

**Title:** Exploring Indoor Air Quality

**Subject:** Science

**Grade Level:** Middle School

**Rational or Purpose:** Students will be able to recognize the industrial impact on air quality.

**Materials:**

- Petri dishes with agar
- Masking tape
- Microscopes
- Access to computers
- Copies of student worksheet

**Lesson Duration:** 50 minutes

**TEKS Objectives:**

§112.22. Science, Grade 6.

(2); (A-D)

(4); (A)

(9); (A)

§112.23. Science, Grades 7.

(2); (A-D)

(4); (A)

(14); (C)

§112.24. Science, Grade 8.

(2); (A-D)

(4); (A)

(14); (C)

**Background Information:**

According to the Environmental Protection Agency, indoor air pollution can be 100 times higher than outdoor levels. This issue has become a growing concern for many as particle pollution can cause a number of serious health problems.

Particle pollution is a combination of microscopic solids and liquid droplets suspended in air. This pollution is known as particulate matter and is made up of a number of substances, including acids (i.e. as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (i.e. fragments of pollen or mold spores). Particulate pollution can come from a variety of sources such as factory and utility smokestacks,

vehicle emissions, wood burning, mining, construction activity, agriculture, and cigarette smoke.

The smaller the size of particles, the more potential they have for causing health problems since these particles can be easily breathed in. Fine particles pose the greatest threat because they can get deep into the lungs and even get into the bloodstream.

**Activity:** Students will explore how different factors affect air quality by using an online simulator. Students will also obtain a greater understanding of the substances in the air by collecting and growing samples.

**Procedure:**

1. Begin a class discussion about what air is composed of and its properties. Draw a concept map of the student's ideas on the board.
2. Introduce the term "particulate matter". Have students watch a short film on particulate matter on the EPA website (<http://www.epa.gov/airnow/pm/pm.html>)
3. Inform students they will have the opportunity to see how individual choices affect air quality by stimulating conditions in "Smog City."
4. Pass out student worksheets and instruct students to read and follow this handout.
5. After completing the simulation, have a class discussion about what they discovered as they altered the different controls for weather, emissions, and population. Discuss the questions listed on the handout under "Class/Group Discussion."
  - a. Was there any one variable that seemed to have a greater increase in particular pollution than others tested? Which one?
  - b. What steps could be taken to control emissions levels?
  - c. Can you think of ways to reduce particle pollution levels?
6. Explain to the class that they will now conduct an experiment to assess the air quality of the classroom.
  - a. Students will place uncovered Petri dishes in various locations around the classroom (i.e. near a window, next to a vent, inside a cabinet/drawer, etc.) Label each Petri dish with the location on a piece of masking tape.
  - b. Have a covered Petri dish to serve as a control.
  - c. Place a Petri dish on your desk next to a candle. You will light this candle for a few minutes every day.
7. After a week (or a time of your choosing), students will examine the particulate matter collected on the Petri dishes using microscopes. Be sure to go over proper use of the microscope.
8. As a class discuss the following questions:
  - a. Which Petri dishes have the most particles?
  - b. Which Petri dishes have the least particles?
  - c. What does the particulate matter look like?
  - d. What is the likely source of the pollution on each dish?
  - e. How would you describe the air quality of the classroom?

**Resources:**

- "Indoor Air: What's the Matter?" Breaking the Mold. 2002. Maryland Public Television. 15 Sep 2008  
<<http://enviromysteries.thinkport.org/breakingthemold/resources/>>.
- "Teacher Resources." AIRAIRNow - Air Quality Students Page. AIRNow.  
<<http://www.airnow.gov/index.cfm?action=student.teachers>>.
- Reading material – Indoor Air quality  
< <http://www.epa.gov/region01/students/pdfs/indoorair.pdf>>.

## Save Smog City 2 from Particle Pollution Student Worksheet

1. Access the Smog City 2 web site at [www.smogcity2.org](http://www.smogcity2.org).
2. Select "Save Smog City 2 from Particle Pollution."
3. Once Smog City 2 loads to your computer, take note of the areas of Smog City, including *Weather Conditions*, *Emissions Levels* and *Population*. All areas have "clickable" choices. Mouse-over or click on the choices.
  - NOTE: in the information box at the bottom of the screen, there is information about each choice.
4. Notice how each of the choices are pre-set to a certain level. These are called the *default settings*. You can use the reset button at any time to return to the default settings. In the chart below, **circle** or **highlight** the default setting for each choice. The first setting, *Sunlight*, has already been completed for you.

