



Estimated Time: 30 minutes

Objectives:

- Learn what particle pollution is.
- Understand how particle pollution can affect people's health.
- Observe through role playing how our bodies (cilia in particular) help protect us from particle pollution.
- Understand how sources of particle pollution.
- Learn what people can do to reduce particle pollution.

Grade Level: K - 5

California State Standards: The Physical Science and Investigation & Experimentation standards both apply to this lesson for all grades K through 3.

Tool Kit Materials:

Additional Materials:

- Flour (about a handful)
- Flashlight
- Student Handout: Human Hair and Particle Pollution (included)
- 75 pre-made newspaper balls (wadded up newspapers to size of tennis balls, wrapped in masking tape)
- Cilia Game Set-up (included)
- 4 orange traffic cones
- Name Tags (optional saying "cilia", "particle pollution", and "lung")
- Sources of Particle Pollution Poster (included)
- Flip chart and marker

The Cilia (not Silly!) Game

One type of air pollution is called particle pollution, which is made up of tiny particles of dust, dirt, smoke, and liquid droplets. Particle pollution comes from things like cars and other vehicles, smokestacks from factories and power plants, fireplaces and wood-burning stoves, volcanoes, and forest fires. When there's a lot of particle pollution in the air, people can get sick from breathing it in. Our bodies help protect us from particle pollution. Cilia, which are tiny hair-like structures that line our respiratory system, try to keep foreign objects like particle pollution out of our lungs. Sometimes the cilia are successful, but not all the time. When particle pollution reaches our lungs, we might feel sick.



Certain people are particularly sensitive to particle pollution, including children, the elderly, people with asthma and other respiratory problems, and people with heart problems. Particle pollution may make people cough or have difficulty breathing, and can make asthma and heart disease worse. People visit hospitals more often when there is a lot of particle pollution. There are things that we can do to help protect our health from particle pollution, such as finding out how clean or dirty the air is, taking it easier outside if the air is not good, and telling an adult if you have trouble breathing on days when the air quality is bad. It's also a good idea to stay away from school bus tailpipes because particle pollution comes out of them.

Tell the class that they are going to play a "Cilia Game" that shows how cilia keep particle pollution out of the lungs, and how some particle pollution gets through the lungs.

Key Questions

- What is particle pollution? (*Answer: Particle pollution is made up of tiny particles of dust, dirt, smoke, and liquid droplets in the air.*)
- Where does particle pollution come from? (*Answer: Particle pollution comes from cars and other vehicles, smokestacks from factories and power plants, fireplaces and wood-burning stoves, volcanoes and forest fires.*)



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- How can particle pollution affect our health? (*Answer: Particle pollution may make people cough or have difficulty breathing, and can make asthma and heart disease worse.*) What might some of the benefits be of reducing traffic and air pollution from vehicles?
- What can we do to protect our health from particle pollution? (*Answers: Find out how clean or dirty the air is. Take it easier outside if the air is not good. Tell an adult if you have trouble breathing on days when the air quality is bad. Stay away from school buses' tailpipes.*)
- What can we do to reduce particle pollution? (*Answer: Use fireplaces and wood stoves less often, or not at all. Make sure you have a clean-burning, EPA-certified wood stove. Carpool or use public transportation when possible instead of driving. Turn off lights when not using them.*)

Vocabulary

Cross Section: A cut through a substance, at a right angle.

Particle Pollution: Air pollution that consists of tiny, often microscopic particle of dust, dirt, smoke and liquid droplets.

Cilia: Small hair-like structures that line the airways in the lungs and help clean out the airways.

