

Name:

## What is Particulate Matter – Vocabulary

Use web resources to define the following terms.

**particulate matter:**

**PM<sub>2.5</sub>:**

**PM<sub>10</sub>:**

**asthma:**

**myocardial infarction:**

**cardiac arrest:**

**arrhythmia:**

**diabetes:**

**hypertension:**

**cancer:**

**Teacher Comments:**

# Particulate Matter Exposure Risk Assessment

Name:

Partner(s):

Date:

Who I am: (Summarize your assigned profile here)		
	Summary of environment & main pollutant(s)	Primary health concerns based on your individual profile
Environment 1:		
Environment 2:		
Environment 3:		
Environment 4:		
Environment 5:		

## Conclusions:

*Based on your profile, which environment should you avoid most and why?*

### Group Discussion 1: Same Age, Different Risks

- *Group together with the other people in your class who are the same age (based on your assigned profile).*
- *Choose one person in your group to be your discussion recorder. At the end of the discussion, this person will summarize your key points to the rest of the class.*
- *Compare your findings from the different environments. Do you all have the same exposure risks? If not, explain why?*

### Group Discussion 2: Risks Known, Actions Taken

**Teacher Comments:**

## COMPREHENSION 1

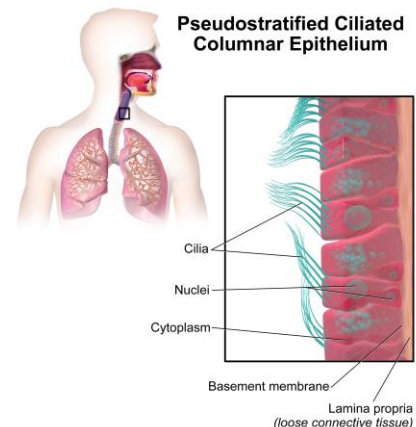
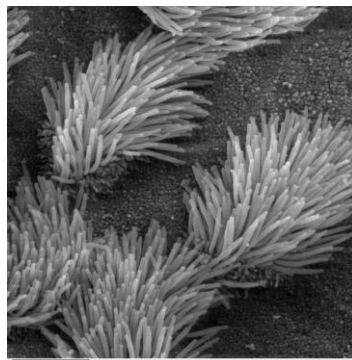
### Health Risks of Particulate Matter Exposure

#### WHAT IS PARTICULATE MATTER?

The term "particulate matter" (PM) includes both solid particles and liquid droplets found in air. Many manmade and natural sources emit PM, both indoors and out, including wildland fires, fossil fuel emissions, road dust, wood stove and fireplace emissions, volcanoes, pesticides used in agriculture, cigarette smoke, and cooking. All forms of particulate matter belong to one of two groups: primary (emitted directly from a source) or secondary (formed through chemical reactions in the air). Particulate matter is also categorized by size. **PM<sub>10</sub>** particles are between 10 and 2.5 microns in diameter. Many of these can be seen with the naked eye and include dust and pollen. **PM<sub>2.5</sub>** particles are 2.5 microns or less and are formed primarily through combustion (wood burning, motor vehicles, power plants, etc.) and certain industrial processes. The Environmental Protection Agency (EPA) has designated an acceptable daily average level of ambient particles (those in the immediate surroundings) at 35 micrograms/m<sup>3</sup> or less, and 15 micrograms/m<sup>3</sup> or less for the annual average.

#### THE HEALTH EFFECTS OF PARTICULATE MATTER EXPOSURE

A wide range of particles and substances exist in the air around us at any one time, from dust to tiny liquid droplets. Our respiratory system has natural defenses to try and protect our lungs from particle inhalation. For example, the hairs in your nose are designed to trap large particles in the air and prevent them from entering your airways. Also, our airways are lined with small, hair-like projections called cilia (see image below) that help propel a liquid layer of mucus that protects our airway out of our lungs and esophagus. Particles inhaled into the airways land on the mucus layer and are then swept back up by the cilia into the pharynx where they are coughed up, sneezed out, or swallowed into the esophagus where they are far less harmful. Unfortunately, these and our other defense systems are not 100% effective, particularly against PM<sub>2.5</sub> particles, which are so small they easily pass our natural barriers and can be embedded in the deepest part of our lungs.

