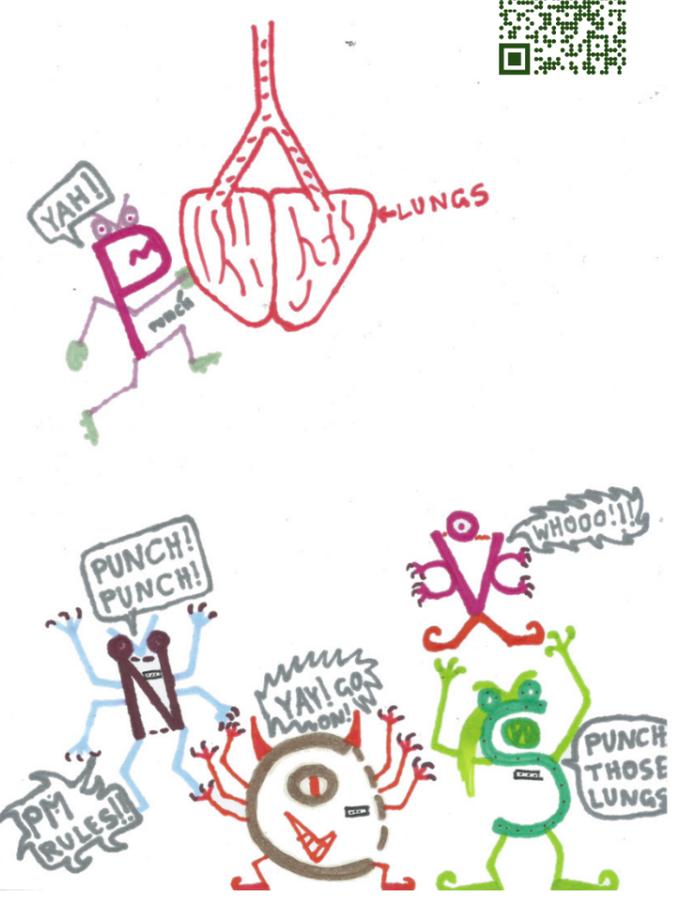


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Art work by Sid and Saachi (2023)

# Know Your Air Pollutants

URBAN emissions .info 

## I am Sulphur Dioxide (SO<sub>2</sub>)



I exist in gas phase.

In short bursts, I can harm the human respiratory system and make breathing difficult. People with asthma, particularly children, are more sensitive.

My aerosol-phase cousin is "sulphates", who is attached to PM<sub>2.5</sub>.

I am the main ingredient of acid rain.

## I am particulate matter (PM)



My other names are - aerosol, soot & dust.

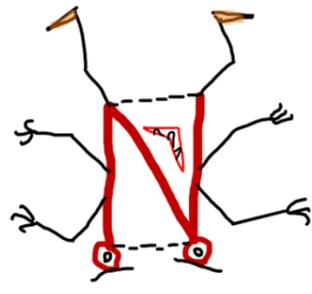
I come in two common sizes - PM<sub>2.5</sub> & PM<sub>10</sub> - all PM with aerodynamic diameter < 2.5 & < 10.0 µm.

I am small enough to enter the lungs, heart, and blood.

I am known to cause premature death and accelerate health effects like:

- Alzheimer (dementia); Anxiety;
- Asthma attacks; Blood pressure;
- Chronic lung diseases (COPD);
- Development damage; Diabetes;
- Heart attacks; Inflammation;
- Low infant birthweight; Lung cancer;
- Pneumonia; Reproductive disorders;
- Shortness of breath; Strokes; and
- Wheezing & coughing.

## I am Nitrogen Dioxide (NO<sub>2</sub>)



I have a large family -- NO, N<sub>2</sub>O, N<sub>2</sub>O<sub>5</sub> as NO<sub>x</sub>

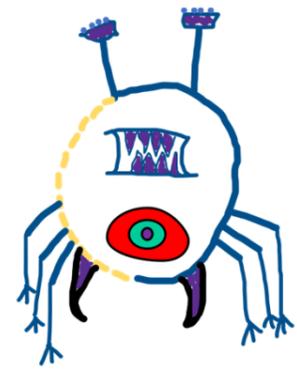
We all exist in gas phase.

In short bursts, I can irritate and aggravate respiratory diseases - such as asthma, coughing, wheezing or difficulty in breathing. People with asthma, particularly children, are more sensitive.

My aerosol-phase cousin is "nitrates", who is attached to PM<sub>2.5</sub>.

I am also part of the acidification and eutrophication problems.

## I am Carbon Monoxide (CO)



I exist in gas phase.

