



# Air pollution

Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentration that can produce undesirable effects on man and his environment. These substance include gases, particulate, radioactive materials, and many others. Most of these materials are naturally present in the atmosphere in low concentrations and are usually considered to be harmless.

## Classification of air pollutants

The air pollutants may be classified in different ways as follows:

### 1) According to origin:

A. **Primary pollutants** are those that are emitted directly from the sources into the atmosphere. A general list of primary air pollutants are:

- 1- Particulate matter
- 2- Inorganic gases
- 3- Olefin and aromatic hydrocarbons.
- 4- Radioactive compound.



## Classification of air pollutants

Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

The air pollutants may be classified in different ways as follows:

### 1) According to origin:

A. **Primary pollutants** are those that are emitted directly from the sources into the atmosphere. A general list of primary air pollutants are:

- 1- Particulate matter
- 2- Inorganic gases
- 3- Olefin and aromatic hydrocarbons.
- 4- Radioactive compound.

Carbon dioxide is generally not considered an air pollutant but, because of its global concentration, its influence on global climate is a great concern.

B. **Secondary pollutants** are those that are formed from chemical and photochemical interactions among primary pollutants and normal atmospheric constituents in the atmosphere. Pollutants such as sulfur trioxide, nitrogen dioxide, PAN (peroxyacetyl nitrate), ozone, aldehydes, ketenes and various sulfate and nitrate salts.

### 2) According to state of matter:

A. Gaseous pollutants

B. Particulates pollutants





## **Air borne particulate matter**

Air borne particulate matter includes solid particles and liquid droplets emitted into the air. It is small enough to be suspended in the atmosphere. Particulates can be composed of inert or extremely reactive materials. The inert materials do not make any changes in the environment, whereas the reactive materials could be further oxidized or may react chemically with the environment.

### **Air born particles can be classified as:**

**Dust:** It contains particles of the size ranging from 1 to 200  $\mu\text{m}$ . These are formed by natural disintegration of rock and soil or by the mechanical process of grinding and spraying. They have large settling velocities and are removed from the air by gravity and other process.

**Smoke:** It is a collection of airborne solid and liquid particulate emitted when a material undergoes combustion or pyrolysis. The size ranging from 0.01 to 1  $\mu\text{m}$ .

**Fume:** These are solid particles of the size ranging from 0.1 to 1  $\mu\text{m}$ , and are normally released from chemical or metallurgical processes.

**Mist:** It is made up of liquid droplets generally smaller than 10  $\mu\text{m}$ , which are formed by condensation in the atmosphere or released from industrial operations.

**Fog:** It is the mist in which the liquid is water.

**Smog:** is a mixture of smoke and fog

**Aerosol:** These included all air-born suspensions either solid or liquid. These are generally smaller than 1  $\mu\text{m}$ .



## Sources of air pollution

Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

Air pollution results from gaseous emissions from mainly industry, thermal power stations, Automobiles, domestic combustion, etc.

- (a) **Industrial waste:** There are numbers of industries which are sources of air pollution. Petroleum refinery are the major source of gaseous pollutants, Cement factories emit plenty of dust, stone crushers, food and fertilizers industries which emit gaseous pollutants, and chemical manufacturing industries which emit acid vapors in air.
- (b) **Thermal power stations:** The chief pollutants are fly ash,  $\text{SO}_2$ , hydrocarbons and other gases.
- (c) **Automobiles:** the source of emission of vehicles exhaust. This exhaust produced many air pollutants such as CO,  $\text{NO}_x$  lead oxides





## Types of Air Pollutants

Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

The most common pollutants emitted from these different sources are as follows:

- 1) Carbon compounds: These are mainly  $\text{CO}_2$  and  $\text{CO}$ ,
- 2) Sulfur compounds: These include  $\text{SO}_2$ ,  $\text{H}_2\text{S}$ , and  $\text{H}_2\text{SO}_4$ ,
- 3) Nitrogen oxides: These include chiefly  $\text{NO}$ ,  $\text{NO}_3$ ,  $\text{HNO}_3$ .
- 4) Ozone ( $\text{O}_3$ ).
- 5) Fluorocarbons
- 6) Hydrocarbons: these are chiefly benzene, etc.,
- 7) Metals: These include chiefly lead, nickel, arsenic, tin, vanadium, titanium, cadmium, etc., present in air as solid particles or liquid droplets or gases
- 8) Particulate matter: These are fly ash, dust, grit and other suspended particulates Matter (SPM)



## Health Effects:

- **Respiratory Diseases:** Air pollution can cause respiratory illnesses, including asthma exacerbation and lung cancer.
- **Cardiovascular Issues:** Short-term exposure to high levels of air pollution has been associated with reduced lung function and increased risks of cardiovascular disease and mortality.

**Children and Vulnerable Populations:** Children and those with pre-existing health conditions are particularly susceptible to the adverse effects of air pollution



Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

## 2. Mechanisms of Health Effects

- How gaseous pollutants enter the body (inhalation) and their mechanisms of action.
- Interaction with biological tissues and potential triggers for health effects.

## 3. Specific Health Effects of Gaseous Pollutants

- **Nitrogen Dioxide (NO<sub>2</sub>):**
  - Respiratory issues: asthma exacerbation, increased susceptibility to respiratory infections.
  - Association with chronic respiratory diseases.
- **Sulfur Dioxide (SO<sub>2</sub>):**
  - Acute and chronic effects: throat and eye irritation; potential for lung function decline.
  - Links to cardiovascular problems.



Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

- **Carbon Monoxide (CO):**

- Mechanism of action: binding to hemoglobin and reducing oxygen delivery.
- Symptoms of exposure: headache, dizziness, potential for severe poisoning.

