

Mid-Atlantic  
**Diesel Collaborative**

on route to cleaner air

**Air Quality Awareness  
&  
Idle Reduction Toolkit**



**Reducing school bus idling and  
improving air quality...  
one bus at a time!**

This toolkit was developed in cooperation with the Mid-Atlantic Diesel Collaborative and the U. S. Environmental Protection Agency



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## **INTRODUCTION**

**Be a champion for cleaner air and improve the environment by creating a "no idle" policy at your school.**

The Mid-Atlantic Diesel Collaborative (MDC), in cooperation with the U. S. Environmental Protection Agency (EPA) Region 3 Office, developed this toolkit to educate school teachers and their students (5<sup>th</sup>-6<sup>th</sup> grade levels) on the importance of reducing school bus idling and air pollution caused by motor vehicles. The toolkit is designed with a culmination project where the students put what they learned into practice and develop an idle-reduction campaign at their own school. Therefore, education of the importance of reducing idling is not only limited to the students, but is transferred to school and transportation officials, the students' families and beyond.

### **Overall objectives for Toolkit users:**

- Raise air quality awareness,
- Understand and educate self, students, and others on the benefits of reducing idling,
- Utilize students as a means for developing and implementing an idle-reduction campaign at school,
- Educate and encourage transportation officials to spread the word of idle-reduction.

### **Why educate about air pollution caused by motor vehicles?**

- *Did you know* that idling a school bus or other motor vehicle for more than ten minutes per day can add up to hundreds of dollars per year in fuel costs? Not only is it expensive and wasteful, but it doesn't even get you anywhere!
- *Did you know* that idling creates air pollution, and can add about 50 pounds of pollutants such as carbon monoxide, particulate matter, and nitrogen oxides to the air annually?
- *Did you know* that polluted air can make breathing more difficult for people with respiratory problems, and can cause asthma attacks?

Vehicles are one of the main causes of air pollution. Driving releases emissions into the air. Idling does the same. The only difference is that driving is necessary whereas idling is not. Car exhaust contains many harmful pollutants—nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOCs), particulate matter (PM), carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>). NO<sub>x</sub> can cause or worsen respiratory diseases like asthma and emphysema. It also combines with water to make acid rain. VOCs can irritate the respiratory system. Both are major components of smog. PM are tiny particles, such as soot, dust, and dirt, which are found in the air. When inhaled, these tiny particles travel deep into the lungs and may enter the bloodstream. Inhalation of PM can cause difficulty in breathing, coughing, and cause or worsen respiratory diseases such as asthma, emphysema, and bronchitis. CO slows the delivery of oxygen to the body's vital organs and tissues, and its inhalation can cause headaches, visual impairment, and it can aggravate heart disease. Talk about CO<sub>2</sub> and global climate change.

These pollutants negatively impact both our health and the environment. They are especially harmful to children because they breathe more quickly and take in more air than do adults, and spend more time outdoors increasing their exposure to vehicle emissions and air pollution. Reducing the release of these pollutants into the air by reducing idling is an easy way to minimize the negative impacts on human health and the environment by improving air quality.

### **Why Educate Transportation Officials and Beyond?**

Your state may have anti-idling laws and regulations in place, so it is important that transportation officials and others are made aware of them. This is one way to ensure that they are well-informed of the importance of reducing idling as well as in compliance with the law!

### **Goals of Toolkit Modules:**

The modules are designed to teach your students

- About the impacts of air pollution on health
- About the science of air pollution
- How reducing idling from vehicles can improve air quality
- To think critically and problem-solve
- How to develop and implement an idling reduction campaign at your school

### **What is in the Toolkit?**

1. **Module 1 -Health:** This module includes classroom activities which will educate your students about the impacts of air pollution on health, and why reducing idling from vehicles can improve air quality and health.

2. **Module 2- Science/Math:** As in the health module, this module includes classroom activities which will educate your students about the impacts of air pollution but it focuses on the science behind it. It also addresses how idle-reduction can improve air quality from a scientific perspective.
3. **Module 3-Social Studies/Civics:** This module focuses on how EPA regulates air quality, what air quality is and how it impacts our communities. Students begin to think critically about improving the air quality in their communities through the exercises in this module.
4. **Module 4-Implementation:** This module will guide you through the process of having your students develop and implement an idle-reduction program at your school. Various marketing materials are included to help you through the process. The health and science modules should be worked through prior to embarking on this module to ensure that your students have a firm grasp on this background information.
5. **Supplemental Materials:** The packet also includes quizzes, puzzles, and student handouts.
6. **Resources:** EPA's Clean School Bus USA has various campaign materials available for use in your idle-reduction campaign. They have items such as informational video, key chains, posters, and more. You can order these items at <http://www.epa.gov/cleanschoolbus/form.htm>.
7. **Feedback Form:** We value your feedback! Please let us know how this packet worked for you and whether there is anything you feel could be improved. An evaluation form is included.

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### **GOAL OF MODULE:**

By doing the activities outlined in this module, your students will learn

- About the impacts of air pollution on health
- How reducing idling from vehicles can improve air quality
- To think critically and problem-solve

### **BACKGROUND:**

#### **How healthy lungs work**

Lungs draw air into (inhale) and out of the body (exhale) through either the nose or mouth. The lungs transfer oxygen into the bloodstream to help the body use its nutrients and remove carbon dioxide ( $CO_2$ ), a waste product, from the bloodstream. The nose helps you detect odors and filters some of the large particles in the air you breathe so they won't enter your lungs.

#### **How a healthy heart works**

The heart is like a pump that delivers blood throughout your body. By contracting like a pump, the heart forces the blood to move throughout your body's blood vessels. The blood delivers oxygen to the cells that, along with nutrients from the food that you eat, give your body energy. Your blood also helps remove  $CO_2$  and other waste products from the cells, so that waste is removed from the body.

#### **Children vs. Adults**

Unlike adults, children's organs (e.g., like their lungs and heart), are still developing. Their organs may be more sensitive to things that they encounter. Children breathe at a faster rate than adults and inhale more air per pound of body weight, so they are particularly affected by poor air quality. They can also be exposed to different elements than adults because of different daily activities. For example, children are usually not as tall as adults, and they may be outdoors playing near areas that contain diesel fuel exhaust from idling vehicles. This exhaust can trigger asthma attacks.

## **Environmental Pollutants Found in the Air**

The Earth's atmosphere is primarily made up of invisible gaseous substances. Most of the major air pollutants are gaseous substances that can't be seen but can adversely affect human health, as well as damage the environment. Among the major ambient air pollutants that may reasonably be anticipated to endanger public health are carbon monoxide, lead, nitrogen oxides, sulfur dioxide, ozone, and particulate matter (See Table 1). To protect public health and welfare, the U.S. Environmental Protection Agency (EPA) has set national emission standards for these pollutants. These are known as National Ambient Air Quality Standards (NAAQS). Additional pollutants, known as hazardous air pollutants or air toxics, can affect people's health, whether it is something that is an immediate (acute) health affect, or something long term, like cancer. In order to prevent those and other potentially dangerous air pollutants from reaching harmful levels, we need to monitor the environment. By monitoring the environment, we are able to identify emission sources.

## **Respiratory & Cardiac Problems & Environmental Air Pollutants**

When the heart or lungs are damaged, diseased, or are more sensitive (like being very young or old, or having specific allergies, etc.), things like air pollutants may affect how these organs work. Many students have asthma or know of someone with this respiratory problem. Asthma is a long-term (chronic) respiratory disease, but it is treatable if managed properly. Proper asthma management includes avoiding certain "triggers." When a person with unmanaged asthma encounters something that triggers a reaction in their lungs that is non-typical, they can have an "asthma attack." During an asthma attack, airways become inflamed and narrow. Sometimes extra mucous is produced, resulting in asthma symptoms. Asthma attacks can range in severity, so people with asthma should understand their triggers and avoid certain environmental pollutants that may irritate their lungs. Other lung problems that are caused by or impacted by environmental pollutants include bronchitis (or inflammation of the bronchiole tubes in the lungs), coughing or other respiratory irritations, and difficulty breathing.

