Air Pollution Exercise

Introduction

This exercise was developed for those who want to better understand their local air quality, nearby sources of air pollution, and how air pollution can impact a person's health.

Objectives

When complete, you will better be able to:

- Identify different types of air pollution
- Describe sources of air pollution around you
- Describe the health effects of air pollution
- Identify techniques to reduce exposure in the home and community
- Develop a plan to take further action steps

You will become familiar with resources to find additional information about topics of interest.

These exercises are interactive and you are encouraged to provide feedback. We hope that you will share with us your experience in putting your planned actions in place to gather information or make a change, so that we can document the use of training. Your feedback will be used to evaluate this training.

Air Pollution Resource 1 – Terms and Definitions

There are **three forms of pollutants** in the air – particles, gases, and vapors

1. Particle – A tiny piece of matter - can be solid or liquid. While all types of air pollution can be harmful to your health and the environment, particles are often linked to health effects. Some particles, such as soot, are large enough that you can see them while many are so small that you cannot. Particle size ranges and important terms are shown on the following page.

2. Gas - an air-like substance (like helium in a balloon) that will move to fill a space

3. Vapor – volatile form of a substance (such as water becoming steam when heated)

Other terms

Fumes – particles from hot processes (e.g., welding or combustion) which are airborne

Aerosol – particles that are suspended in a gas, usually air

VOC (Volatile Organic Compound) – a chemical with a very low boiling point so it evaporates to the gaseous form from solids and liquids at room temperatures; some products that result in release of VOCs include paint, cleaning supplies, pesticide formulations, and glues.

Particulate matter – another way of describing particles

Agglomerate – when particles clump together; this changes the size of the particle and how it travels in the air

Compound – a mixture of two or more chemicals

SOX (pronounced 'socks')—sulfur oxide compounds

NOX (pronounced 'knocks')—nitrogen oxide compounds

The EPA describes many categories of air pollutants at:
https://www.epa.gov/environmental-topics/air-topics

Resource 2 – Particle Size

Particle size can make a difference in the potential effect on health.

Size comparisons

μm = micrometer; there are 1 million micrometers in a meter (39.4 inches)

nm = nanometer; there are 1 billion nanometers in a meter (39.4 inches)

Particle size terms used by EPA

- Super coarse: diameter (d) > 10 micrometer (μm)
- Coarse: 2.5 um < d < 10 μm
- Fine: 0.1 um < d < 2.5 μm
- Ultrafine: d < 0.1 μm
- PM_{10}: Particulate Matter with median particle size of 10 μm
- $PM_{2.5}$: Particulate Matter with median particle size is 2.5 μm

Note: Median - If all of the diameters are listed from smallest to largest, the median is the diameter halfway between the end points. For particles in the air the median is rarely the same as the average because there are many more smaller particles than larger ones.

The smallest thing most people can see is human hair or a grain of sand. Look how small $PM_{2.5}$ and PM_{10} particles are in comparison.