Procedure

SETTING THE STAGE

- Darken the classroom. Gently throw a handful of flour into the air, keeping it away from students.
- Quickly shine a flashlight on the flour as it is falling. Ask students to describe what they see.
- Discuss how the flour floats in the air, separating into tiny pieces, like dust. Tell students that these tiny pieces are called “particles.” Explain that many different kinds of particles float in the air and can be inhaled into our lungs, sometimes making people cough.
- Explain that when tiny particles of dust, dirt, or smoke mix with liquid droplets in the air, scientists call this “particle pollution.” When there is a lot of particle pollution in the air, people can get sick from breathing it into their lungs. They may have trouble breathing and become more tired. Particle pollution can aggravate heart or lung disease. Breathing particles has been linked to heart attacks and even death.
- Have one student come up to the blackboard and draw a large circle on it. Tell students to pretend that the circle is a strand of hair, cut open—a “cross section.” Have the student label the diameter “70 microns.”
- Have two other students draw two tiny circles inside the large circle and label their diameters “2.5 microns.” Explain that microns are very, very small units of measurement. Tell students that particles can be very tiny—we may not be able to see them, but they may still be there.
- Distribute the Student Handout: Human Hair and Particle Pollution and observe it with students.
- Explain what cilia are and the role they play in our health and air pollution. (Background information on cilia: Tell students that cilia (pronounced: sih-lee-uh) are tiny hair-like structures in our respiratory system. The job of cilia is to protect our respiratory system by keeping foreign matter—like particles—from entering our lungs. Cilia do this by moving back and forth to remove particles that enter our nose with the air we breathe. As air is inhaled, the cilia wave around, pushing any foreign matter away from the lungs.)

PLAYING THE GAME!

1. Tell students they are going to play a “Cilia Game.” (Not a Silly game!) As for student volunteers, as follows: (if you are using name tags for the roles, pass them out now)
 - Two students as the “lungs”
 - Half the class, plus a few more, as “particle pollution”
 - The remaining students as “cilia”
2. See the enclosed graphic for the Cilia Game Set-Up. In an open area, set up the boundaries of the game in a trapezoid shape, using 4 traffic cones or similar size (and safe) objects,

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leaving approximately 15 feet between the “Lungs” boundary and the “Particle Pollution” boundary.

3. Read the game rules to the class:

- The “lungs” students stand on the short side of the trapezoid.
- The “particle pollution” students line up along the longer edge of the game area
- The “cilia” students stand in between the “particle pollution” and the “lungs.” Tell the cilia students that they can stretch and wave their arms like cilia to keep particle pollution from entering the lungs, but they must stand still with their feet together, and must not hit other students. Have the cilia students practice this movement.
- Place some of the pre-made particle pollution newspaper balls near each of the “Particle Pollution” students. Explain that the “Particle Pollution” students will throw the particle pollution balls towards the “Lungs” students, and the “Cilia” students will try to defend the Lungs by waving their arms and batting the particle pollution balls away from the Lungs. Emphasize that the balls should NOT be thrown too hard and not anywhere near anyone’s face. Demonstrate by having a Particle Pollution student throw one of the newspaper balls at you.
- Tell students to take a deep breath and feel the air moving in their own lungs.

4. Begin the game by declaring the day bright and clear, with little particle pollution, and tell two Particle Pollution students to throw two balls each towards the Lungs. The Cilia students should try to bat the balls away from the Lungs.

Ask the “Lungs” how they are feeling.

5. Explain that now it is a day with lots of particle pollution. Tell students that when you say “Go,” all of the Particle Pollution students should throw all of their balls; one at a time, towards the Lungs, and the Cilia students should try to stop the balls from reaching the Lungs by waving their arms. Then shout out “Go!”
6. When all the balls have been thrown, stop the game and allow time for students to calm down. Then ask the Lungs students how it felt to have all of that particle pollution thrown at them. Tell the Lungs students to count how many Particle Pollution balls reached them. Ask the Cilia students how they felt during the game.
7. Review with students what happened in the Cilia Game: when there was just a little particle pollution, it was easier for the cilia to keep the particle pollution away from the lungs. When there was a lot of particle pollution, it was much harder for the cilia to keep the particle pollution away from the lungs, and the lungs may have felt attacked by the particle pollution.
8. Explain/review that at certain levels, everyone can be affected by particle pollution. Some groups of people are more sensitive, including children, the elderly, people with asthma and other respiratory problems, and people with heart problems. Breathing in particle pollution may make people cough, make it harder to breathe, and can make asthma and heart disease worse. People visit hospitals more often when there is a lot of particle pollution.
9. Discuss with the class what they can do to protect their lungs and hearts from particle pollution in the air. Tell them they can:

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- Find out how good or bad the air quality is each day from the Air Quality Index, or AQI. The AQI is often in the newspaper on the weather page, sometimes on the TV news, and always on the Internet (at www.airnow.gov).
- If the air quality is not good, take it easier if you're outside- walk instead of run, and take breaks often.
- If it feels harder to breathe when the air is not good, tell an adult.
- Stay away from the tailpipes of school buses- you don't want to breathe in the particle pollution that comes out of those.

Note: See "For Further Exploration" below for a discussion of sources of particle pollution and ways to reduce particle pollution.

FOR FURTHER EXPLORATION

If time permits, have a discussion with students about where particle pollution comes from. Share with the class the *Sources of Particle Pollution* poster at the end of this lesson. Ask students if they or their families ever create particle pollution and how.

(Teacher discussion information: There are many sources of particle pollution created by people's activities. Cars and trucks, factories, and power plants that produce electricity release particle pollution. Unpaved roads, and construction projects that grind or crush rocks or soil, also cause particle pollution. Wood-burning stoves and fireplaces, outside burning of branches or trash, smoke from cigarettes and cigars, and off-road vehicles such as ATVs and lawn mowers also create particle pollution. Sometimes nature can pollute the air, too. Forest fires and volcanoes can pollute the air with particles. If you lived near a forest fire, what do you think it would feel like to breathe the air that day? [Wait for an answer or two.] The air would be very smoky, and it might make you cough, or you might find it harder to breathe.)

Continue the discussion by asking students what they think they, their families, and their communities can do to reduce particle pollution. Write the answers on the flip chart. Guide the class discussion to include the following categories:

- Use fireplaces and woodstoves less often or not at all. Some town or city governments already ban such burning when there's a lot of air pollution. Also, if your family uses a woodstove, make sure it's a clean-burning, EPA-certified unit, which produces less particle pollution than older units. Use only dry seasoned wood; wet wood or plastics cause more smoke and that's not good for you to breathe, indoors or outdoors.
- Use public transportation such as buses, trains, and subways whenever possible instead of driving in cars and trucks.
- Companies and governments can develop cleaner (less polluting) fuels (gas or other fuels) and cars, and people can buy these cleaner cars and fuels.
- Power plants can use cleaner ways to make electricity (such as water, wind, or solar power; cleaner coal; and special equipment to reduce pollution).
- Factories can use cleaner ways to make their products and special equipment

to reduce pollution.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry: Abilities Necessary to do Scientific Inquiry

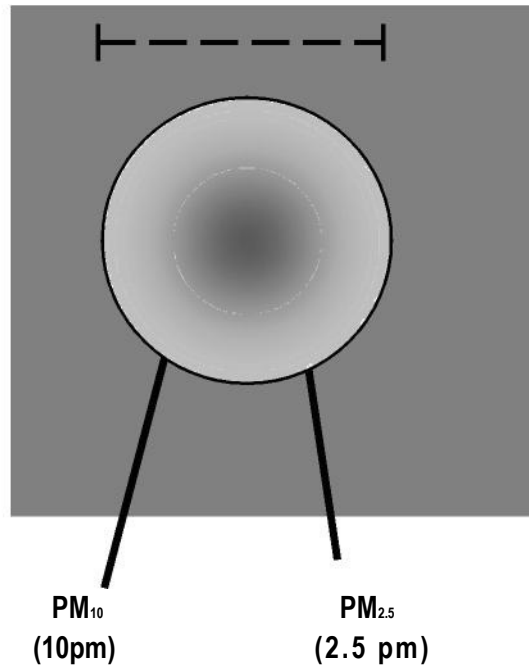
Science in Personal and Social Perspectives: Personal Health, Changes in Environments