There are a variety of heart problems that can be affected by air pollution, specifically "particle pollution." Problems can include irregular heart beats and non-fatal heart attacks. People that are more sensitive to air pollution or have respiratory and/or heart diseases should be aware of the air pollution in their community. EPA has information about air quality available through brochures ("Smog: Who does it Hurt?" and "AQI—Air Quality Index"), as well as its air quality website ([www.airnow.gov](http://www.airnow.gov)).

EPA, along with state and local agencies, monitors air quality by measuring how clean or dirty the air is. You can find out about the pollution levels in your community by visiting the AirNow website at [www.airnow.gov](http://www.airnow.gov) to get an idea of what pollution levels are projected for the next few days.

Some areas of the country even have a service that will email you with a notification of the local air quality forecast. This program, EnviroFlash, allows people concerned about their health or their family's health, the ability to adjust their plans for unhealthy air quality days.

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### OBJECTIVE

Students will learn about the importance of good respiratory health by exploring what it means to have a healthy heart and lungs. NOTE: Students participating in this session should not have any physical limitations. If anyone has breathing problems or problems with physical exertion, make sure they understand that they don't have to participate.

### MATERIALS

Small diameter straws  
Clock or timer

### BACKGROUND

Asthma is a serious, sometimes life-threatening respiratory disease that affects the quality of life for millions of Americans. Although there is no cure for asthma yet, asthma can be controlled through medical treatment and management of environmental triggers. When asthma causes breathing problems, the person experiences an "asthma attack", or episode. During an attack, three major changes can take place in the lungs:

1. Cells in the air tubes make more mucus than normal. The mucus is thick and sticky and tends to clog up the air tubes.
2. Cells in the airways get inflamed, causing the air tubes to swell.
3. The muscles around the air tubes tighten. These changes cause the air tubes to narrow and make it hard to breathe.

In people with asthma, exposure to low levels of  $\text{NO}_2$ , from idling vehicles, may cause increased bronchial reactivity and make young children more susceptible to respiratory infections. Long-term exposure to high levels of  $\text{NO}_2$  can lead to chronic bronchitis.

### PROCEDURES AND ACTIVITIES

#### Anticipatory Set:

1. Ask the students: What does it mean to have healthy lungs and heart? What is average pulse and breathing rate for kids? What affects your breathing and pulse? What does it feel like when someone has an asthma attack? What happens

### DURATION

45 minutes

### VOCABULARY

Asthma

Heart

Lungs

Pulse

Respiratory health

when you are outside on a humid day or if you are stuck behind a trash truck or tractor trailer?

**Activity:**

1. Distribute straws to each person in class. Determine if anyone has asthma by asking the students or discussing with the school nurse prior to the exercise. These students should not participate in the actual exercise, perhaps they could be the recorder or timer.
2. Have the students measure their resting breathing rate and pulse for one full minute. Record those measurements.
3. Have students guess to see how much their heart rate will change with 45 seconds of jogging in place? Record results.
4. Have the students jog in place for 45 seconds. Measure their pulse rate and breathing rate immediately after exercising. Students can also count their heart beats for six seconds and multiply by 10 to yield beats per minute.
5. Wait five minutes while the students' breathing and pulse rates return to normal.
6. To find out what an asthma attack may feel like, have students jog in place again for 45 seconds.
7. Immediately after jogging in place, have the students pinch their noses and breathe only through the straw for 15 seconds or 3-5 breaths. Tell them they can breathe without the straw if necessary.
8. Measure pulse rate and breathing rate after the straw exercise. Do they notice any difference?

**Closing:**

1. Engage them in a discussion about the exercise. Explain how breathing through a straw simulates what people suffering from asthma feel like.
2. Have students journal or discuss the activities they couldn't do if they had asthma. What would or could trigger an asthma attack? What should you do if someone you know is having an asthma attack?

**EXTENSION:**

- Have students research the local American Lung Association in their area. Perhaps they might be able to get a speaker to talk to the class.
- Have students research asthma rates in your area; list 10 actors, sports stars, family or friends that have asthma and lead a discussion in class.



### OBJECTIVE

This exercise lets students use their noses as monitoring devices to determine the source of odors introduced into the classroom atmosphere and to demonstrate the importance of monitoring air pollution sources.

### MATERIALS

Blue, red, and yellow food coloring  
Plastic containers with lids (sandwich size)  
Chalkboard or flipchart  
Colored chalk or markers  
Vanilla extract  
Vinegar  
Minty mouthwash (or other non-irritating odorous liquids)

### DURATION

40 minutes

### VOCABULARY

Concentration  
Intensity  
Monitoring  
Odor detection  
Olfaction  
Odor recognition  
Threshold

### BACKGROUND

The Earth's atmosphere is almost completely made up of invisible gaseous substances. Most of the major air pollutants also are invisible, gaseous substances that can adversely affect human health, as well as damage the environment. Among the major ambient air pollutants that may reasonably be anticipated to endanger public health are carbon monoxide, lead, nitrogen oxides, sulfur dioxide, ozone, and particulate matter. To protect public health and welfare, the EPA has set national emissions standards for these pollutants. However, in order to prevent these and other potentially dangerous air pollutants from reaching harmful levels, it is important to be able to detect their presence and to identify their emission sources.

Students will put their noses to the test as air monitoring devices. They will use their keen sense of smell to search out, detect and recognize odors in the air. Odor is the subjective perception of the sense of smell (*olfaction*). They will learn that not everyone has the same ability to smell objects at the same levels (*concentrations*). The minimum concentration (*threshold*) of an odor that can be detected and identified through the

sense of smell depends on how the odor is presented (such as flow rate and purity) and the sensitivity of the olfactory cells in the nose, which vary from person to person. Odors usually are identified at higher levels than what the nose can actually detect as being an odor. These levels are known as "thresholds." Odor thresholds are the concentrations (or amounts) of the odor that are detected or identified. For example, the detection threshold of ammonia is about 17 parts per million (ppm). NOTE: The unit, ppm, is common for concentrations measured on a volume basis, and the recognition threshold is 37 ppm.

## **PROCEDURE AND ACTIVITIES**

### **Prep work:**

1. Mix the blue, red, and yellow food coloring to make a color that is similar to the color of 3 odor samples. (You may use any substance or combination of substances to approximate the color of the vanilla mouthwash and vinegar, but they should create as little odor as possible. The idea is to use this mixture as blanks or decoys for the real samples.) Place into container.
2. Put a small amount of your samples and decoys into the 6 containers. You should use just enough to cover the bottom of the container.
3. Place the containers around the room and cover.
4. On the chalk board, draw two maps (with white chalk) of the classroom, one for charting time and the other for charting intensity. (Students will have one worksheet for tracking both measures.) Fill out the map to show each student's location.

### **Anticipatory Set:**

1. Have students get into a group and discuss different types of outdoor odors both good and bad that we smell every day and their sources. Are there some sources that can be seen, smelled or both?
2. Have each group list their info on the board and discuss some of the pollutants as a class.
3. Explain how determining what and where air pollutants come from (monitoring) is an important part of protecting people and the environment. Detection (what is there) of pollutants can be accomplished by different kinds of monitoring devices (tools). A simple example of visual detection is the dirt on the classroom window where pollutants have stuck to (or deposited on) the glass. When you breathe, the hairs in your nose act like a monitoring tool by filtering dust, and special cells (olfactory) in the back of the nose allow you to identify some chemicals in the air. Explain that because monitoring tools are expensive and take longer to use than you have in class, the students are going to use their noses to detect and identify air chemicals. Instruct them to use their noses like scientists would use a monitoring device to detect and estimate the strength (volume or intensity) of an odor and to determine the source of that odor.

### **Classroom activity:**

1. Explain that they will need to map the classroom to chart the results of the experiment. Hand out the worksheets. You fill in the maps on the chalkboard as each student fills in his or her own. Make sure the students understand where they are on the map.
2. When the maps are complete, briefly describe the experiment. Tell them the idea is to record when they first smell an odor and to measure how strong it is at various times. Go over the time and intensity (strength) measurements and make sure everyone understands how to fill out his or her worksheet.
3. Remove the covers from the sources throughout the room containing the liquids. Leave the containers uncovered for 2 minutes before beginning exercise. Announce the time every 30 seconds (for example, "A" on the worksheet would be T+30 seconds; "B" would be T+60 seconds, and so on). Remind students to find their Place on their worksheet map and fill in the letter (time) and number (intensity) the **FIRST TIME** they smell an odor. If they detect more than one odor, they should fill in the letter (time) and number (intensity) the first time they smell **EACH** odor.
4. At the end of two minutes, cover all the sources again.
5. Call on a number of students in different parts of the room. (If time permits, let all students participate.) Have each, in turn, come forward and mark their location (in colored chalk) on each of the maps on the board with the time and intensity information they have recorded on their worksheet.