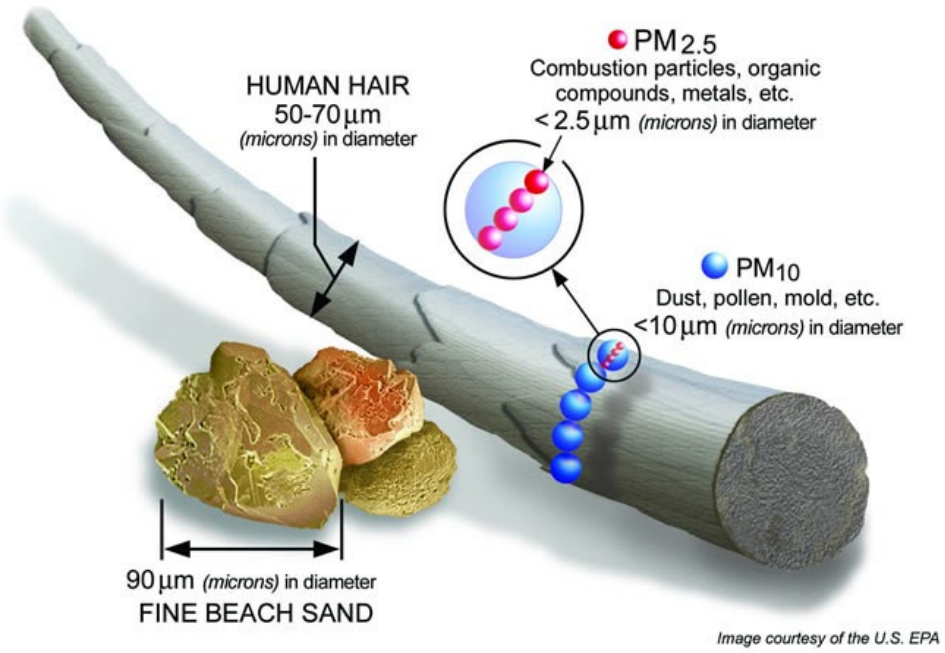


Image courtesy of the U.S. EPA

The smallest particles – particles between 1 and 100 nanometers in size are referred to as nanoparticles.

Watch about 4 minutes of the following video to learn about sources of air pollution and particle size differences. Cut and paste the link into your browser if clicking it doesn't work.

Introduction to Aerosols* https://www.youtube.com/watch?v=BIvos4ppeNM&t=178s

*This lesson has been created by the Midwest Emerging Technologies Public Health and Safety Training (METPHAST) Program, a collaboration of the University of Minnesota School of Public Health, the University of Iowa College of Public Health, and Dakota County Technical College. Funding for the METPHAST Program is provided by the National Institute of Environmental Health Sciences of the National Institutes of Health under Award Number R25ES023595. The content of this lesson is solely the responsibility of the developers and does not necessarily represent the official views of the National Institutes of Health.

Resource 3 - Sources of pollutant emissions

Look at the graphic below and identify sources of air pollution.

