

AIR POLLUTION



SWBAT differentiate between different types of air pollution & the sources & mitigation for criteria pollutants.

Warm Up:

Where do most pollutants come from?

AIR POLLUTION – chemical or physical changes brought about by either natural processes or human activities resulting in air quality degradation.



OVER THE LAST 20 YEARS AIR QUALITY HAS IMPROVED IN DEVELOPED COUNTRIES & BECOME WORSE IN DEVELOPING COUNTRIES (10x's higher in mega cities)

147 million metric tons of air pollution (not CO₂ or dust) is released by the U.S./yr.

Natural sources of air pollution – volcanoes, dust storms, sea spray, viruses, bacteria, pollen, spores trees & vegetation (which emit VOC's). Methane (2/3) from decaying vegetation & guts of termites & ruminant animals.



Anthropogenic sources alter & overload natural systems. Although most particulates come from natural causes, in some cities 90% come from human activities.

Primary pollutants – directly released from a source into the air in a harmful form.

Secondary pollutants – modified to a hazardous form after they enter the air (acid rain or smog) or are formed by chemical reactions as components of the air mix & interact. Example:
NO_x



National Ambient Air Quality Standards (NAAQS)

Ambient Air – Air all around us.

The Clean Air Act, which was last amended in 1990, requires EPA to set **National Ambient Air Quality Standards** for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards.

Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$).

Criteria or conventional pollutants contribute the largest volume of air-quality degradation & are considered the most serious of all air pollutants. 1970 Clean Air Act designated 6.

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
Particulate Matter Airborne solid or liquid particles smaller than 10 microns in diameter or smaller than 2.5 microns	PM ₁₀ PM _{2.5}	<ul style="list-style-type: none"> *Power plant boilers steel mills *Chemical plants *Unpaved roads & parking lots •Wood-burning stoves & fireplaces •Automobiles & other. 	Aggravates respiratory effects like asthma & emphysema. May cause lung and heart problems. May carry toxic material deep into the respiratory system. Impairs visibility	Pollution control equipment (wet & dry scrubbers & cartridges) Reduction of fuel combustion.

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
<p><u>Sulfur dioxide</u> – a colorless nonflammable gas.</p>	<p>SO₂</p>	<p>Power plant boilers, sulfuric acid plants, petroleum refineries, smelters, paper mills, & fuel combustion in diesel engines.</p>	<p>Respiratory irritant. Aggravates lung & heart problems. In presence of moisture & oxygen, sulfuric acid forms. Sulfuric acid can damage marble, iron, steel & damage crops & vegetation.</p>	<p>Low sulfur fuel, energy conservation (reduces power plant emissions) & pollution control equipment. (Neutralizing the acid.)</p>

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
<p>Carbon Monoxide Odorless , colorless gas.</p>	<p>CO</p>	<p>Incomplete combustion of carbon-based fuels in motor vehicle & industrial boilers.</p>	<p>Reduces the ability of blood to deliver oxygen affecting the cardiovascular & nervous system. Impairs vision, causes dizziness, & can lead to unconsciousness or death.</p>	<p>Transportation planning, vehicle emissions testing, pollution equipment.</p>

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
OZONE (Smog) Colorless or bluish gas.	O ₃	Emissions of volatile organic compounds (VOC) & nitrogen oxides in the presence of sunlight. Fuel combustion in motor vehicles, gasoline storage & transport, solvents, paints & landfills.	Irritates mucous membranes, aggravates lung & heart problems. Damages rubber, some textiles & dyes. Damages plants. Reduces crop yields.	Use of low-VOC solvents, evaporative controls, vehicle emissions testing, pollution control equipment.

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
<p>Nitrogen Dioxide A reddish-brown gas.</p>	<p>NO₂</p>	<p>Fuel combustion in motor vehicles & industrial sources. High temperature burning combining nitrogen & oxygen in the air.</p>	<p>Respirator irritant. Aggravates lung & heart problems. Precursor to ozone & acid rain. Causes brown discoloration of atmosphere.</p>	<p>Exhaust gas recirculation in cars, reduction of combustion temps. In industrial sources, energy conservation & pollution control equipment.</p>

Pollutant	Symbol	Sources	Human Health & Welfare Effects	Control Methods
<p>LEAD A toxic heavy metal.</p>	<p>Pb</p>	<p>Smelters, lead-acid battery manufacturing, electric arc furnaces, incineration of garbage containing lead products, & use of leaded gasoline.</p>	<p>Toxic to the nervous system, organs, & most levels of body function.</p>	<p>Phase-out of leaded gasoline, & use of pollution control equipment in industrial plants.</p>

National Ambient Air Quality Standards

Pollutant	Primary Stds.	Averaging Times	Secondary Stds.
Carbon Monoxide	9 ppm (10 mg/m ³)	8-hour ¹	None
	35 ppm (40 mg/m ³)	1-hour ¹	None
Lead	1.5 µg/m ³	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m ³)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM ₁₀)	50 µg/m ³	Annual ² (Arith. Mean)	Same as Primary
	150 µg/m ³	24-hour ¹	
Particulate Matter (PM _{2.5})	15.0 µg/m ³	Annual ³ (Arith. Mean)	Same as Primary
	65 µg/m ³	24-hour ⁴	
Ozone	0.08 ppm	8-hour ⁵	Same as Primary
	0.12 ppm	1-hour ⁶	Same as Primary
Sulfur Oxides	0.03 ppm	Annual (Arith. Mean)	-----
	0.14 ppm	24-hour ¹	-----
	-----	3-hour ¹	0.5 ppm (1300 µg/m ³)

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2/6/2005