### **Closing:**

1. Lead a student discussion of the results of the experiment. Ask why some students recorded stronger odors sooner than others. Did the odor move in one direction more than another?
2. If so, what does that suggest about the way pollutants move in the air? Did anyone detect more than one odor? Where did the odor(s) come from? The students' answers should point you to the real sources. (If not, be prepared to point out the real sources and explain how real scientists might use additional trials or put out more monitors to be sure the results are accurate.)
3. Describe why it is necessary to determine where contaminants, particularly invisible ones, are coming from (health effects, environmental and ecological effects). Give some examples. Explain that if the contaminants in the experiment had been harmful, finding out where they were coming from would make it possible for their local officials and EPA to take steps to remove them.

### **EXTENSIONS (OPTIONAL)**

- Expand the discussion following the experiment by suggesting variables (open door or window, fans, air conditioning, more people in the room, etc) that could influence the

path and speed with which the odor moves. Encourage the students to discuss the potential impact of these variables and, by extension, how variables complicate the process of monitoring air pollution. Students could journal for homework.

- Ask the students how they might design a monitoring system that could locate the worst source (that which releases the highest volume) of a pollutant among multiple emission sources of the same pollutant? Suggest that they use the classroom model to help structure their thinking.
- Students could research the threshold limits for normal household items and different air pollutants, comparing them to what they smelled today.

\* Adapted from Project A.I.R.E. (Air Information Resources Education). Visit [www.epa.gov/region1/students/teacher/aire.html](http://www.epa.gov/region1/students/teacher/aire.html) for more educational exercises.

STUDENT WORKSHEET  
**WHERE'S THAT ODOR?**  
 CLASSROOM MAP

			Front of Classroom				
			Back of Classroom				

**TIME**

A= \_\_\_\_\_

B= \_\_\_\_\_

C= \_\_\_\_\_

D= \_\_\_\_\_

**INTENSITY**

1		NO ODOR DETECTED AT ALL
2		BEGIN TO SMELL THE ODOR
3		ODOR IS STRONG
4		ODOR IS VERY STRONG

Table 1: Sources of Air Pollution and Their Health Effects

Pollutant	Description	Sources	Effects
Carbon Monoxide (CO)	Colorless, odorless gas	<ul style="list-style-type: none"> <li>• Vehicles (e.g., lawn mowers, motorcycles)</li> <li>• Indoor sources including kerosene, wood-burning, natural gas, or coal-burning stoves and heaters</li> </ul>	<ul style="list-style-type: none"> <li>• Headaches</li> <li>• Reduced mental alertness</li> <li>• Heart damage</li> <li>• Death</li> </ul>
Lead (Pb)	Metallic element	<ul style="list-style-type: none"> <li>• Vehicles burning leaded gasoline</li> <li>• Metal refineries</li> </ul>	<ul style="list-style-type: none"> <li>• Brain and kidney damage</li> <li>• Contaminated crops and livestock</li> </ul>
Nitrogen Oxides (NO <sub>x</sub> )	Gaseous compounds composed of nitrogen and oxygen	<ul style="list-style-type: none"> <li>• Vehicle exhaust</li> <li>• Power plants burning fossil fuels</li> <li>• Coal-burning stoves</li> </ul>	<ul style="list-style-type: none"> <li>• Lung damage</li> <li>• Reacts in atmosphere to form acid rain</li> <li>• Deteriorates buildings and statues</li> <li>• Damages forests</li> <li>• Forms ozone and other pollutants (smog)</li> </ul>
Ozone (O <sub>3</sub> )	Gaseous pollutant; smog	<ul style="list-style-type: none"> <li>• Vehicle exhaust and certain other fumes</li> <li>• Formed from other air pollutants in the presence of sunlight</li> </ul>	<ul style="list-style-type: none"> <li>• Lung damage</li> <li>• Eye irritation</li> <li>• Respiratory tract problems</li> <li>• Damages vegetation and crops</li> </ul>
Particulate Matter (PM)	Very small particles of soot, dust, or other matter, including tiny droplets of liquids	<ul style="list-style-type: none"> <li>• Diesel engines and vehicle exhaust</li> <li>• Power plants</li> <li>• Industries</li> <li>• Wood stoves</li> </ul>	<ul style="list-style-type: none"> <li>• Heart and lung damage</li> <li>• Eye irritation</li> <li>• Reduces visibility</li> <li>• Discolors buildings and statues</li> </ul>
Sulfur Dioxide (SO <sub>2</sub> )	Gaseous compound composed of sulfur and oxygen	<ul style="list-style-type: none"> <li>• Coal-burning power plants and industries</li> <li>• Coal-burning stoves</li> <li>• Refineries</li> </ul>	<ul style="list-style-type: none"> <li>• Eye irritation</li> <li>• Lung damage</li> <li>• Kills aquatic life</li> <li>• Reacts in atmosphere to form acid rain</li> <li>• Damages forest</li> <li>• Deteriorates buildings and statues</li> </ul>



#### OBJECTIVE

Students will discover that ground-level ozone occurs in many areas of the country and that ground-level ozone problems are often associated with high-population centers.

#### MATERIALS

- Printed color copies of the two AQI color charts on the *Air Quality Index (AQI)—A Guide to Air Quality and Your Health* Web page; or students can access the charts from the Internet at: <http://www.airnow.gov/index.cfm?action=aqibasics.aqi>
- Internet access or color copies of the Ozone Map at: <http://www.k12science.org/curriculum/airproj/airqualitymap.htm> or they can use the [www.airnow.gov](http://www.airnow.gov) website for realtime data.
- Student Worksheet and Teacher Answer Sheet (included)

#### DURATION

30 minutes

#### VOCABULARY

Chemical Reaction

Ozone

Air Quality Index

#### BACKGROUND

Ozone is a gas consisting of three oxygen atoms. Ozone can be good or bad depending on where it is in the atmosphere. "Good" ozone occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface. This good ozone forms a layer that protects life on earth from too much of the sun's harmful ultraviolet rays.

Ozone at "ground-level"—that is, in the earth's lower atmosphere—is bad because it pollutes the air. Ozone pollution can cause people to have breathing problems. An easy way to remember these differences about ozone is: "good up high, bad nearby."

Ground-level ozone comes mostly from motor vehicles that we drive, factories that make products we use, and power plants that produce our electricity. Ozone pollution is not produced directly from these sources. Rather, heat and sunlight "bake" certain other chemicals (nitrogen oxides, or  $\text{NO}_x$ , from vehicles and power plants; and volatile organic compounds, or VOCs, from gasoline-powered cars, factories, and products such as paints), which causes a chemical reaction and produces ozone. Weather is an important factor in ozone formation—more ground-level ozone usually is formed in

summertime, when there is the most heat and sunlight. Also, wind can transport ozone "downwind" to other areas far from where it was formed, and pollute those areas.

This Internet activity allows students to explore the different concentrations of ground-level ozone in various areas of the country and develop an understanding of why more ground-level ozone may occur in certain areas.

### Key Questions:

- Do people contribute to ground-level ozone pollution when they drive or ride in cars? (*Correct answer: Yes*) When they ride bicycles? (*Correct answer: No*) When they walk? (*Correct answer: No*)
- In what parts of the country do you think ozone pollution might be the worst? Why? (*Possible answers: In cities; in places where the wind has blown the ozone pollution; in places with a lot of cars and/or factories.*)

### Vocabulary:

**Chemical reaction**—A change that takes place when two or more substances interact to form a new substance.

**Ozone**—A gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone can be "good" or "bad" for people's health and the environment, depending on its location in the atmosphere. High up in the atmosphere, ozone helps protect people's health from too much ultraviolet radiation from the sun. Near the Earth's surface, ozone is an air pollutant that can result in breathing difficulties.

