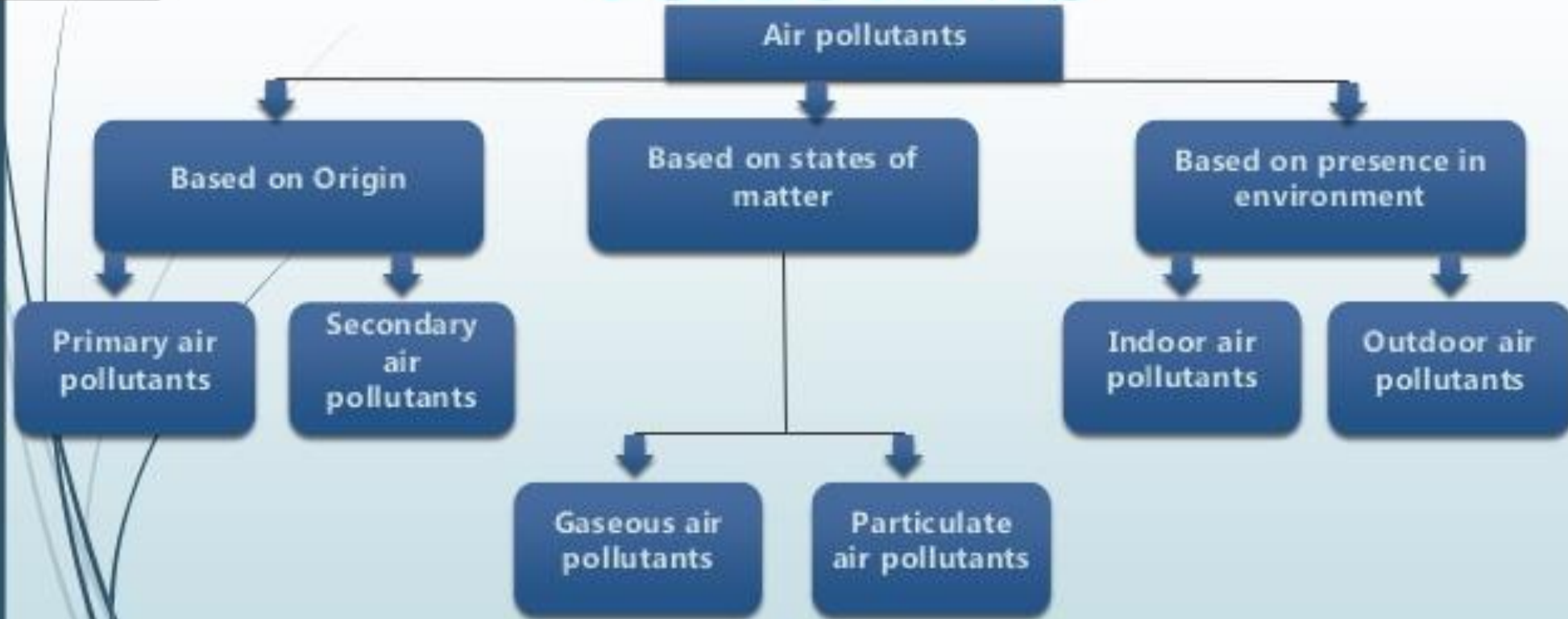


Definition

- Air pollution is the presence of substances in the atmosphere that are harmful to the health of humans and other living beings, or cause damage to the climate or to materials.

CLASSIFICATION OF AIR POLLUTANTS



Primary vs. Secondary Air Pollutants

- **Primary Pollutant** – a pollutant that is put directly into the air by human activity.
 - Examples: CO, NO_x, PM, SO_x, VOCs
 - Sources: Electricity Production, Industry, Transportation, Other Sources
- **Secondary Pollutant** – when primary pollutants react with other primary pollutants or natural substances to form a new pollutant.
 - Example: Ground-level ozone



Sources of air pollution



Major air pollutants

- Particulate pollutants
 - Aerosol
 - Mist
 - dust
 - smoke
 - fume
 - Fog
 - smog.
- Gaseous pollutants
 - Inorganic gases
 - Organic gases



- An aerosol (abbreviation of "aero-solution") is a suspension of fine solid particles or liquid droplets in air or another gas.
- An aerosol is a tiny particle (solid or liquid) in the atmosphere.
- Some aerosols are so small that they are only made of a few molecules and are invisible, some are visible but still very small.
- The smaller and lighter a particle is, the longer it stays in the air.
- Larger particles settle to the ground due to gravity after a few hours, whereas the smallest particles can stay in the atmosphere for weeks.