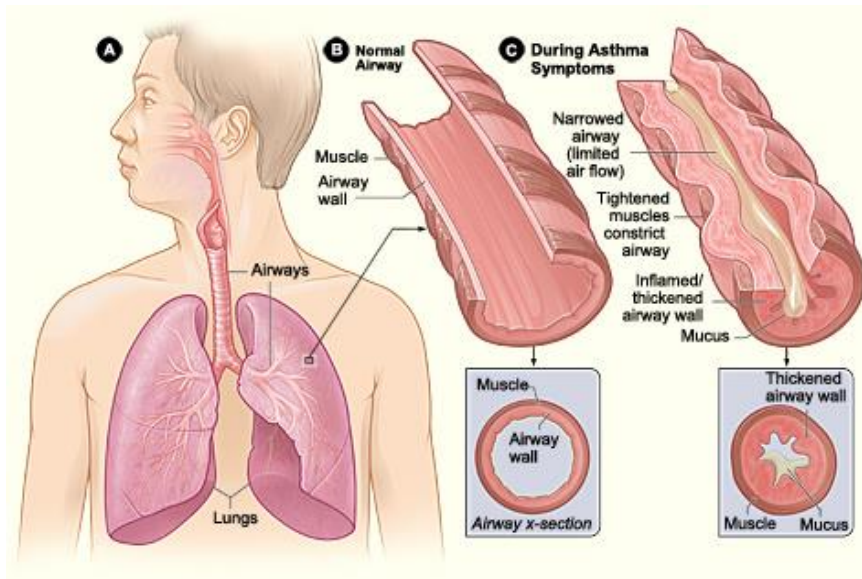


There are many informational resources available for particulate matter. Start by exploring the EPA's website:

<http://1.usa.gov/1DOeqph>

A number of negative health effects due to long-term particulate matter exposure have been, and continue to be, discovered. Some conditions are manageable, such as allergies and asthma, while others can be fatal, such as heart attack or cancer. Below are a number of serious health conditions exacerbated or caused by particulate matter exposure.

**Asthma:** Asthma is the most common illness associated with particulate matter exposure. Asthma is a chronic (long term) illness that causes inflammation and closure of the airways.



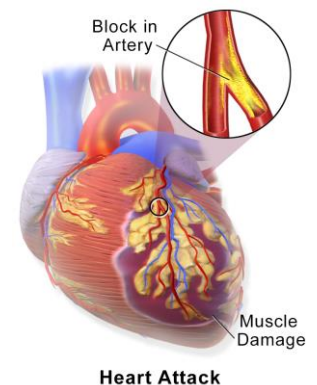
As the diagram above shows, when aggravated, the muscles in the airways of an asthmatic can spasm and the interior walls swell with fluid, causing the airway walls to become thicker and preventing oxygenated air from readily entering the lungs. Many types of particulates can exacerbate the condition and trigger asthma attacks including: dust, molds, smoke and other combustion products. Though many people manage asthma attacks with an inhaler, an attack can be fatal: in 2011, 3,345 deaths were attributed to asthma. About 8% of the population suffers from asthma, with rates even higher in Native American communities (12%) and among African Americans (13%). Between 1980 and 1994, the rate in asthma increased 75%, leading to deeper studies into how air pollution affects this condition. Beyond particulate matter being a trigger for asthma attacks, there is speculation that PM exposure can cause genetic changes in utero that may lead to asthma.

**Hypertension:** Hypertension is also known as high blood pressure. Blood pressure is the force exerted on the walls of the arteries as the heart pumps blood. People with high blood pressure may not experience obvious symptoms, but it can cause damage to the heart, blood vessels, kidneys and other parts of the body. Blood vessels that are damaged from hypertension become more vulnerable to build up of plaque in the arteries. A number of studies link PM exposure to hypertension, even among healthy individuals.

**Myocardial infarction:** Also known as a heart attack, myocardial infarction occurs when blood flow to an area of the heart stops, causing muscle damage and loss of heart function. As mentioned above, particulate matter exposure is known to

### Did you know?

PM<sub>2.5</sub> can travel hundreds, even thousands of miles. Particle pollution from China has been observed to travel across the Pacific ocean to the West coast of the United States, making PM pollution a truly global issue.