Student Handout- Human Hair and Particle Pollution

**Average Human Hair =
70 microns**

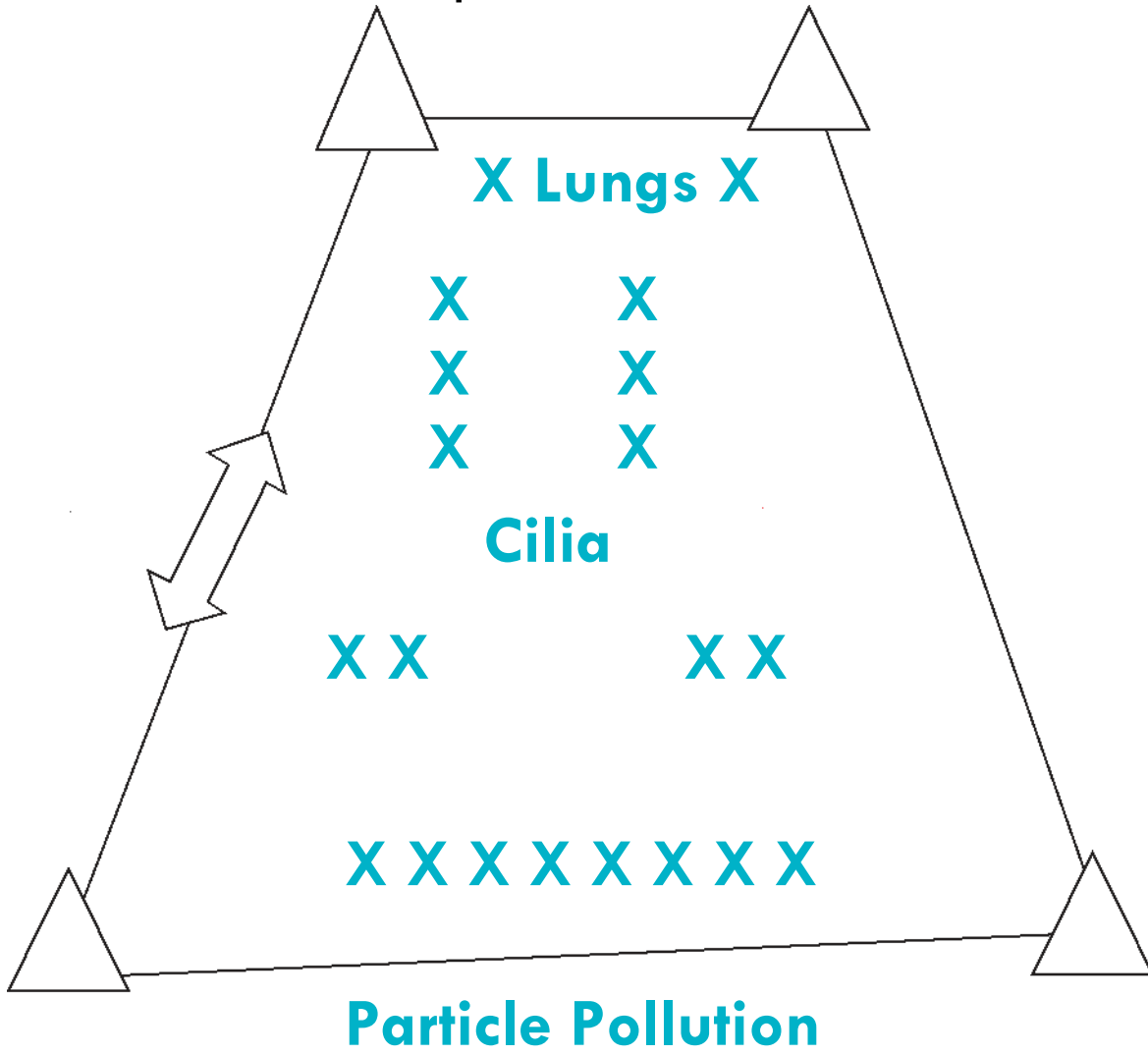


Particle Pollution
(shown as 10 and 2.5 microns)