- Aerosols can derive from natural processes, like salt from the sea, dust from dry regions, or particles released by wildfires, but human activities like fossil fuel burning in factories and air pollution from cars also contribute to aerosols in the environment.
- Aerosols are one of the main air pollutants, leading to the premature deaths of millions of people every year as they damage lungs and can even enter the bloodstream.
- Aerosols affect the climate as strongly as greenhouse gases, but in a completely different way.
- They are able to scatter sunlight, meaning they actually cool the planet by reflecting about 1/4 of the sun's rays back to space

- However other types of aerosol, particularly black carbon or brown carbon/organic matter (depending on the brightness of the underlying ground), will absorb light radiation, adding to warming the atmosphere.

Mist

- Mist is a phenomenon caused by small droplets of water suspended in air.
- It is most commonly seen where warm, moist air meets sudden cooling



Fog

- A thick cloud of tiny water droplets suspended in the atmosphere at or near the earth's surface which obscures or restricts visibility .
- Fog and mist differ by how far you can see through them. Fog is when you can see less than 1,000 meters away, and if you can see further than 1,000 meter , we call it mist.



Dust

- Dust is made of fine particles of solid matter



Smoke

- Smoke is a fine solid formed by incomplete burning.
- Smoke primarily consists of particles and can include other gaseous air pollutants, including nitrogen oxides, carbon monoxide, and hydrocarbons that may be toxic.
- Exposure to smoke can cause health effects and make existing health conditions worse.
- Most healthy children and adults will recover from short-term smoke exposure. However, certain sensitive populations may experience more severe acute and chronic symptoms, and even healthy people may experience symptoms.

- Most smoke is a mix of very small liquid droplets and solid particles that become suspended in the air and can remain airborne for up to a week.
- When we talk about particle pollution, we are referring to inhalable “Particulate Matter” less than 10 microns in diameter (PM10, also known as coarse particles) and less than 2.5 microns in diameter (PM2.5, also known as fine particles).