**Air Quality Index (AQI)**—A color-coded scale that provides daily air quality and health information.

### PROCEDURES AND ACTIVITIES:

1. If you are using printed color copies of the AQI color charts on the *Air Quality Index (AQI)—A Guide to Air Quality and Your Health* Web page, hand them out to the class. If you are using the Internet to access the charts, tell students to go to: <http://www.airnow.gov/index.cfm?action=aqibasics.aqi> (The rest of the page can be used for additional background information.)
2. Explain to the class what the Air Quality Index (AQI) is while having them look at the AQI Color Chart. Tell students that the Air Quality Index, or AQI, is an index for reporting daily air quality. It uses a simple color-coded scale to tell you how clean or polluted the air in a particular location is, and how you can protect your health at different levels of pollution. There is an AQI for five pollutants, one of which is ground-level ozone, which we are discussing in this lesson. The AQI is like a yardstick

that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 200 represents very unhealthy air quality. (Note: More information on the AQI is available on the rest of the Guide page and at [www.airnow.gov](http://www.airnow.gov).)

3. Have students answer Questions 1-5 on the Student Worksheet, using the AQI color charts and the Ozone Map or have them use the [www.airnow.gov](http://www.airnow.gov) website.
4. Review students' answers for Questions 1-5 on the Student Worksheet with the class.
5. Give students time (approximately 5 to 10 minutes) to answer Questions 6 and 7.
6. As a class, discuss students' answers to Questions 6 and 7.

## EXTENSIONS

- Have students explore different cities around the country and record the information. More information about ground-level ozone is available on the AIRNow Web site ([www.airnow.gov](http://www.airnow.gov)). Have students explain differences and the reason for the seasonal ozone values.
- Have students explore "nitrogen oxides" (NO<sub>x</sub>) and Volatile organic compounds" (VOCs) on the AIRNOW website for several cities throughout the country. Have the students explain why they might see differences.

## ACKNOWLEDGEMENTS:

1. *Air Pollution: What's the Solution?* project, developed by the U.S. EPA, the Northeast States for Coordinated Air Use Management, and the Center for Innovation in Engineering + Science Education. See:  
<http://www.k12science.org/curriculum/airproj/airqualitymap.htm>
2. AIRNow program. The Air Quality Index (AQI) is always available at the AIRNow Web site at: <http://www.airnow.gov/>
3. Walking for Health and the Environment Curriculum, by Walk Boston and ERG. Web site: [www.walkboston.org/work/safe\\_routes.htm#](http://www.walkboston.org/work/safe_routes.htm#)

\*Adapted from the AQI Toolkit for Teachers ([http://airnow.gov/index.cfm?action=resources.aqi\\_toolkit](http://airnow.gov/index.cfm?action=resources.aqi_toolkit))

Student Worksheet: The Ozone Between Us

Name \_\_\_\_\_

**Ozone Map**

Look at the AQI color charts then look at the "Ozone Map" and answer the following questions:

1. Next to each Air Quality category listed below, write the name of the color that is used on the map for that category:

Air Quality Category	Color Used
Good	
Moderate	
Unhealthy for Sensitive Groups	
Unhealthy	
Very Unhealthy	

2. Find your school's city on the Ozone Map? What is the air quality level for your city?
3. Find Los Angeles, CA on the Ozone Map. What is the air quality in Los Angeles? Circle:  
Good Moderate Unhealthy for Unhealthy Very Sensitive Groups Unhealthy
4. Find another city on the map that has the same air quality as Los Angeles. Write the city and state below.
5. Find two cities on the map where the air quality is "unhealthy for sensitive groups." Write the city names and states below.
6. Where are the most of the red and orange areas on the map, near or far away from cities?
7. Write a sentence that compares the kinds of places where good air quality is found and the kind of areas where unhealthy air quality is found. Why do you think that is?
8. Go to [airnow.gov](http://airnow.gov) and find out the actual air quality for the questions above.

## The Air Quality Index (AQI)

AQI Category	Color	Numerical Value	Health Concerns
Good	Green	0-50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	Yellow	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	Orange	101-150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	Red	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	Purple	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	Maroon	>300	Health warnings of emergency conditions. The entire population is more likely to be affected.

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#### OBJECTIVE

Students will identify some of the health symptoms associated with specific air pollutants and identify preventative measures that people can take to protect their health.

#### MATERIALS

- Background Reading: What are the Health Impacts of Air Pollution? (one for each student)
- Pollutants Chart: Sources and Effects of Air Pollutants
- Group Task Cards
- Symptoms Scenarios A, B and C
- Student Worksheet & Teacher Answer Sheet #1: What are the health Impacts of Air Pollution?
- Students Worksheet & Teacher Answer Sheet # 2: Which Pollutant?

#### DURATION

2 class periods or  
90 minutes

#### VOCABULARY

Ethical  
Ozone pollution  
Precursor  
Particle pollution  
React

#### BACKGROUND

Breathing clean air is important to maintain our health. Millions of Americans live in areas where the air is sometimes considered unhealthy to breathe because it is polluted. One common air pollutant is ground-level ozone. The effects of ground-level ozone pollution are different than the effects of the ozone layer high up in the atmosphere, which helps protect us from receiving too much of the sun's ultraviolet radiation. At ground level, ozone can cause breathing difficulties, aggravate lung diseases, such as asthma, and may cause permanent lung damage. An easy way to remember the different types of ozone is: "Good up high, bad nearby." Ground-level ozone pollution is formed when certain pollutants, known as precursors, are released from vehicles, industries, and power plants, and in the presence of sunlight and heat react together to form ozone.

Another common air pollutant is particle pollution, which can cause breathing difficulties, aggravate heart disease as well as lung disease, and may cause chronic bronchitis or reduced lung function in children. Particle pollution consists of tiny particles of dust, dirt, smoke, and liquid droplets that contain chemicals.

In this lesson, students first read background materials about the health impacts of air pollution, followed by a teacher-led discussion. Students then role-play realistic case studies, as patients with health symptoms and their family members. The rest of the

class interviews the patient and family members to try to determine which air pollutant may have caused the symptoms. The class then discusses what they can do to protect their health when air quality is poor.

## VOCABULARY

**Ethical**—Behavior considered good or right.

**Susceptible**—Vulnerable or predisposed to certain effects. A member of a population who is at risk of getting a disease or illness if exposed to something that causes the disease or illness.

**Ozone pollution**—Ozone is an air pollutant when near the Earth's surface. (In contrast, in the Earth's upper atmosphere, ozone protects people from receiving too much ultraviolet radiation from the sun.)

**Particle pollution**—Tiny particles of dust, dirt, smoke, and liquid droplets in the air.

**Precursor**—A compound that participates in a chemical reaction that produces another compound.

**React**—When two or more chemicals interact and form a new product.

## PROCEDURES AND ACTIVITIES

### Anticipatory Set:

1. Ask students if they think air pollution levels in your area could be high enough to affect people's health. If so, what might some sources of air pollution be? Hold a brief class discussion of their answers. (*Possible answers:* Cars and other vehicles, dust from construction sites, smokestacks from factories and power plants, yard burning, fireplaces and wood stoves. Also see the enclosed Pollutants Chart: Sources and Effects of Air Pollutants.)
2. Either as homework the night before or in-class, have students read Background Reading: What Are the Health Impacts of Air Pollution and Pollutants Chart: Sources and Effects of Air Pollutants. Then have the students complete Student Worksheet #1: What Are the Health Impacts of Air Pollution? Tell students to keep all three of these items for future use.
3. Hold a brief class discussion of the reading, chart, and students' Worksheet #1 responses. Discussion could include teacher prompts such as: Did you know about the health effects of air pollution discussed in the Background Reading and the Pollutants Chart? Were you surprised at any of these health effects? Have you or anyone you've known experienced any of these effects?
4. Select 12 students and divide them into three groups of four students each for role-playing.