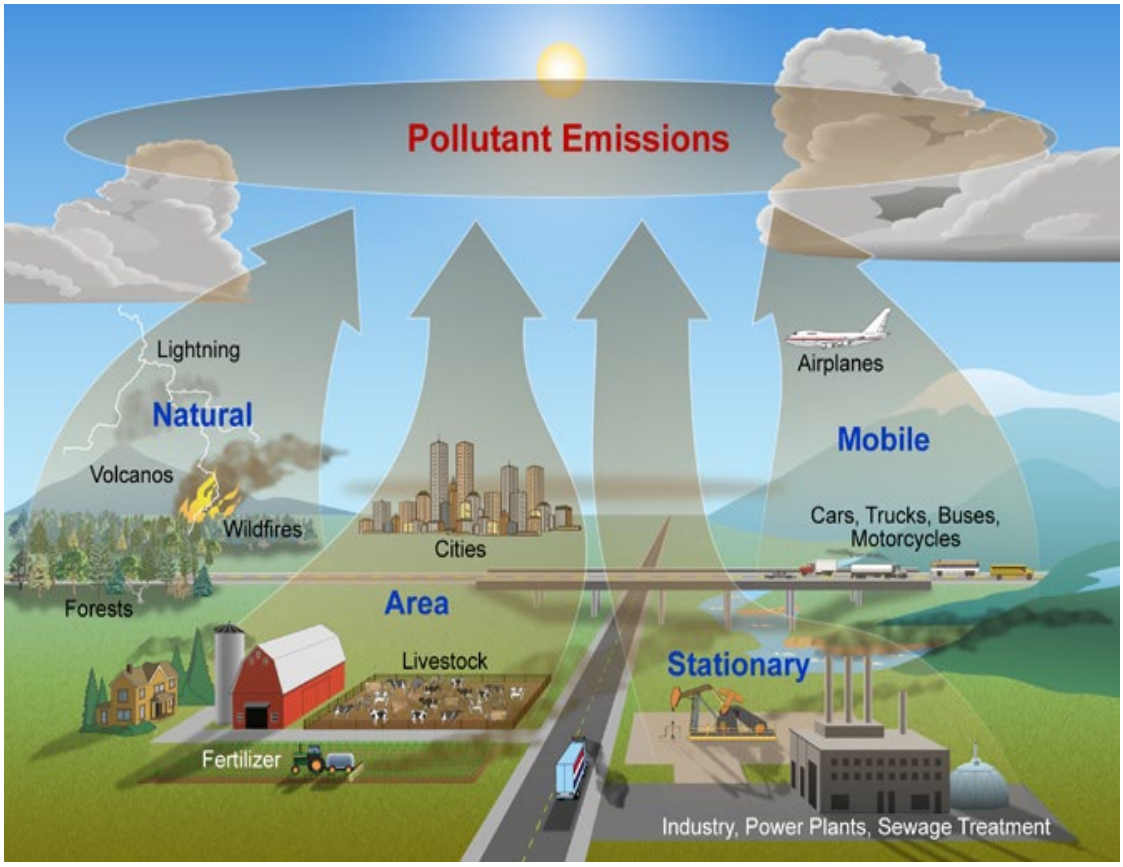


Image credit: nps.gov

The three forms of air pollution (harmful gases, vapors, and particles) are put into the air from four sources:

Mobile - cars, buses, planes, trucks, and trains
Stationary - power plants, oil refineries, industrial facilities, and factories
Area - agricultural areas, cities, and wood burning fireplaces
Natural - wind-blown dust, wildfires, and volcanoes

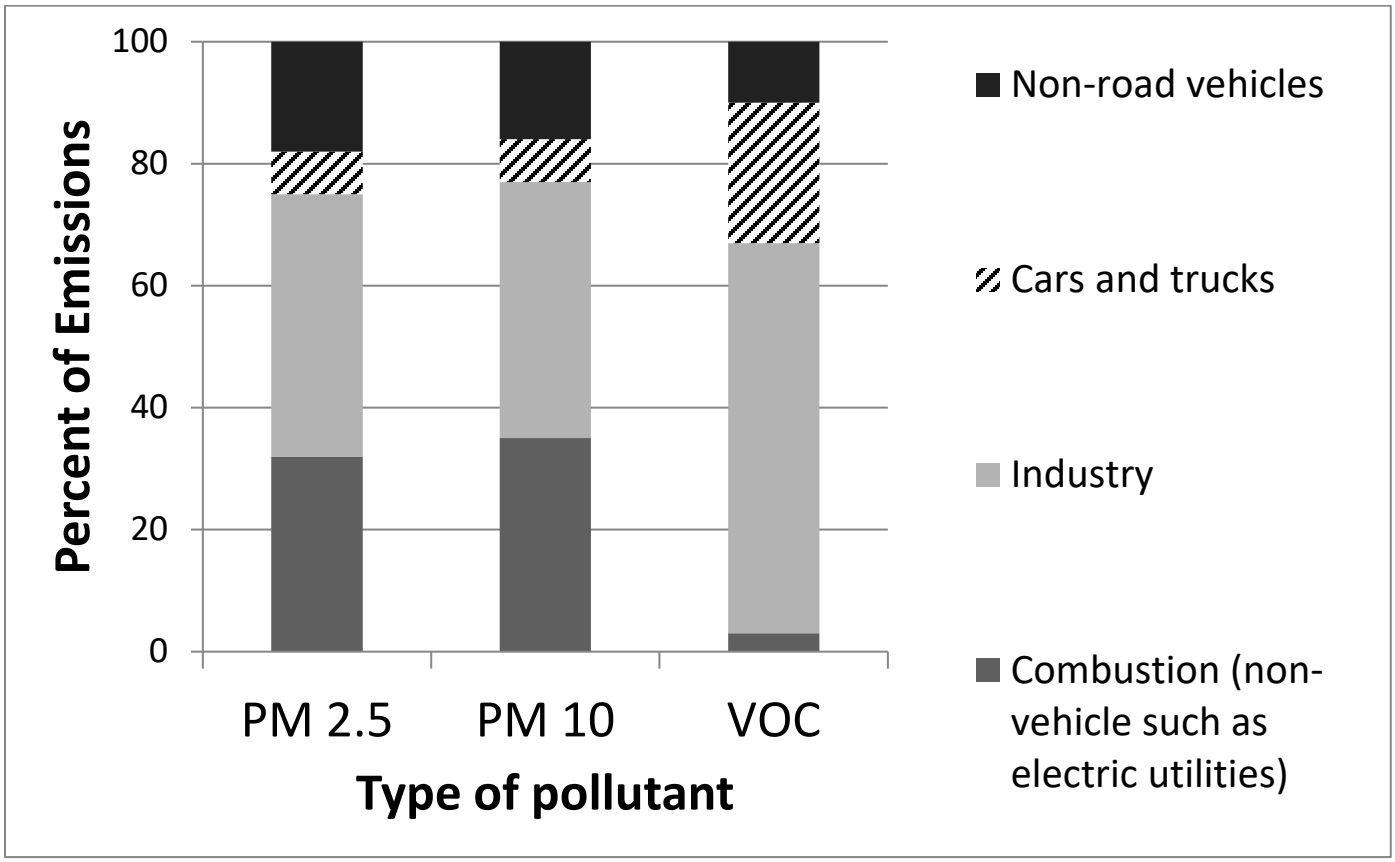
All three forms of air pollution are emitted from this diesel powered school bus (in need of maintenance!): particles, gas such as carbon monoxide, and vapors of volatile organic compounds (VOCs).