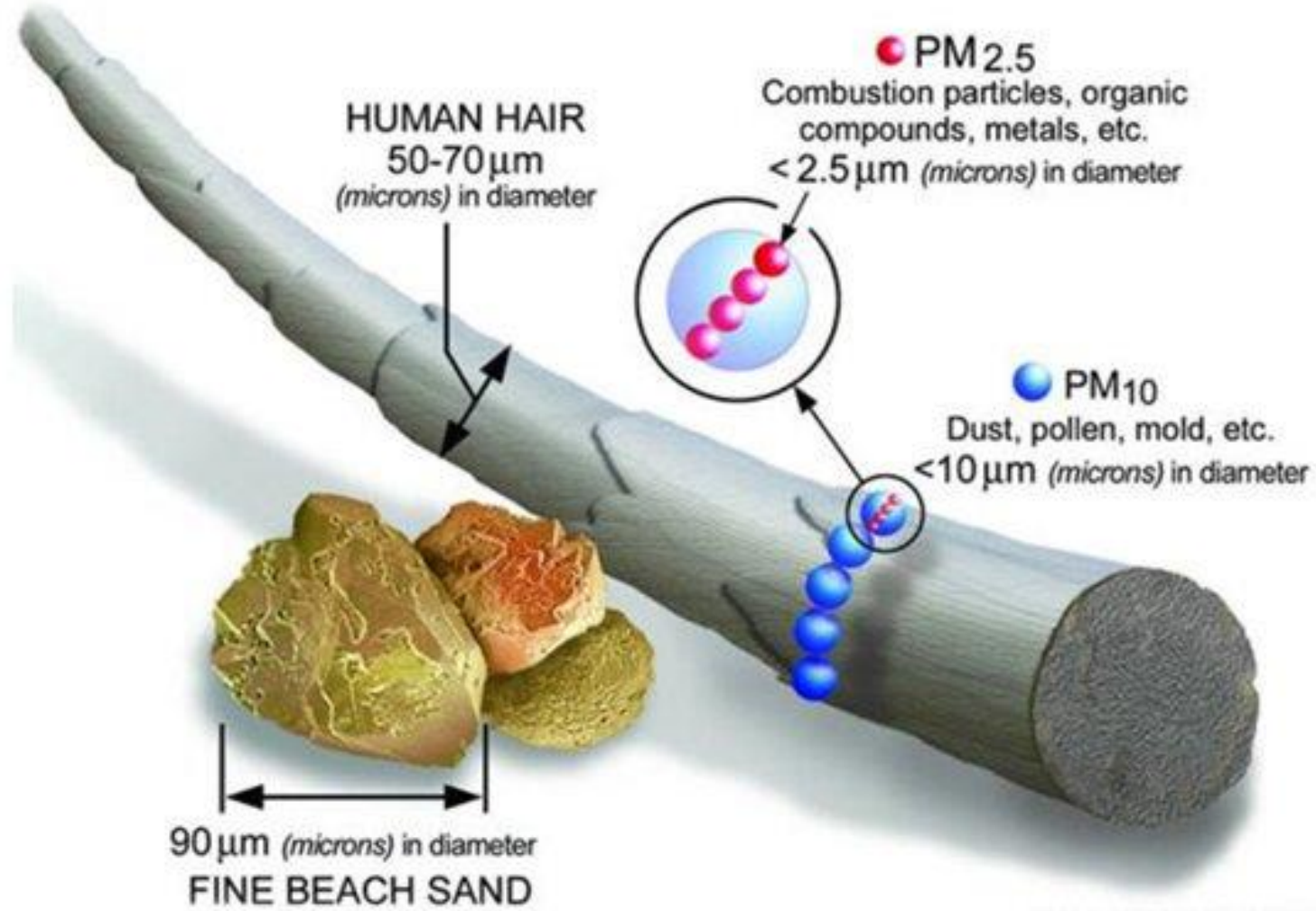


Image courtesy of the U.S. EPA

Cigarette smoke produces 10 times more air pollution than diesel car exhaust

The air pollution emitted by cigarettes is 10 times greater than diesel car exhaust, suggests a controlled experiment, reported in Tobacco Control.

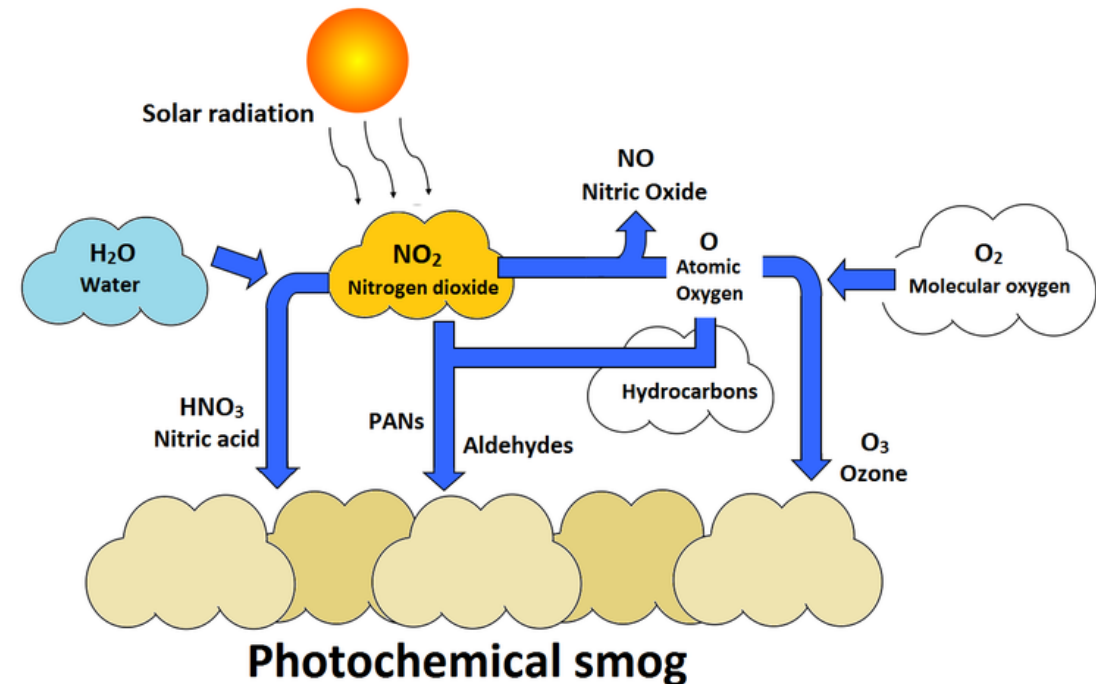
Environmental tobacco smoke produces fine particulate matter, which is the most dangerous element of air pollution for health. Levels indoors can far exceed those outdoors, because new engine models and lead free fuels have cut the levels of particulate matter emissions from car exhausts, say the authors.