5. Distribute materials (below), some to the groups and others to the rest of the class, as indicated:
  - a. To the three groups of role-playing students:
    - i. Symptoms Scenario (hand out Scenario A to one group, Scenario B to a second group, and Scenario C to the third group)
    - ii. Group Task Cards (after cutting them to size, give a full set of 4— Patient, Family Member (or Second Patient), Class Monitor, and Scribe—to each group)
  - b. To the rest of the class:
    - i. Student Worksheet #2: Which Pollutant? (one for each student)
    - ii. Background Reading, Pollutants Chart, and Student Worksheet #1 (previously distributed; provide to students who don't have these with them, if done as homework)
6. While the rest of the class is reviewing the materials distributed in Step 5, explain to students in the three role-playing groups that each member of their group will choose and assume a specific responsibility, as defined on the Group Task Cards, and will present their Scenario to the class.
7. Explain that one "patient" and one "family member" (or, "second patient") from each group will introduce themselves to the class (acting skills welcome!) based on the information in their Symptoms Scenario. Another group member will act as class monitor, maintaining order during questions and answers; and another will act as scribe, writing answers on the board. Each of the cards describes the tasks in more detail.
8. Give the groups time to prepare (5 to 10 minutes), allowing them to briefly read and discuss their Symptoms Scenario and Group Task Cards amongst themselves to prepare for their presentations, while the rest of the class continues to review the materials distributed in Step 5 and proceeds to activity.

**Activity:**

1. Tell students in the audience that they are going to be "doctors" trying to determine the pollutant most likely associated with or causing the symptoms presented. Tell them to listen carefully to each of the three presentations and make doctor's notes on Worksheet #2: Which Pollutant?, as they listen. Tell them they will be asking the patient and family member in each group questions to help the class come up with answers.
2. Have the first group present its Symptoms Scenario to the class. Assist the group as needed.

3. After the presentation, tell the rest of the class to go ahead and ask “doctor” questions to try to determine possible causes of the symptoms. Tell them they can use their Student Worksheet #2: Which Pollutant?, the Pollutants Chart, and the background reading as guides. Have the presenters respond. Assist the class as needed in asking targeted questions to obtain pertinent information included in the Symptoms Scenarios. Each presenter should respond as best they can, based on their Scenario. Other members of their group (e.g., family member, class monitor, scribe) can help them answer questions.
4. At the beginning of this Step, give the role-playing groups the Pollutants Chart and Student Worksheet #2 so they have the same information as the rest of the class.
5. After a reasonable amount of time questioning the Scenario presenter group, have the class as a whole (presenting group, other groups, and audience) together continue to try to determine the pollutant associated with or causing the symptoms, as well as identify health prevention measures, with teacher guidance—but don’t tell students yet which pollutant it is or possible preventive measures.
6. See Teacher Answer Sheet #2: Which Pollutant? for information on symptoms and other “hints” of information that might be shared with the class at this point.
7. Discourage students from arriving at answers too quickly. Encourage questions about other aspects of the patient’s life (e.g., cigarette smoking) that could also be an influence. Inform students that even when air pollution is a primary factor, many other factors can still influence our health.
8. Have students write down their answers on Student Worksheet #2: Which Pollutants?
9. Repeat Steps with each of the other two groups.

### **Closing:**

1. Using Teacher Answer Sheet #2: Which Pollutants?, share and discuss the answers with the class, including the pollutant most likely associated with or responsible for each group’s symptoms/illness, and precautions that people can take to protect their health.

\*This lesson plan was from the EPA AQI Toolkit for Teachers. Visit [www.airnow.gov](http://www.airnow.gov) for more information or to see the complete toolkit.

## **Background Reading:**

# **What are the Health Impacts of Air Pollution?**

### **Air Pollution and Our Health**

Every minute of every day, we breathe six to ten liters of air. If the air carries unhealthy levels of pollutants, those pollutants can enter our bodies and affect us in many ways. Millions of Americans live where the air is often unhealthy to breathe. Enough people are affected so that the health impacts of air pollution costs us millions of dollars every year.

Air pollution is especially harmful to the very young and old. Infants and children are at risk because their lungs are not fully developed until they are about 18 years old and because they breathe faster. The elderly are at risk because they are more likely to have undiagnosed heart or lung disease.

Since the respiratory system comes in direct contact with the air we breathe, it is the body system most likely to be affected by air pollutants. People who already have asthma, emphysema, or other respiratory conditions, as well as people with heart or other circulatory problems, are especially susceptible to the effects of air pollution.

Even healthy people can be affected by air pollution. Air pollution can affect anyone. Healthy teenagers, young adults, and strong athletes can suffer negative effects from high pollution levels, especially when exercising outdoors.

### **A Tricky Question**

It's a real challenge for scientists to study the health effects of different air pollutants. It wouldn't be ethical for researchers to put people in a lab and expose them to high levels of a pollutant. Also, outside the lab, people who live in heavily polluted areas are exposed to not just one pollutant but to many pollutants. And, the concentration of each pollutant changes during the day. All of this makes it difficult to separate out the effects of each pollutant.

In addition, how susceptible people are to the effects of air pollutants can vary widely. Think about a roomful of healthy people who are all exposed to the same cold virus. Some will develop a bad cold, others a mild cold, and others no cold at all. In a similar way, susceptibility to pollutants can vary greatly even among a group of healthy individuals.

Finally, there are always many influences on our health. If you develop symptoms that might be caused by air pollution, it's often difficult to be sure that pollution was "the"

cause. Just as with other health problems, there are likely to be several factors affecting your health.

### **How Much Do We Know?**

One way to study the relationship between air pollution and health is to compare hospital records and death records to pollutant levels. Researchers have found that during extreme air pollution events, hospital admissions for respiratory problems increase. Death rates also increase, especially among the elderly and those who already have circulatory or respiratory problems.

Another type of research involves evaluating the physiological effects of exposure to pollution. In general, we know that exposure to irritants in the air can cause inflammation and bronchio-constriction of the airways and reduce the effectiveness of bacteria-destroying white blood cells. Irritants can also increase production of mucous, which, although annoying, helps the cilia clear out the airways. Normally, the cilia of the epithelial cells in the airways make sweeping movements to keep the airways clean. The cilia move mucous, along with germs and dirt caught in the mucous, out of the respiratory tract. Air pollutants can irritate or kill the cells with cilia, so that the cilia's protective action slows down or even stops. This leaves sensitive tissues unprotected. Then microorganisms and bits of foreign matter in the air are more likely to remain in the lungs and can cause infections.

Although the part of our bodies most affected by air pollution is the respiratory system, the circulatory system can also be affected. Exposure to unhealthy levels of air pollutants can result in low oxygen levels in red blood cells, abnormal heart rhythms, and increased risks of blood clots and narrowing of blood vessels. These effects can lead to worsening of heart diseases such as heart failure and increased risks of heart attacks or strokes.

*The Pollutants Chart: Sources and Effects of Air Pollutants* summarizes the sources and health effects of two air pollutants: particle pollution and ground-level ozone. When we inhale particle pollution (dust, soot, dirt, and liquid droplets, which may or may not be visible), tiny bits of foreign matter can travel deep into the lungs where they become lodged in the alveoli, which are small balloon-like sacs in which oxygen exchange occurs. This is where carbon dioxide from the blood is exchanged for oxygen from the air. Some particles can be exhaled or moved out by the cilia; other particles may sink into underlying tissue or move into the blood stream. Health effects from particles range from coughing and aggravated asthma to chronic bronchitis and even premature death. For people with heart disease, exposure to particle pollution can cause serious problems in a short period of time—even heart attacks—with no warning signs.

Ozone pollution, which is invisible, can irritate the respiratory system, reduce lung function, inflame and damage the lining of the lungs and the cilia, and cause structural damage of the lungs. Ozone pollution can also reduce the number and functioning ability of bacteria-destroying white blood cells. Ozone pollution can aggravate asthma and increase people's susceptibility to respiratory illnesses like pneumonia and bronchitis. Symptoms to watch for when ozone is in the air include coughing, pain when taking a deep breath, and breathing difficulties, especially when active or exercising outdoors. But ozone damage can also occur without any noticeable signs. For some people, several months of repeated exposure to ozone can permanently damage the lungs.

It is important to know that ozone can have two very different effects, depending on where it is in the atmosphere. "Good" ozone occurs naturally high up in the atmosphere (the stratosphere), where it helps protect us from receiving too much of the sun's harmful ultraviolet rays. "Bad" ozone at ground level is air pollution, as we have been discussing, and can result in health and environmental problems. An easy way to remember the difference is: "Ozone: good up high, bad nearby."