Flaring (the burning off of gases in energy recovery operations) results in particles and VOCs going into the air

Look at the chart below:

Which source emits the most particles overall (PM_{10}), small particles ($PM_{2.5}$) and VOCs?

Chart: Distribution of national total emission estimates by source category for three pollutants



Adapted from: U.S. EPA

Activity 1 - Better understand air quality & identify specific emission sources

The EPA maintains a website, *MyEnvironment*, so you can access environmental information about your community and neighborhood

Working in small groups of 3-5, go to: https://enviro.epa.gov/myenvironment/

Enter your zip code (or city name or other location)

While this website has lots of information about your environment, we are going to focus on air quality. Select MyAir

Detailed information is provided about the location you entered, including Air Quality Index (AQI), pollutant levels, ozone, particulate (PM2.5), radon, sources of emissions (click on topics on the map), and local projects. Take some time to explore what may interest you.

Find:

What is your current AQI? _____

What is your forecast AQI? _____

More information about AQI found at: https://www.airnow.gov/aqi/aqi-basics/

Next, go to Toxic Release Inventory (TRI) www.epa.gov/tri/ a website for information on sources of emissions.

Scroll down the page to the TRI Toxics Tracker. Enter a location using a State, County, City name or zip code then click on “View Search Results”. A map will be generated with your location. Use the left-side menu to view different toxic aspects of your area.

Complete the following:

Number of TRI reporting facilities in 10-mile radius _____

What chemical is released most? _____

Are most releases by land, water, or air? _____

Facility where most releases reported _____

Industry _____

What facility is second? _____Industry? _____

Are releases to air increasing or decreasing? _____

Find a facility with violations _____

How can you use this information? _____

Activity 2 – Indoor Air Quality (IAQ) House

There are also **indoor sources** of air pollution such as radon, mold, cooking emissions, cleaning activities, and off-gassing from furniture and building materials. You may also consider secondhand cigarette smoke as contributing to air pollution exposure inside a home, office, or vehicle that can affect your health.

Take a Tour of the Indoor Air Quality (IAQ) House created by the US Environmental Protection Agency at https://www.epa.gov/indoor-air-quality-iaq/interactive-tour-indoor-air-quality-demo-house

Using the IAQ House website, what exposures may be found in each room? Working with your small group, circle the exposures you find.

Living room –	Carbon Monoxide Secondhand smoke	Dust Mites Pesticides	Mold Radon	Pet Dander VOCs
Bathroom -	Carbon Monoxide Secondhand smoke	Dust Mites Pesticides	Mold Radon	Pet Dander VOCs
Bedroom -	Carbon Monoxide Secondhand smoke	Dust Mites Pesticides	Mold Radon	Pet Dander VOCs
Kitchen –	Carbon Monoxide Secondhand smoke	Dust Mites Pesticides	Mold Radon	Pet Dander VOCs
Basement –	Carbon Monoxide Secondhand smoke	Dust Mites Pesticides	Mold Radon	Pet Dander VOCs

Resource 4 - Health Effects of Air Pollution

The potential for health problems is related to the size of the particles. Small particles less than 10 μm pose a threat because they can get deep into your lungs. Larger particles can irritate your eyes, nose, and throat but are not usually associated with serious health concerns. The upper part of the respiratory system helps prevent particles from entering deep into the lungs. Chemicals on or in the particles may increase the health hazard.