Fume

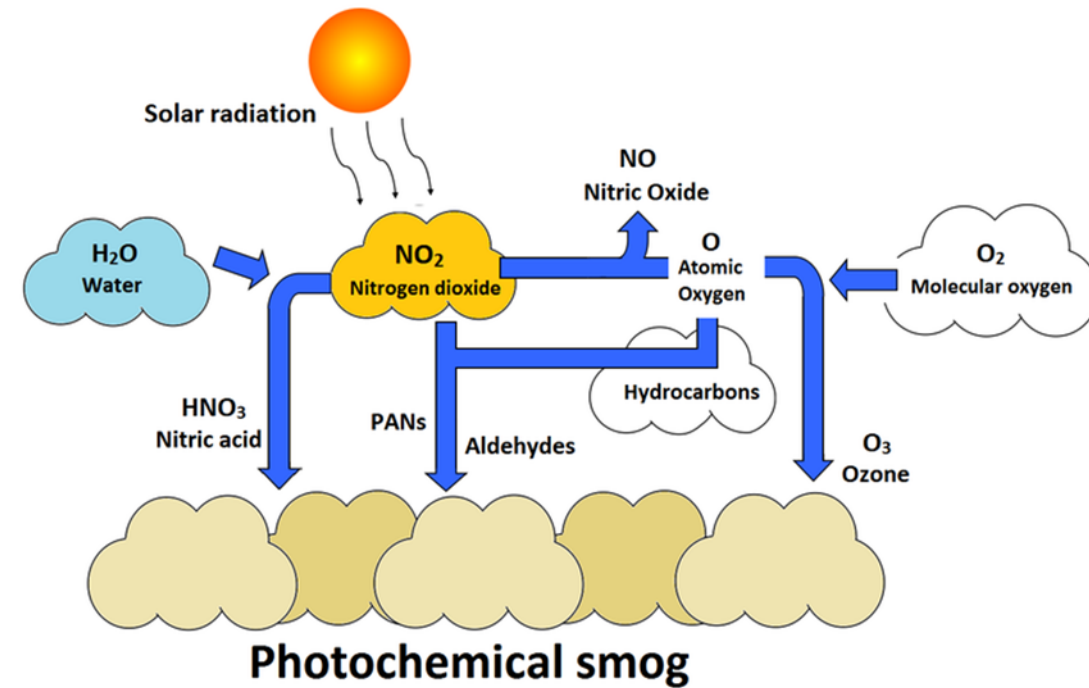
- Fumes are fine airborne particles produced when a solid vapourises and condenses.

smog

- "smog" is a combination of the words "smoke" and "fog."
- Photochemical smog - Photochemical smog is a type of smog produced when ultraviolet light from the sun reacts with nitrogen oxides in the atmosphere. It is visible as a brown haze, and is most prominent during the morning and afternoon, especially in densely populated, warm cities.



Nitric oxide (NO) and nitrogen dioxide (NO₂) are emitted from the combustion of fossil fuels, along with being naturally emitted from things such as volcanos and forest fires. When exposed to ultraviolet radiation, NO₂ goes through a complex series of reactions with hydrocarbons to produce the components of photochemical smog—a mixture of ozone, nitric acid, aldehydes, peroxyacyl nitrates (PANs) and other secondary pollutants.