### **The Air Quality Index (AQI)**

The Air Quality Index (AQI) provides information about the current day's and the next day's air quality and includes descriptions of associated health effects. Ground-level ozone and particle pollution are two of the five pollutants for which the U.S. Environmental Protection Agency calculates an AQI. The AQI is like a yardstick that runs from 0 to 500. The higher the number, the greater the air pollution. The AQI has six color-coded categories ranging from "Good" to "Hazardous." Each category corresponds to a different level of health concern. The chart below lists the AQI categories, their corresponding colors and numerical values, and associated health concerns for each category.

(Source: *Students For Clean Air. Clean Air Program*, Pima County Department of Environmental Quality, Tucson, Arizona)

## The Air Quality Index (AQI)

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Very Unhealthy	Purple	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	Maroon	>300	Health warnings of emergency conditions. The entire population is more likely to be affected.

## Pollutants Chart: Sources and Effects of Pollutants

Pollutant	Sources	Possible Effects on Humans	Other Effects	Comments
Particle pollution (also called PM or particulate matter)	<ul style="list-style-type: none"> <li>Dust</li> <li>Motor vehicle exhaust</li> <li>Factories</li> <li>Burning of coal for power</li> <li>Natural sources: forest fires, volcanoes</li> </ul>	<ul style="list-style-type: none"> <li>Irritates nose &amp; throat</li> <li>Difficult or painful breathing</li> <li>Coughing, chest tightness</li> <li>Reduces lung function</li> <li>Lowers resistance to respiratory infection</li> <li>Aggravates asthma and existing lung &amp; heart disease</li> <li>Chronic bronchitis or reduced lung function in children (long-term exposure)</li> <li>Premature death</li> </ul>	<ul style="list-style-type: none"> <li>Reduces visibility</li> <li>Discolors statues, buildings, painted surfaces</li> <li>Interferes with photosynthesis, may damage crops</li> <li>May alter climate</li> </ul>	<ul style="list-style-type: none"> <li>75% from motor vehicles</li> <li>Usually refers to particles less than 10 (PM10) or 2,5 (PM2.5) microns (1 micron=1/1,00,000 of a meter)</li> <li>Particle pollution is often worse in winter, and near busy roads or factories.</li> </ul>
Ground-level Ozone (O <sub>3</sub> )	<ul style="list-style-type: none"> <li>Formed when nitrogen oxides (NOx) and volatile organic chemicals (VOCs) react in heat and sunlight.</li> <li>Sources of NOx and VOCs include vehicle exhaust, industrial emissions, gasoline vapors, and chemical solvents.</li> </ul>	<ul style="list-style-type: none"> <li>Coughing, wheezing, pain with deep breathing, shortness of breath</li> <li>Nausea</li> <li>Irritates respiratory system, chest tightness</li> <li>Damages lung tissue</li> <li>Reduces lung function</li> <li>Aggravates existing lung diseases, including asthma</li> <li>Structural changes (long-term exposure)</li> <li>Premature death</li> </ul>	<ul style="list-style-type: none"> <li>Deteriorates rubber, paint some building materials</li> <li>Damages fruits and seeds</li> <li>Injures crops and trees</li> <li>Affects whole eco-systems by altering wildlife habitat</li> </ul>	<ul style="list-style-type: none"> <li>Ozone pollution is often worse in warmer weather, in late afternoons and early evenings.</li> <li>Ozone is good up high in the upper atmosphere where it helps protect us from too much of the sun's harmful ultraviolet rays. Ozone is bad at ground level where it can result in health and environmental problems. Remember: "Ozone good up high, bad nearby".</li> </ul>

## Symptoms Scenario A

*Patient: Francisco (if man) or Francesca (if woman) Grijalva*

*Family Member: Jorge Grijalva (cousin)*

**Patient**—*Use this information to introduce yourself and your family member to the class:*

My name is Francisco (or Francesca) Grijalva. I used to be a runner years ago. I stopped for a few years, but took it up again last year. Lately I've been feeling short of breath in the middle of my run. This is my cousin Jorge, who is also my roommate. He'll tell you that I'm a pretty serious runner.

**Patient and Family Member**—*Use this information to answer class questions about the patient:*

- 34 years old
- Lives and works in \_\_\_\_\_ [fill in name of nearby city or town]
- Works as a computer programmer
- Works with a small, independent company
- The office building he works in is well-ventilated
- Running is an important personal interest
- Other hobbies include hiking, bird-watching, and surfing the Net
- Smoked from age 14 to 16, but "I quit when I got smart enough to know better"
- Roommate smokes, but only outside, so Francisco is not breathing Jorge's smoke
- Ran pretty regularly from age 20 to around age 30
- Started running again last year, in December
- Ran in the early morning, about 6:00 to 6:30 a.m., all winter
- In April, started working an early schedule and running after work, around 2:00 pm
- Last winter, felt refreshed and really "up" after running, just like years ago
- Has been running very regularly and is confident he's in good shape
- Lately has been feeling short of breath halfway through a run
- He also notices that he seems to cough and needs to spit while running, which didn't happen before
- Has never had any lung or respiratory problems in the past
- Cousin Jorge will vouch that Francisco has been running as regularly as he says—five or six times a week, for over a year—so this can't be happening because he's in poor shape

## Symptoms Scenario B

*Patient: Chris Chapman*

*Family Member: Rose Chapman (his wife)*

**Patient**—Use this information to introduce yourself:

My name is Chris Chapman. I have been having chest pain and chest tightness for the last two or three months. Since these problems don't seem to be going away, I went to see my doctor last week. She told me that I have arrhythmia, which is an irregular heartbeat. I had a minor heart attack when I was 56, but have felt pretty good since then.

**Patient and Family Member**—Use this information to answer class questions about the patient:

- Chris is 62 years old
- He retired early, at age 50
- Never smoked cigarettes or anything
- Used to work for the city as a technician installing and repairing traffic lights
- They live in the city of \_\_\_\_\_ [fill in nearby city] because they like living near their children and grandchildren
- Love kids
- Every Monday through Friday, ever since retiring, Chris volunteers as a school crossing guard at a busy intersection, helping kids get across the street
- He does this for an elementary school and a middle school, that start at two different times, so he's out there almost two hours early each morning and two hours each afternoon
- Likes to wear white shirts, even though they always look really dirty after doing the crossing guard work
- They live in an apartment near the same intersection
- Several factories are nearby
- His hobbies include bowling, going to grandchildren's soccer and softball games, babysitting for the youngest granddaughter, and staying in close touch with world news
- Not really into exercise or working out
- Rose and Chris take a walk around the neighborhood a couple of times each week, usually right after he finishes crossing guard duty

## Symptoms Scenario C

*Patient: Jerry Wolak*

*Second Patient: Dot Wolak*

**Patient:** *Use this information to introduce yourselves:*

My name is Jerry Wolak and this is my wife Dot. We live in \_\_\_\_\_ [fill in nearby city or town]. We came back from our afternoon walk feeling just awful.

**Patient and Second Patient-** *Use this information to answer class questions about the patients:*

- He's 58 years old
- She's 48 years old
- They take a brisk walk together almost every day, in mid-afternoon
- Usually walk two miles, along a local canal, where it's quiet and there's no traffic
- Jerry's interests include cooking, woodworking, and fishing
- Dot's interests include painting and playing drums with a jazz band
- Today was a beautiful sunny day and the first really hot day of spring
- Today they took a different route than usual
- The traffic was backed up for several blocks on one road, and they were curious why, so they decided to turn up that road and see for themselves
- Ended up sitting by the road for an hour in the middle of the walk, talking with a friend who was stuck in the giant traffic jam
- Near the end of the walk, both Jerry and Dot started wheezing and coughing
- Dot was feeling some nausea
- Jerry felt like his asthma was acting up for the first time in years