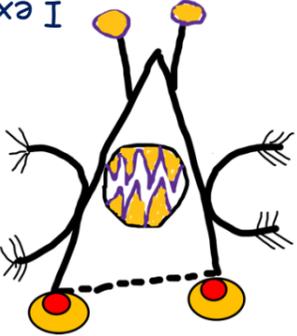
I am an integral part of 100s of atmospheric reactions with NO<sub>x</sub>, VOCs, and ozone.

At low concentrations, I can cause fatigue and chest pain.

At higher concentrations, I can cause vision impairment; headaches; dizziness; confusion; and nausea.

And at very high concentrations, I form carboxyhemoglobin in the blood, which inhibits oxygen intake and lead to death.

## I am VOCs



A gaseous shape-shifter, collectively known of "Volatile Organic Compounds"

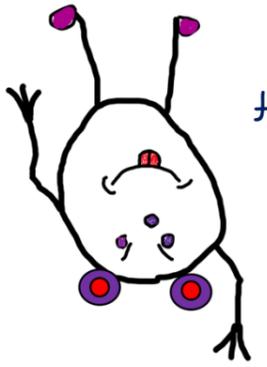
I exist as benzene, xylene, toluene, formaldehyde, and many forms of alkanes, alkenes, acids, alcohols, etc.

With NO<sub>x</sub>, I can decide to make or destruct ozone.

I help in the oxidation of many chemical species and am an integral part of 100s of atmospheric reactions with CO, NO<sub>x</sub> and ozone.

My aerosol-phase cousin is "secondary organic aerosols" (SOA), who is attached to PM<sub>2.5</sub>.

## I am Ozone (O<sub>3</sub>)



I exist in gas phase.

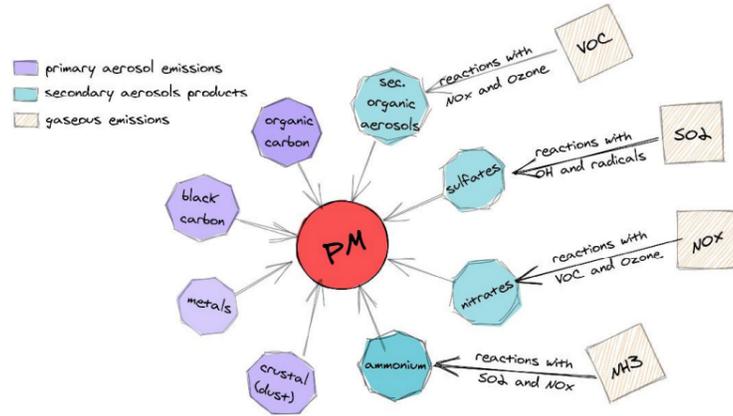
I come to being only after a series of chemical reactions between NO<sub>x</sub>, CO, and VOCs, in the presence of sunlight. I help in the oxidation of many chemical species.

I can cause coughing, itchy throat, itchy eyes, breathing impairment, inflammation in the airways, and aggravate lung diseases such as asthma, emphysema, and chronic bronchitis, and eventually leading to premature death.

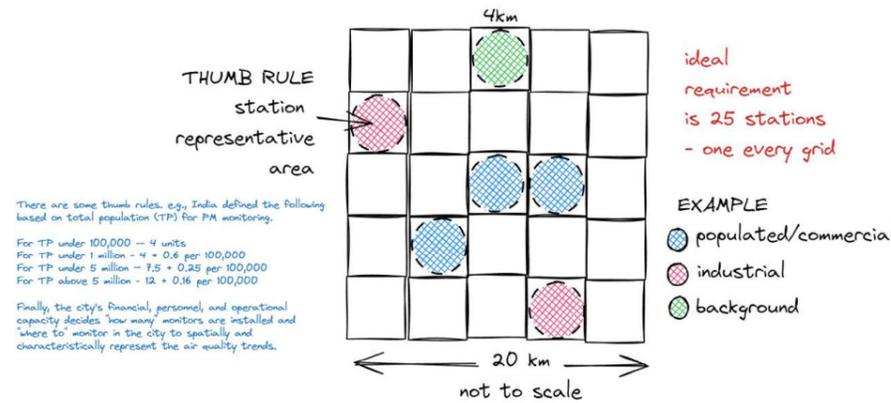
In the stratosphere, I am considered good, blocking UV rays from reaching Earth's surface.