Gaseous pollutants

- Inorganic gases
 - Oxides of sulphur
 - Sulphur dioxide
 - Oxides of carbon
 - Carbon monoxide
 - Carbon dioxide
 - Oxides of Nitrogen
 - Nitrous oxide
 - Nitrogen dioxide
 - Ozone
 - Other inorganic gases
 - HF, H₂S, NH₃, Chlorine, Phosgene etc

Sulphur dioxide

- Combustion of fossil fuel in domestic and industrial area.
- Colourless gas with Suffocating and pungent smell
- Under certain conditions, SO_2 react with oxygen to form Sulphur trioxide
- It combines with water to form sulphurous acid and Sulphuric acid.
- So SO_2 would be then called Primary Pollutant
- H_2SO_3 and H_2SO_4 – Secondary pollutants



- Use of Combustible fuels
- Green house effect and Global warming
- Disastrous effect on flora and fauna

CO

- Incomplete burning of fossil fuels, Wood and charcoal
- Colourless, Odourless and tasteless gas
- Formation of Carboxyhaemoglobin
- Reduces oxygen carrying capacity

NO_x

- Main sources are thermal power stations, factories, automobiles and aircrafts
- Formation of Nitrous acid and Nitric acid
- Formation of Photochemical smog and PANs

OZONE

- Colourless gaseous secondary air pollutant
- Produced by the reaction between reactive organic gases and oxides of nitrogen
- Nitrogen oxides + Hydrocarbons $\xrightarrow{\text{Sunlight}}$ PAN + Ozone

Organic gases

- Aldehydes
 - Thermal degradation of fats, oil and glycerol
 - Affect Nasal and respiratory tract
 - Cause extreme irritation
- Hydrocarbons
 - Methane, Volatile terpenes
 - Affect mucus membrane.

Effects of air pollution

- Effect on human health
- Effect on plants
- Effect on animals
- Effect on materials
- Effect on climate

Effect on human health

- Polluted air directly affect eyes, Nose, Throat and lungs
 1. SO_2 produce drying of mouth, Scratchy throat and smarting eyes . In the form of H_2SO_4 , it damages the tissues.
 2. Oxides of Nitrogen at higher concentration impairs the functioning of lungs by causing accumulation of water in the air pores
 3. Higher level of CO – disturbance of psychomotor functions, decrease in visual perception, serious effect on cardio vascular systems etc. Prolonged exposure to CO may lead to death.

4. SO_3 , NO_x and CO diffuse into blood, combine with haemoglobin and cause problem in oxygen transport.
5. Silicon particles – Silicosis
6. Spores, Pollen grains, bacteria and fungi cause various allergic reactions like bronchial asthma and diseases like tuberculosis, dermatitis etc

Effects on animals

- The general effects of air pollution on animals are similar to those on human beings.
- Fluorosis - Fluoride toxicity is commonly found in domestic animals which ingest various fluoride compounds that fall on leafy part of the plants. Fluorosis results in loss of weight, abnormal calcification of bones and teeth, Frequent diarrhoea etc.

Effects on plants

- SO_2 pollution develops symptoms like bleached spots leaves, Chlorosis, Early abscission, reduced leaves etc. Plants sensitive to SO_2 pollution are barley, pumpkin, alfalfa, cotton, wheat, lettuce, apple, oats, Aster, Pine, grapes etc.
- SO_2 adversely affect various metabolic activities including stomatal physiology and photosynthesis.

- Oxides of Nitrogen reduce the crop yield. They suppress plant growth
The important sensitive plants are sunflower, mustard, tobacco etc.
- Fluoride reduce crop yield and damage leaf tissue.
- Unsaturated hydrocarbons such as ethylene cause premature leaf fall, floral bud shedding, curling of petals, discolouration of sepals, chlorosis etc
- Ozone cause premature leaf fall of trees
- Photochemical smog bleaches the leaves of important foliage plants.

Effect on materials

- Acid rains and the products of photochemical smog cause considerable effects on metals and buildings.
- Acidic products of air pollutants causes disintegration of textiles, paper and marbles
- Air pollutants damage historic monuments
- H_2S decolourises silver and lead paints

Effect on climate

- The release of green house gases from various sources are causing rise in global temperature.
- Freon gas from aerosol sprays and nitrogen oxide in the atmosphere deplete ozone layer.

Control of air pollution

- Use of purified petrol
- Installation of air treatment plants
- Use of alternative energy source
- Treatment of emission – Settling chambers, Cyclone separator, wet and gas scrubbers, Bag filters, Electrostatic precipitators etc
- Plantation of trees

- Changing life style
- Enforcement of air act 1981
- Environment education

Thank
you