## Group Task Cards

<p><b><u>Group Task Card:</u></b> <b><u>Patient</u></b></p> <p>You play the role of the primary character described on the Symptoms Scenario card. Using information on the card, you will introduce yourself to the class and then answer questions from them. A member of your family will help you answer questions. After some time has passed, if you feel that there is important information on your Scenario card that has not been covered by the question, you may decide to volunteer that information</p>	<p><b><u>Group Task Card:</u></b> <b><u>Family Member or Second Patient</u></b></p> <p>You will play the role of someone in the patient's family. The patient will introduce you to the class, using information on the Scenario card. You will then help the patient answer questions from the class. If questions are asked which are not covered on the Scenario card, you will consult with the patient about how to best answer the question (in a way that would not alter the conclusion reached by the class).</p>
<p><b><u>Group Task Card:</u></b> <b><u>Class Monitor</u></b></p> <p>It is your responsibility to maintain order and designate whose turn it is to ask a question. Call on those with their hand raised so that they can ask questions one at a time and everyone can hear the answers. You will want to pace the questions so that the scribe has time to write the answers on the board.</p>	<p><b><u>Group Task Card:</u></b> <b><u>Scribe</u></b></p> <p>You are responsible for writing information on the board as they patient and his or her family member answer questions from the class. Making a list of this info will make it easier for the class to focus on what they know so far, choose good questions to ask next, and determine the pollutant that is associated with or causing the patient's symptoms.</p>

## Student Worksheet #1: What are the Health Impacts of Air Pollution?

Name: \_\_\_\_\_

Complete this worksheet after reviewing *Background Reading: What Are the Health Impacts of Air Pollution?* and the *Pollutants Chart: Sources and Effects of Air Pollutants*. (Use the back of this page if more space is needed. )

1. How much air do we breathe every minute?
2. Which body system is most likely to be affected by air pollutants?
3. Who is affected by air pollution?
4. Why is it difficult to determine the health effects of different air pollutants?
5. Briefly explain how researchers study the health impacts of air pollution.
6. Which system, besides the respiratory system, can be affected by air pollution?
7. Describe the health effects of particle pollution.
8. Describe the health effects of ground-level ozone.

## Student Worksheet #2: Which Pollutant?

Name: \_\_\_\_\_

Refer to the *Background Reading: What Are the Health Impacts of Air Pollution?* and the *Pollutants Chart: Sources and Effects of Air Pollutants* as needed as you try to determine the following information about the "patients" in each group. Enter your answers for each patient below during group presentations and afterwards during class question and answer sessions. You will be seeking information about:

- **Symptoms**—Note key symptoms or behaviors in the patient.
- **Pollutant most likely to be associated with or causing symptoms**— Note the pollutant most likely to be associated with or cause these symptoms.
- **Health Precautions**—Note precautions that could have been taken to prevent or decrease the likelihood of the problem arising.

## Student Worksheet #2 Which Pollutant?

	Symptom Scenario A	Symptom Scenario B	Symptom Scenario C
	Francisco Grijalva (young adult runner)	Chris Chapman (crossing guard)	Jerry and Dot Wolak (middle-aged walkers)
Symptoms			
Pollutant most likely associated with symptoms			
Health Precautions			

## Teacher Answer Sheet #1: What are the Health Impacts of Air Pollution?

[Instruct students to complete Worksheet #1 after reviewing the *Background Reading: What Are the Health Impacts of Air Pollution?* and the *Pollutants Chart: Sources and Effects of Air Pollutants*]

1. How much air do we breathe every minute? *Answer:* 6 to 10 liters of air.

2. Which body system is most likely to be affected by air pollutants?

*Answer:* Since the respiratory system comes in direct contact with the air we breathe, it is the body system most likely to be affected by air pollutants.

3. Who is affected by air pollution?

*Answer:* Air pollution can affect anyone. People with lung disease (and heart disease, for particle pollution), children, adults who are active outdoors, and older adults are at greater risk from air pollution. But even healthy teenagers, young adults, and strong athletes can experience negative health effects from high levels of air pollution, especially when exercising outdoors.

4. Why is it difficult to determine the health effects of different air pollutants?

*Answer:* First, it would not be ethical for researchers to put people in a lab and expose them to high levels of a pollutant. Second, people who live in heavily polluted areas often are exposed to more than one pollutant. In addition, the concentration of each pollutant changes during the day. All of this makes it difficult to separate out the effects of each pollutant. Also, some people are more susceptible to the effects of air pollutants than other people.

5. Briefly explain how researchers study the health impacts of air pollution.

*Answer:* One way to study the relationship between air pollution and health is to compare hospital records and death records to pollutant levels. Researchers have found that during extreme air pollution events, hospital admissions for respiratory problems increase. Death rates also increase, especially among the elderly and those who already have circulatory or respiratory problems.

6. Which system, besides the respiratory system, can be affected by air pollution? *Answer:* The circulatory system.

7. Describe the health effects of particle pollution and ground-level ozone.

*Answer:* When we inhale particle pollution, tiny particles get deep into the lungs. Particle pollution can:

- Irritate the eyes, nose, and throat
  - Produce coughing and phlegm
  - Result in chest tightness and breathing difficulties
  - Aggravate lung disease (including asthma) or heart disease
  - Reduce lung function in children (long-term exposure)
  - Cause chronic bronchitis (long-term exposure)
  - Result in premature death
- When we inhale ozone, we may experience:
- Coughing, wheezing, shortness of breath
  - Throat irritation, chest tightness
  - Pain with deep breathing
  - Reduced lung function
  - Aggravated lung disease, including asthma
  - Structural changes of the lungs (long-term exposure)
  - Premature death
- Aggravation of heart or lung disease can lead to:

**From exposure to ozone-**

- Increased medication use
- Increased school absences
- More doctor visits

**From exposure to both particle pollution and ozone-**

- More symptoms of ill health
- More emergency room visits
- Increased hospital admissions
- Increased number of deaths

## Teacher Answer Sheet #2: Which Pollutant?

Note: Instructions to students on Student Worksheet #2 are: Refer to the *Background Reading: What Are the Health Impacts of Air Pollution?* and the *Pollutants Chart: Sources and Effects of Air Pollutants* as needed as you try to determine the following information about the "patients" for each group. Enter your answers for each patient below during group presentations and afterwards during class question and answer sessions. You will be seeking information about:

- **Symptoms**—Note key symptoms or behaviors in the patient
- **Pollutant most likely associated with or causing symptoms**—Note the pollutant this is most likely to be associated with or causing these symptoms
- **Health Precautions**—Note precautions that could have been taken to prevent or decrease the likelihood of the problem arising

1. **Symptoms Scenario A: Francisco** (or Francesca) Grijalva (young adult runner)

**Symptoms:** Feeling short of breath, coughing and spitting while running, symptoms occurring during outdoor exercise on summer afternoons

**Pollutant most likely associated with or causing symptoms:** Ground-level ozone

**Health Precautions:** Exercise outdoors in the early morning before ozone levels begin to rise

**Teacher Notes for Discussion of Symptoms Scenario A:** Exposure to high ground-level ozone concentrations can affect even healthy teens and active adults. In this scenario, the time of day and time of year during which the problem occurs provide clues that ground-level ozone, rather than another pollutant, is likely to be responsible.

2. **Symptoms Scenario B: Chris Chapman** (crossing guard)

**Symptoms:** Chest pain and chest tightness, previous heart attack, white shirt gets dirty after crossing guard work

**Pollutant most likely associated with or causing symptoms:** Long exposure to high levels of air pollutants, especially particle pollution, from work installing traffic lights, working as a crossing guard, and taking walks in the area.

**Health Precautions:** Check the AQI when particle pollution is "Unhealthy." Be sure to take walks on less busy roads with less traffic pollution. (And don't wear white shirts!)

**Teacher Notes for Discussion of Symptoms Scenario B:** The busy traffic intersection and the presence of several factories in the area are indications that high amounts of particle pollution may be present. Also, particle pollution can be high at any

time of day or year, even early mornings, and in winter (while ozone is usually higher in the afternoons and evenings, in warmer weather.)

3. **Symptoms Scenario C: Jerry and Dot Wolak** (middle-aged walkers)

**Symptoms:** Wheezing and coughing, feeling queasy, asthma acting up

**Pollutant most likely associated with causing symptoms:** Ground-level ozone

**Health Precautions:** Avoid exercising along busy roads. Avoid exercising during the times of day when ozone levels are highest (which is late afternoon or early evening).

**Teacher Notes for Discussion of Symptoms Scenario C:** The time of day (mid-afternoon) and the fact that it's a warm, sunny day are clues that ozone is the problem, in addition to the actual physical symptoms. Even young, trained endurance athletes can suffer similar symptoms at unhealthy ozone levels.



