human body like:
 - Nervous system damage
 - Digestive issues
 - Kidney damage
 - Impacts on intelligence
- Hence, Lead was banned as an additive to fuels and other products.
- Lead mixed with water and food can create cumulative poisoning.
- It has long term effects on children as it lowers intelligence.

Fly Ash

- Fly Ash are particles of oxides and other heavy metals. Majority of them are aluminium silicate (in large amounts), silicon dioxide (SiO_2) and calcium oxide (CaO).
- Thermal power plants are a major source of Fly Ash pollutant.
- Its deposition in agricultural fields can cause heavy metal contamination of crops and vegetables.

The Ministry of Environment and Forests has made it mandatory to use Fly Ash-based products in all construction projects, road embankment works, and low lying landfilling works that are within a 100 km radius of Thermal Power Stations and mine-filling activities within a 50 km radius of Thermal Power Stations.

Nanoparticles (NP)

- Nanoparticles have diameters less than 100 Nanometers (**10⁻⁹**).
- NP are responsible for the formation of dust clouds, Ozone depletion, environmental hydroxyl radical concentration and stratospheric temperature changes.

Gaseous Pollutants

Gaseous Pollutants	Description	Impacts
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<p>Carbon monoxide (CO)</p>	<ul style="list-style-type: none"> • Highly toxic. • Produced from internal combustion engines due to incomplete combustion. • Other sources are volcanoes, forest fires, etc. • Greenhouse gas. 	<ul style="list-style-type: none"> • Carbon monoxide poisoning. • Produces carboxyhemoglobin reducing the oxygen-carrying capacity of the blood.
<p>Carbon dioxide (CO₂)</p>	<ul style="list-style-type: none"> • Heavier than air. • Source are volcanoes, fire, etc. • Greenhouse gas. 	<ul style="list-style-type: none"> • CO₂ is an asphyxiant gas (asphyxia: a condition arising when the body is deprived of oxygen, causing unconsciousness or death.). • Has other harmful effects if a high concentration of CO₂ is inhaled like dizziness, headache, etc. • Carbonic rain in high polluted areas.
<p>Chlorofluorocarbons (CFCs)</p>	<ul style="list-style-type: none"> • Used in refrigerators, air conditioners, aerosols, etc. 	<ul style="list-style-type: none"> • Highly destructive to the Ozone layer.
<p>Ozone (O₃)</p>	<ul style="list-style-type: none"> • Very useful in the Stratosphere but harmful at ground layer. • It's produced due to industries and vehicles. • Greenhouse gas. 	<ul style="list-style-type: none"> • Has toxic effects. • Causes watery and itchy eyes.
<p>Nitrogen oxide (NO_x)</p>	<ul style="list-style-type: none"> • Various oxides of Nitrogen come under NO_x. • Caused due to reaction between oxygen and nitrogen at high temps such as in combustion engines and industries. 	<ul style="list-style-type: none"> • Aggravates Ashtamatic conditions and other respiratory issues in humans. • Plays a major role in the formation of SMOG, acid rain (nitric acid) and the greenhouse effect.

Sulphur dioxide (SO₂)	<ul style="list-style-type: none"> Pungent smelling colourless gas produced from mostly volcanic activities, industrial processes and production of sulphuric acid. 	<ul style="list-style-type: none"> Respiratory issues, premature deaths and death of certain nerves when inhaled.
Volatile Organic Compounds (VOCs)	<ul style="list-style-type: none"> Volatile Organic Compounds (VOCs) are a large group of carbon-based chemicals that easily evaporate at room temperature. 	<ul style="list-style-type: none"> Irritations in eyes, skin, nose and throat. Long-term exposure can cause serious damage to liver and other organs.
Benzene	<ul style="list-style-type: none"> Found in petrochemicals and used as a fuel additive 	<ul style="list-style-type: none"> Increases cancer risk and a major cause of bone marrow failure.
Ethylene	<ul style="list-style-type: none"> Used in plastic and chemical industries in the production of Polyethylene and other polymers. 	<ul style="list-style-type: none"> Excess exposure can cause headaches and dizziness. Ethylene oxide is a carcinogen.
Asbestos	<ul style="list-style-type: none"> Occurs naturally as a fibrous mineral. 	<ul style="list-style-type: none"> Prolonged exposure and inhalation can be very harmful and can cause fatal illness.

UPSC Questions related to Air Pollutants

What are the 6 major air pollutants?

- The six common air pollutants are:
 - Particulate matter
 - Ground-level ozone
 - Carbon monoxide
 - Sulfur oxides
 - Nitrogen oxides
 - Lead

What are the causes of air pollutants?

- Air pollutants are a result of some **anthropogenic processes** like vehicles, industries, construction sites/activities, etc. or **natural sources** like pollen, volcanic eruptions, natural gaseous precursors, etc.
- The solid and liquid particles suspended in our air are called **aerosols**.