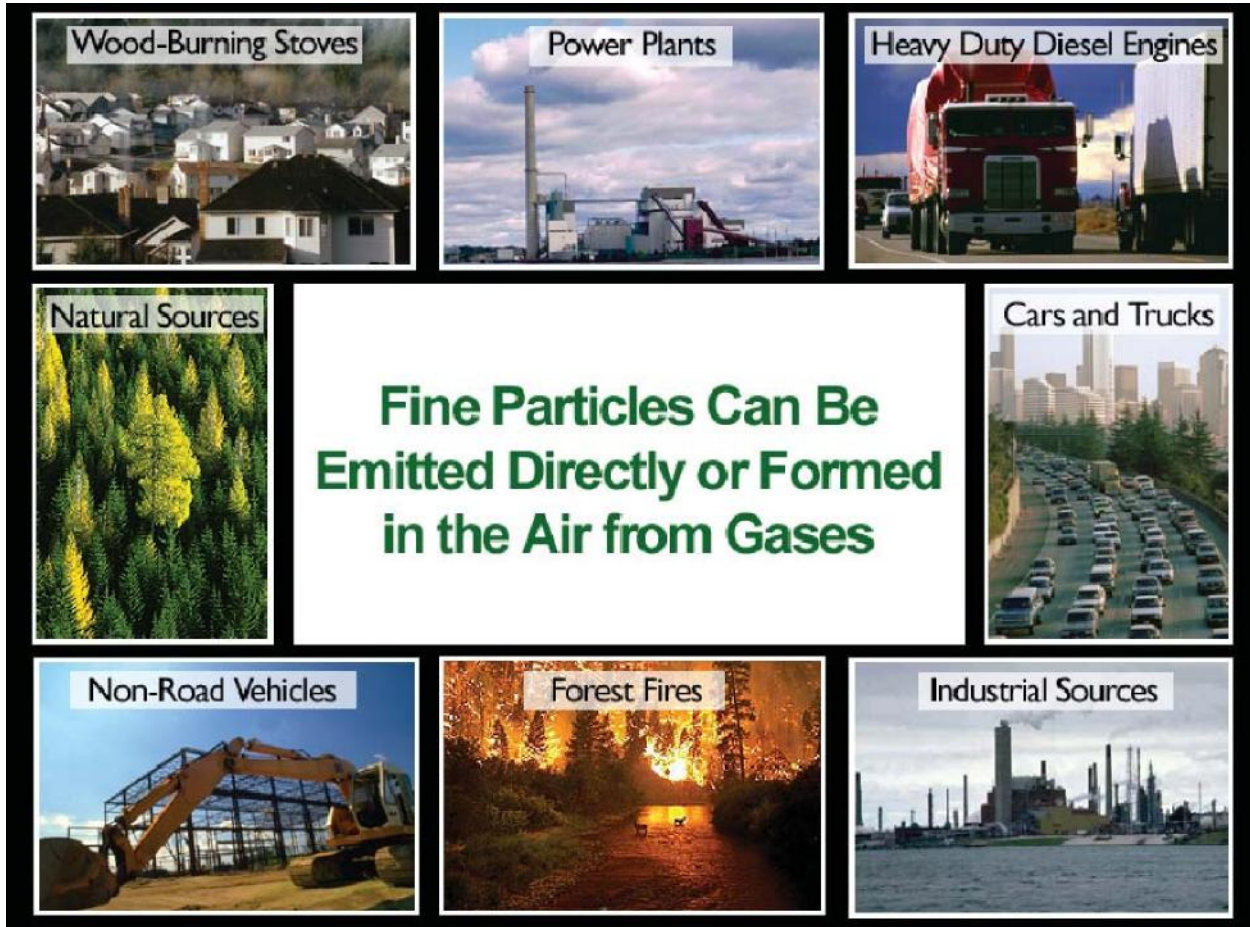


(Particle pollution is also known as particulate matter, or PM)

Cilia Game Set-Up



Sources of Particle Pollution



Source: U.S. EPA, Office of Air Quality Planning and Standards.