Nanoparticles can reach the lungs, as well as move from the respiratory system to the bloodstream and other organs. They may carry with the particle any chemicals that have become attached to its surface.

People with heart or lung disease, older adults, and children are considered at the greatest risk from air pollution.

Exposure to particle pollution has been scientifically linked to health issues including:

- increased hospital visits for breathing and heart problems
- increased respiratory symptoms such as coughing or difficulty breathing
- asthma and chronic obstructive pulmonary disease (COPD) symptoms get worse
- chronic bronchitis
- decreased lung function
- decreased lung growth in children
- lung cancer
- heart attacks
- irregular heartbeat
- premature death in people with heart or lung disease

Short-term exposure to air pollution has not been shown to cause serious health effects to healthy children or adults but may cause temporary minor irritation when the air quality is poor. This is of particular concern in densely populated areas.

Activity 3 - Respiratory system identification

- With exertion, people tend to breath more through their mouth than nose. The mouth is less efficient than the nose at removing particles.
- Particles >10 µm can be removed from the windpipe by cilia, sticky hair-like structures.
- Particles <10 µm can reach deep into the lungs. Particles deposited in the lungs can cause respiratory symptoms or more serious health effects.

Using the concepts above, work with your group to fill in the blanks below.

100 µm

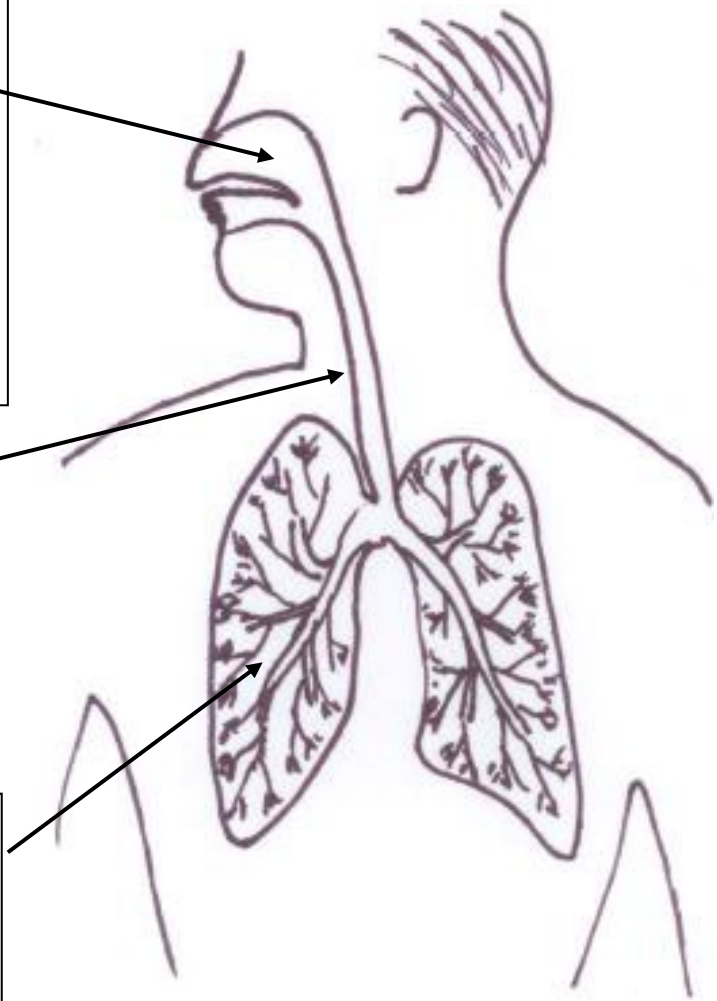
Particles of this size can enter through the nose; some will be caught by nose hairs or removed by sneeze**.** With _____, mouth-breathing is used more. The mouth is _____ than the nose at removal of particles. Some particles that reach the back of the throat can be removed by cough.

>10 µm

Sticky hair-like structures in the trachea (windpipe) called _____ can trap and remove particles larger than 10 µm. Smaller particles can continue deeper.