Weather Conditions	Choices Included in the Area:
<b>Sunlight :</b>	<b>Clear</b> -Partly Cloudy - Cloudy
<b>Inversion Layer:</b>	No inversion - Low inversion - High inversion
<b>Wind Speed:</b>	Calm - Light Breeze - Breezy - Windy
<b>Maximum Daily Temperature:</b>	30°F - 40 °F - 50°F - 80°F - 90°F - 100 °F - 110 °F

Emission	Choices Included in the Area:
<b>Energy Sources –</b>	Some energy sources produce more smog-producing emissions than others.(level 1 is cleaner sources like a wind or solar technology, level 3 produces more smog like a coal-fired power plant) Levels: 1 2 3
<b>Cars and Trucks –</b>	This includes Passenger vehicles (all sizes), large and medium trucks, motorcycles Levels: 1 2 3 4 5
<b>Off Road Vehicles –</b>	This includes airplanes, trains, power boats, earth movers, tractors, harvesters, forklifts, bulldozers, backhoes Levels: 1 2 3 4 5

<b>Consumer Products-</b>	This includes paint thinner, charcoal lighter fluid, glue or other adhesives, gasoline Levels: 1 2 3 4 5
<b>Industry –</b>	This includes manufacturing facilities, power plants, oil refineries/storage/distribution centers, food and agricultural processing Levels: 1 2 3 4 5

<b>Area Name:</b>	<b>Choices Included in the Area:</b>
<b>Population –</b> Population in Smog City 2 affects air quality. Changing population, as shown by the “total emissions” chart and the emission sources in the cityscape, affects VOCs, NO <sub>x</sub> and SO <sub>2</sub> . The compounds react to form ground-level ozone and particle pollution. When temperatures are cool, changing population also changes the usage of wood-burning stoves, which emit particle pollution	In Smog City 2, you can increase the population from near-zero to about two million people.  Levels: 1 2 3 4 5

5. Observe the AQI (Air Quality Index) box in the lower right corner. The default settings, which are circled above, result in a “red”, or “Unhealthy” AQI for particle pollution. The health message is: “Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion.”

### Scenario 1: Emission Sources

1. Minimize the “Save Smog City 2 from Particle Pollution!” instructions at the top of the screen.
2. Turn only Cars and Trucks control to 1. Leave all other choices at the default settings. Record what happens on the Student Worksheet in the table below. Use the reset button to return the Cars and Trucks control to 3, so all controls are in default position.
3. Turn only Off Road down to 1. Leave all other settings alone. Record what happens on the Student Worksheet. Use the reset button to return the Off Road control to the middle setting, so all controls are in default position.

### Student Worksheet

Energy Sources	Cars & Trucks	Off Road	Consumer Products	Industry	Air Quality Index (AQI) Color   message   value
Default					Red – Unhealthy – 157
2	1	3	3	3	
2	3	1	3	3	

4. Using the worksheet below, adjust each of the remaining controls noted in red and record the result in the worksheet.

### Student Worksheet

Energy Sources	Cars & Trucks	Off Road	Consumer Products	Industry	Air Quality Index (AQI) Color   message   value
2	3	3	1	3	
2	3	3	3	1	
1	3	3	3	3	

5. Move all Emission controls to level 1. What is the AQI? Why?

6. Using the reset button, return all Emission controls to the middle setting and turn the Population control to level 1. What is the AQI? Why? (Hint: Read “WHAT IS THIS” in the information box)

### Scenario 2: Weather

1. Using the reset button, return all Emission and Population controls to the middle setting. What is the AQI level?

2. Set the Temperature to 80 degrees F. Check the black sign in the cityscape for the temperature. How does this affect particle pollution? Why?

3. Move the Inversion control to low-altitude (the far right). How does this affect particle pollution levels? Why?

### **CLASS / GROUP DISCUSSION**

In a Class or Group Discussion based on all the data collected, answer the following questions on the Student Worksheet:

1. Was there any one variable that seemed to have a greater increase in particle pollution than others tested? Which one?
2. What steps could be taken to control emissions levels?
3. Can you think of ways to reduce particle pollution levels?