To learn more about hypertension, atherosclerosis, and myocardial infarction watch the short video at <http://www.webmd.com/heart-disease/video/atherosclerosis>

cause hypertension that can stress the walls of arteries, making them more susceptible to narrowing and plaque buildup called atherosclerosis (ATH-er-o-skler-O-sis). This plaque buildup can break open in the artery and cause a blood clot to form on the surface of the plaque. If the blood clot becomes large enough, it can block the flow of blood in the coronary artery, which usually supplies blood to your heart. When this happens, the portion of the heart muscle that is not getting oxygen rich blood begins to die and can lead to heart failure.

**Cardiac Arrest:** Cardiac arrest is the abrupt loss of heart function due to a malfunctioning of the heart's electrical system. This is in contrast to a heart attack, which is caused by blockage of the blood supply to the heart (see above). A number of studies examining PM<sub>2.5</sub> levels in the air on the days prior to and the day of cardiac arrest events have found an association between elevated PM levels and higher numbers of cardiac arrest cases.

**Arrhythmia:** The beating of the heart is controlled by electrical impulses that usually come at regular intervals. Arrhythmia is a condition in which a person has an irregular heartbeat; the electrical impulses may come too quickly or slowly, or be erratic. If the heart is not pumping correctly then the blood is not being delivered correctly to the brain, lungs, or other vital organs of the body—resulting in damage. Equally, arrhythmia can result in the pooling of blood in the heart, increasing the chance of creating a blood clot that can cause a heart attack. Studies in the last decade have linked episodes of higher ambient particle pollution to arrhythmia, which has the potential to cause death, especially in elderly patients.

**Type II Diabetes:** Type II diabetes occurs when the body can no longer process sugars in the blood correctly. A hormone produced in the pancreas, called insulin, is responsible for signaling your body to remove sugars from the blood stream and have cells convert them into usable energy. Unlike with Type I diabetes, which is a genetic disease in which people do not produce insulin, people with Type II diabetes do produce insulin, but their cells no longer process it correctly. This is called insulin resistance. When the body can no longer process sugars correctly, it can damage your kidneys, liver, eyes, nerves, and ability to heal wounds. The development of Type II Diabetes is generally associated with lifestyle (poor diet, obesity, lack of physical exercise), it's now been shown that long-term PM<sub>2.5</sub> exposure may make individuals more susceptible to developing Type II Diabetes.

**Cancer:** Cancer is caused by abnormal, uncontrolled cell division, which results in damage to surrounding tissues. Cancerous cells have the potential to spread to other parts of the body. It is the second leading cause of death in the United States, just behind heart disease. An estimated 1,620 people will die *a day* from cancer in the US alone in 2015. Cancer can be caused by inherited genetic mutations, but is often caused by external factors such as exposure to toxins, like particulate matter. There is a known link between lung cancer and PM<sub>2.5</sub> exposure. Lung cancer accounts for more deaths than any other cancer in both men and women.

Particulate matter exposure is now linked to a multitude of other illnesses and conditions such as low birth weight, dementia, attention deficit hyperactivity disorder, and autism.

## Notes:



Name:

## PM LESSON 2: Guiding Questions

Read *Health Risks of Particulate Matter Exposure* and answer the following questions completely and concisely:

1. What is the difference between PM<sub>2.5</sub> and PM<sub>10</sub>?
2. The EPA (Environmental Protection Agency) has set acceptable average levels of particulate matter pollution in a 24-hour period in order to limit exposure. What is the acceptable average ambient (outdoor) level?
3. Why is PM<sub>2.5</sub> considered more dangerous to human health than PM<sub>10</sub>?
4. What is an asthma attack and why might an asthmatic want to monitor PM levels?
5. Hypertension and myocardial infarction are closely related to one another. Explain how.
6. How does hypertension lead to myocardial infarction?
7. Why is arrhythmia dangerous?
8. Why do you think that athletes are at particularly high risk on high pollution days?
9. A great deal of scientific research is being done on the health effects of particulate matter exposure. Find one recent *scientific* article on a health effect related to particulate matter exposure. Summarize the study and its findings. Print the title/abstract page (not the entire article!) and attach it to this sheet.

**Teacher Comments:**