<10 µm

Small particles _____ can reach deep into the lungs. Particles deposited on the large airways can irritate and cause respiratory symptoms. Particles landing on alveoli and terminal bronchioles can lead to more serious _____ effects.



How might you reduce personal exposures?

Outdoor exercise and physical activity cause people to take more particles into their lungs because they are breathing more deeply. To reduce your exposure:

- Spend time outdoors on days when the AQI is better
- Reduce your amount of physical exertion outdoors or substitute another activity that involves less exertion
- Spend time away from busy roads, where there are higher levels of particulate exposure
- What else can you do to reduce outside exposure?

Particle levels can be high indoors, especially when outdoor levels are high. You can reduce indoor exposures by:

- Using filters and room air cleaners
- Not smoking inside
- Reducing your use of candles, wood-burning stoves, and fireplaces
- Use vent over stove when cooking
- Cook at lower temperatures
- Minimize frying

Activity 4 - Effect/exposure of particles

Choose a topic (health effect, exposure/emission) of interest. Using the websites listed on the following page and a computer, tablet, or smartphone, work with your small group to find more information about the topic. Report back to the large group what you were able to find.

One example is given below.

Topic	Who affected?	Source of Pollution	Can the source be reduced or eliminated?	Where are gaps in information on this?	What else is needed?
Asthma	Adults and children	Oil refinery, diesel exposures near highways, living near refinery	Yes	Proximity to source	More information on source of pollutant, remediation options
Your topic:					

Below are some web sites that include information about air pollution and the health effects of air pollution.

Overall: http://www.epa.gov/air/airpollutants.html

Particulates: http://www.epa.gov/pm/

Indoor air: http://www.epa.gov/iaq/

http://www.epa.gov/sites/production/files/2014-05/documents/healthy_homes_brochure_english.pdf

Secondhand smoke: https://www.epa.gov/indoor-air-quality-iaq/secondhand-tobacco-smoke-and-smoke-free-homes

Ozone, particulates, benzene, formaldehyde:
http://ephtracking.cdc.gov/showAirContaminants.action

Health effects of small particles: http://www.epa.gov/pm/health.html

http://ephtracking.cdc.gov/showAirHIA.action

http://ephtracking.cdc.gov/showAirHealth.action#ParticulateMatter

Potential exposures indoors:
http://www.lung.org/our-initiatives/healthy-air/indoor/at-home/how-to-know-if-your-air-is-unhealthy.html

IAQ school toolkit:
http://www.epa.gov/iaq/schools/actionkit.html

Activity 5 - What is the next step for you? Developing an Action Plan

Think about what you've learned. Complete the following on your own to help decide your next step for action plan on either a community or personal level.

I would like to…	Yes	No/don't know
get more information about my home and indoor air pollution concerns		
get more information about what school officials are doing to reduce air pollution		
get more information about my outdoor environment		
get involved in local fact-finding (community)		
meet with others who are concerned about the air pollution, such as environmental groups		
Other:		

Next, develop a plan to achieve your goal, including a timeline. See the example below:

Personal plan example (will complete in five weeks)

Goal: Follow the Air Quality Index (AQI) for a month to help asthmatic relative

Steps: Create a calendar to track AQI

Identify source (app, web link, news)

Alert my grandmother on days with unhealthy AQI

Possible Barriers:

Grandma likes to sit on the porch every afternoon

I will talk with her about this; will speak with her nurse

Measure: How many days with unhealthy AQI

How many of those days did grandma stay inside?

Use the Worksheet below (or use your own format) to organize your plans

Goal:

	Step	Barriers/ Strategies	Measures	Target date	Reason for delay	Date done
1						
2						
3						
4						
5						

Report back to the larger group regarding your plan.

Additional Resources for your use

Toxic air pollutants:
http://www.epa.gov/ttn/atw/allabout.html

Releases in your zip code and air quality:
https://www.epa.gov/toxics-release-inventory-tri-program

EPA air pollution resources: http://www.epa.gov/air/airpollutants.html

Videos from Midwest Emerging Technologies Public Health and Safety Training (METPHAST) Program:

“Hands-on Exposure and Dose” https://www.youtube.com/watch?v=tAuEiVE89hM

“Hands-on Orders of Magnitude” https://www.youtube.com/watch?v=-bXHNxpA0ec