- **Ozone (O<sub>3</sub>):**

- Health effects related to short-term and long-term exposure: respiratory tract inflammation, decreased lung function.
- Vulnerability in sensitive groups (children, elderly).

#### **4. Vulnerable Populations**

- Identification of populations at greater risk, including:
  - Children (developing lungs).
  - Elderly individuals (pre-existing health conditions).
  - Those with chronic illnesses (asthma, heart disease).





Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

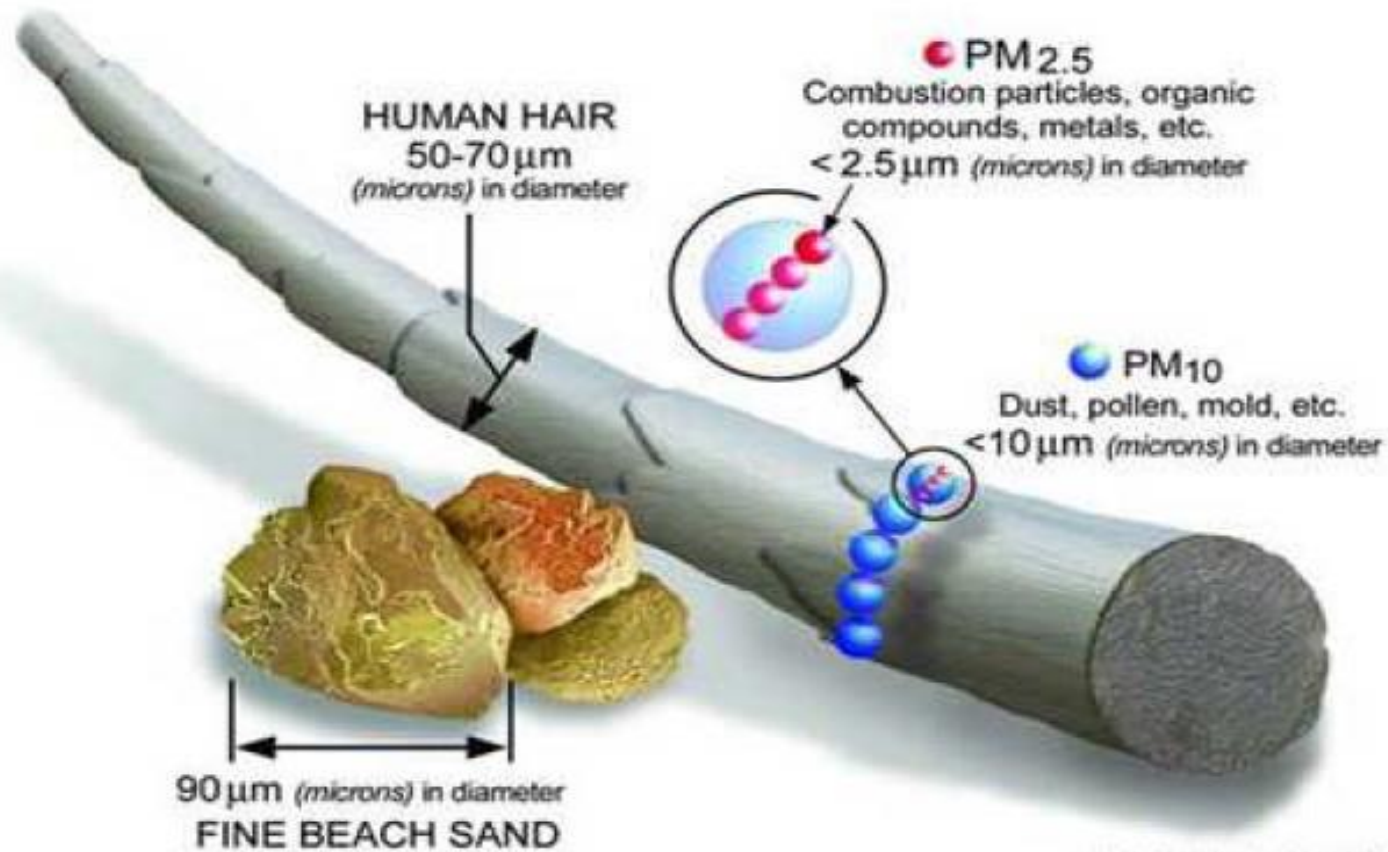


Image courtesy of the U.S. EPA



Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

# Indoor sources of air pollution in classrooms

- Dust
- Construction and insulating materials
- Surface materials (wall covering, carpets, blinds, curtains)
- Furnishings
- Evaporation of volatile chemicals from new materials
- Paints
- Waxes, repellents
- Glues and resins



Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

- Waxes, repellents
- Glues and resins
- Solvents
- Photocopiers, inks
- Cleaning/disinfecting products
- Biocides
- Personal care products
- People (exhaled air, smoking?)
- Pets, rodents, insects
- Mould (from moisture)

### Secondary material emissions:

- e.g., due to moisture
- ozone from laser printers
- outdoors and nitrogen oxides reacting with VOC
- cleaning materials can react with surfaces







Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

# Microbial Indoor Air Pollution



- mould
  - bacteria, viruses
  - pet hair, skin flakes, faeces, urine
  - insects (cockroach faeces, dust mites, etc.)
  - pollen
- Outdoor sources: mould, pollen in outdoor air



Email: [dr.malikmustafa@uomus.edu.iq](mailto:dr.malikmustafa@uomus.edu.iq)

## ➤ Indoor sources - major concern:

- humidifiers and stagnant waters
- moist surfaces and materials
- vapour from showering
- air conditioning
- upholstered furniture and carpets
- animals (the allergens can be present months after the removal of the source)
- infected people