# What is Particulate Matter (PM)? Frequently Asked Questions

## Why PM is an important pollutant of concern?



## How many sensors are required to monitor PM pollution in a city?



## Is PM the most harmful of air pollutants?

PM is epidemiologically linked to many health endpoints

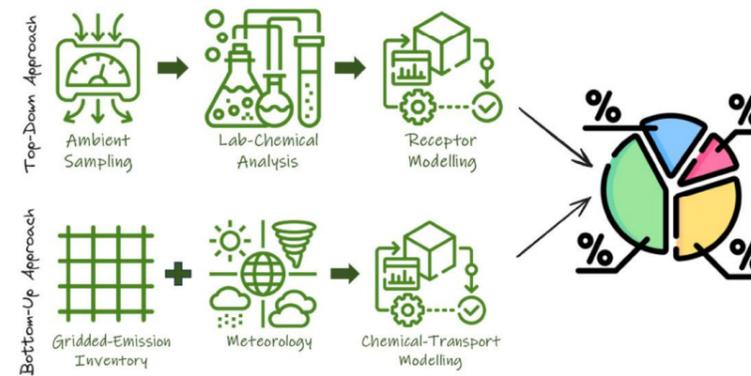
- Cases of ischemic heart disease (heart attacks)
- Cerebrovascular disease (strokes)
- Chronic obstructive pulmonary diseases (COPD)
- Lower respiratory infections (asthma)
- Cancers (in trachea, lungs, and bronchitis)
- Obesity
- Diabetes and
- Alzheimer's disease.

## What are the common PM size fractions?

PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>1</sub>	UFP
all particles with aerodynamic diameter < 10 micro-meter	all particles with aerodynamic diameter < 2.5 micro-meter	all particles with aerodynamic diameter < 1 micro-meter	Ultra fine PM with aerodynamic diameter < 100 nano-meter
most commonly measured size fraction	size fraction linked to various health impacts	new research linked to health impacts	emerging research linked to health impacts

1 micro-meter = 1 μm = 10<sup>-6</sup> m  
100 nano-meter = 0.1 μm = 10<sup>-7</sup> m

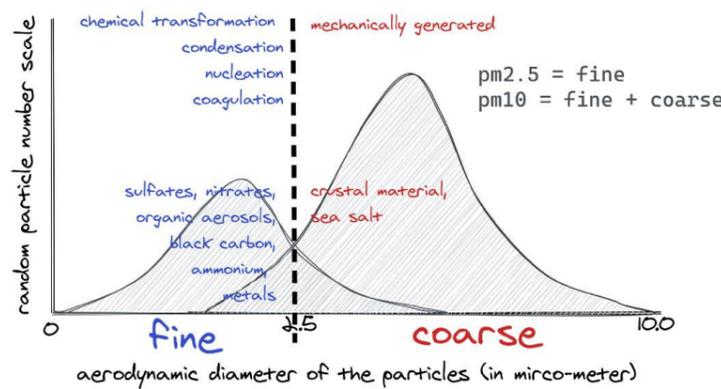
## What is PM source apportionment?



## Can we vacuum air pollution using purifiers and smog towers?

A vacuum cleaner can ..	YES	NO
.. pull dirt out of a rug	✓	
.. suck dust on the road	✓	
.. trap particles in a stack	✓	
.. freshen up a (closed) room	✓	
.. clean the ambient air		✗

## What is the difference between fine and coarse PM?



## Is transport the main culprit of PM pollution?

<b>All transport</b> 10-30% This includes all road, rail, and aviation modes and combustion of petrol, diesel, and gas.	<b>All dust</b> 10-30% This includes dust from resuspension on the roads and construction activities.	<b>All industries</b> 10-30% This includes all small, medium, and large industries, including power plants and brick kilns.
<b>All Residential</b> <10% in summer <30% in winter This includes all cooking, lighting, and heating activities.	<b>Waste burning</b> 5-15% This includes all open waste burning at kerbs and residential sides, and at the landfills.	<b>Power plants</b> <7% This is mostly from power plants outside the city limits.
<b>Dust storms</b> <5% This is a seasonal source.	<b>Agricultural residue burning</b> <3% This is a seasonal source.	<b>Firecrackers</b> <1% This is a seasonal source.

### Summary of all studies from Delhi

Earliest known results are from the 1997 White Paper by the Central Pollution Control Board. The latest results in this pool are from 2023 real time source apportionment experiment by the Delhi Pollution Control Committee on their premises.

Majority of the results follow the filter sampling, chemical analysis, and receptor modeling method.

## Can we model PM pollution and its impacts?

- ↑ stakeholders participation ↓
- screen for information**  
stakeholders, maps, reports, data, existing surveys, literature, media reports, contacts websites, GIS, satellite imagery, previous modeling applications, and interventions history
  - list analysis component**  
overall goals, key pollutants, sources, geographical characteristics impacts, intervention characteristics, and decisions to be made
  - make calculations**  
databases, spreadsheets, GIS, emission and pollution models, uncertainty assessments
  - analyze results & scenarios**  
spatial/temporal maps and graphs, health impact analysis, alternate scenario analysis, and sensitivity analysis
  - identify options**  
determine regulatory, policy, and financial needs to build institutional and technical capacity to implement actions
- this schematic is adopted from similar training material

For applications of these steps, visit the Air Pollution knowledge Assessments (APnA) city program portal @ [www.urbanemissions.info](http://www.urbanemissions.info)