AIR POLLUTION

Particulate Matter (PM) and Gaseous

WHAT ARE PARTICULATES?

Particulate air pollution is made up of small particles that are suspended in air and breathed in with a chance at depositing in the lungs. Particulate pollution may be droplets of liquids, solids or solids with other chemicals adsorbed onto their surfaces.

They are classified by size. All particles < 10 microns (PM10), All particles < 2.5 microns (PM2.5), and all particles < 0.1 microns (PM 0.1). For reference, a human hair is ~ 75 microns in diameter. The smaller the particle the greater likelihood of depositing in the lungs and being biologically active.

SOURCES OF PM

- Incomplete combustion
- Residuals after combustion (ash)
- Breakdown products, e.g. demolition, tire wear
- Condensation of melted plastics or metals aka fumes

HEALTH EFFECTS OF PM

Small particles cross into the bloodstream and can cause angina, vasospasm, and atherosclerosis.

In the lungs they can exacerbate lung diseases to include asthma and emphysema.

WHY IS THIS A HEALTH PROBLEM?

Imagine different sized particles in a river. A fallen tree is going to get hung up quickly. Branches will be able to spin off a few structures in the river but may wash up at a bend or a sand bar. Leaves will travel further down the river and begin to settle out when the water slows down. Silt can continue to be suspended in the water. When the water is quiet the larger silt particles settle out, but the smallest particles remain suspended in the water indefinitely.

The same basic principles work in the lungs.

Big particles catch on nose hairs and don't enter the airway further. Large particles have momentum and crash into mucous covered bones in the nose or at branches in the upper airway. The further down the lungs you get the slower the air moves and the more frequent the branching of the airways until you get to the air sacs where gas exchange occurs. The smallest particles penetrate deep into the lungs and settle out and interact with individual cells that make up the alveoli where the air is exchanged. The particles may interact with the alveoli and cause inflammation and/or scarring or if they are small enough, they may pass through or around the alveolar cells and get into the blood stream.

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GASEOUS POLLUTION

Volatile organic compounds (VOC's): These include thousands of carbon containing compound capable of evaporating or left over in a gaseous phase after incomplete burning.

BTEX is a group of 4 VOC's that are specifically ***linked to cancer***, they are benzene, toluene, ethylbenzene and xylene. They are components of crude oil, but can also be produced in forest and other wood fires.

Indoor air pollution: VOC's can concentrate in buildings. Wet buildings can lead to growth and overgrowth of molds and bacteria. Fragments of broken mold or bacteria can be inhaled in the lungs as particulates and those fragments can be coated with mycotoxins or bacterial toxins. They produce gasses with low odor thresholds that are noxious but which to date are usually not considered disease causing.

SOx – Sulfur oxides: SOx are products of combustion, especially of diesel fuel. They contribute to acid rain. They are respiratory irritants and contribute to exacerbation of asthma, and COPD. It increases susceptibility to infection

NOx – Nitrogen oxides: NOx exposure comes from combustion, especially diesel fuel. It contributes to acid rain and smog. It exacerbates asthma and COPD. It reduces the lungs ability to cope with oxidative stress and increases susceptibility to infection. It causes the brown color of air pollution

SOURCES OF VOC'S

- Incomplete burning
- Gas from carpets, permanent press clothing, adhesives, degreasers, perfumes, deodorants
- Evaporate from fuel storage
- Can be produced in animals or their excrement

HEALTH EFFECTS OF VOC'S

In general VOC's cause irritation not only of the lungs but also of the eyes and potentially mucous membranes of the sinuses and throat.

They can contribute to headaches, dizziness, acting as anesthetics at high concentrations; they too can exacerbate asthma.

Ozone: This is formed when NOx combines with VOC's and water in the presence of sunlight. It is also generated by electrical equipment. It is irritating and disturbs the lungs removal of mucous. It causes oxidative stress and exacerbates asthma and COPD as well as increasing susceptibility to infections.