### **HEALTH MODULE EXTENSIONS**

You can assign these research activities to students as a means to reinforce the lessons learned in class. Students can work on these assignments individually or in small groups.

1. Have students research more about lung and heart diseases. Find out more about other respiratory or heart diseases that are affected by air pollution.
2. Ask students to research more about why their health as young people is impacted by certain environmental conditions more so than healthy adults.
3. Have students research more about asthma and what can either "trigger" an asthma attack or exacerbate asthma symptoms.
4. If the students know someone with asthma who doesn't mind sharing this information, have them interview the person about their asthma triggers, and ask whether they notice certain environmental triggers that worsen their asthma. Ask about what it feels like when they have an asthma attack and how they manage their asthma.
5. Research other sources of "particulate matter," such as second-hand smoke, coal plants, and wood stoves.
6. The earth's ozone layer occurs naturally in the stratosphere and provides a protective layer shielding the Earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant, a greenhouse gas, and a major component of smog. What are some of the sources for tropospheric ozone? Have the students identify some of the common sources found in their community.

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### **GOAL OF MODULE:**

By doing the activities outlined in this module, your students will learn

- About the impacts of air pollution and the science behind it
- How reducing idling from vehicles can improve air quality
- To think critically and problem-solve

### **BACKGROUND:**

#### **Auto Exhaust Contributes to Air Pollution\***

Automobiles emit several pollutants that EPA classifies as probable or definite carcinogens, including benzene, formaldehyde, acetaldehyde, and particulates (a.k.a. as particulate matter), like soot or smoke, especially from diesel vehicles. EPA estimates that toxic emissions from cars, trucks, and buses could be responsible for as many as 1,500 cases of cancer each year.

In addition, automobile exhaust contains hydrocarbons and nitrogen oxides that react with sunlight to create ozone, the major component of smog. Ozone at ground level is responsible for choking, coughing, and stinging the eyes associated with smog. Ozone also inhibits plant growth and can cause widespread damage to crops and forests. In typical urban areas, at least half of the hydrocarbons and nitrogen oxides come from motor vehicles. Nitrogen oxides also are produced by power plants, factories, and even lawnmowers. Hydrocarbons are found in many consumer products, including paints, hair spray, charcoal starter fluid, solvents, and plastic "bubble" packaging. EPA sets national standards for ozone (one of the six widespread "criteria pollutants"), and the states must take action to ensure that standards are met. Areas that fail to meet the standards for at least one criteria pollutant are called "non-attainment areas."

#### **Smog Clean-up Approaches\***

Many of the smog clean-up requirements involve motor vehicles (cars, trucks, buses) because virtually everyone is exposed to their emissions. Also, as the pollution gets worse, pollution controls are required for smaller sources. Strategies that may be required by law to reduce and control toxic emissions include state permitting programs, changes in the composition of gasoline, use of alternative fuels (such as natural gas and electricity), and use restrictions imposed by individual communities.

Many new and innovative approaches are being taken by local governments across the country to reduce air pollution in non-attainment areas. Some of these options include:

- Banning charcoal barbecues and wood burning in stoves or fire places when pollution levels are high
- Developing high-occupancy vehicle (HOV) programs for local highways to encourage car pooling
- Restricting traffic in specific areas of the city
- Providing incentives for citizens to use public transportation systems
- Expanding public transportation systems using clean-fueled vehicles, such as municipal buses that use compressed natural gas (CNG) or electric trolley buses
- Eliminating payments by employers that reduce parking costs of employees who do not car pool
- Requiring employers to contribute to employee mass transit costs
- Assessing "smog fees" on cars in proportion to the number of miles driven and vehicle emissions produced
- Requiring more stringent vapor recovery at gas stations
- Requiring large companies to purchase fleet cars that run on clean fuel
- Buying and scrapping older cars.

**Visit the Following Sites for More Info on the Following Topics**

- Energy and why it is needed [www.fossil.energy.gov/education.index.html](http://www.fossil.energy.gov/education.index.html)
- Different fuels used in transportation and how they relate to energy [www.rqriley.com/energy.htm](http://www.rqriley.com/energy.htm)
- How a diesel engine works (compression ignition) and how gasoline engine works (spark ignition) [www.auto.howstuffworks.com/diesel.htm](http://www.auto.howstuffworks.com/diesel.htm)
- How a gasoline engine works [www.auto.howstuffworks.com/engine.htm](http://www.auto.howstuffworks.com/engine.htm)

\* From Project A.I.R.E. (Air Information Resources Education). Visit [www.epa.gov/region1/students/teacher/aire.html](http://www.epa.gov/region1/students/teacher/aire.html) for more educational exercises.



## OBJECTIVE

This exercise will introduce the students to the 6 major air pollutants. They will complete a graphic organizer related to the six pollutants and how idling contributes to pollution.

## MATERIALS

Computer and access to the internet

Reproducible #1 Graphic Organizer: Air Pollutants

Reproducible #2 Graphic Organizer: Persuasive Organizer

Reproducible #3 Graphic Organizer: Persuasive Essay: Student Directions

Reproducible #4 Graphic Organizer: Persuasive Essay: Rubric

## DURATION

2-45 minute  
classes

## VOCABULARY

Air Pollution  
Idling  
Smog

## PROCEDURE AND ACTIVITIES

### Anticipatory Set: (Idling Discussion)

1. Ask students: What does idle mean? Solicit responses.
2. Have students run in place for 1 minute. Ask them if they traveled anywhere. Ask them if this was a waste of energy. If they were outside and needed to run a distance, would it make sense to run in place before they started traveling? Why would this idea be using a lot of energy wastefully?
3. Now, think about a vehicle. What does a vehicle do? Gets you from place to place. Does it make sense to simply let your vehicle run in place without going anywhere? Why is it a bad idea? Why do you think people would do this? When people do this, they are idling. This is expending energy. In a vehicle this idling contributes to air pollution.
4. Have you noticed any cars idling at our school? Lead students to a discussion about the car rider lane. Is this good for us?? Could you use the power of your writing to inform others about the negative impact of their actions and try to influence them to stop idling?

### Activity One:

1. Divide students into groups of 3 or 4. Provide each student with **Reproducible#1 Six Major Air Pollutants** and assign each group one of the six air pollutants (Ozone, Carbon Monoxide, Nitrogen Oxide, Sulfur Dioxide, Particulate Matter, Lead).

2. Have each group research the causes and effects of each air pollutant at the following websites:
  - a. <http://www.epa.gov/air/urbanair>
  - b. <http://www.epa.gov/airnow/aqikids/index.html>.
3. Students will share their findings with the class and compile information into one graphic organizer on the board. All students should add missing information to their own organizer.
4. As a class, discuss the information and talk about how reducing idling would reduce pollutants in the air.

### **Activity Two: Transferring to Persuasive Organizer**

1. Pass out **Reproducible #2: Persuasive Organizer** to each student.
2. Let the students know that they will be writing a persuasive essay on why it is important to reduce how much we idle our cars. They will categorize facts into 3 reason categories such as health-related, environment and economic.
3. Students should select 3 specific facts for each reason category. Allow them to answer these sheets using information gathered during activity one.  
Next, inform the students that they will use **Reproducible #2: Persuasive Organizer** to help them write a persuasive essay. Then pass out **Reproducible #3 Persuasive Essay: Student Directions** and explain the directions.
4. To follow the writing process you may have students complete a rough draft, edit, and revise.  
Refer to **Reproducible #4 Persuasive Essay: Rubric** to grade the essays.

### **Closing:**

1. Ask students the following questions:
2. What are the 6 major air pollutants?
3. How does idling contribute to air pollution?
4. Are graphs an effective way to communicate information about idling at our school?
5. Did you see trends and/or patterns when you analyzed the data?
6. How do you think education and awareness will reduce idling at our school?
7. What else can we do to promote "No Idling" at our school?

## RESOURCES

<http://www.epa.gov/air/urbanair>

<http://www.epa.gov/airnow/aqikids/index.html>

<http://www.cleanaircampaign.com/Kids-Schools/The-Clean-Air-Schools-Program/Program-Components/No-Idle-Program>

<http://www.cleanaircampaign.com/Air-We-Breathe/The-Truth-About-Idling>

<http://www.idlefreevt.org>

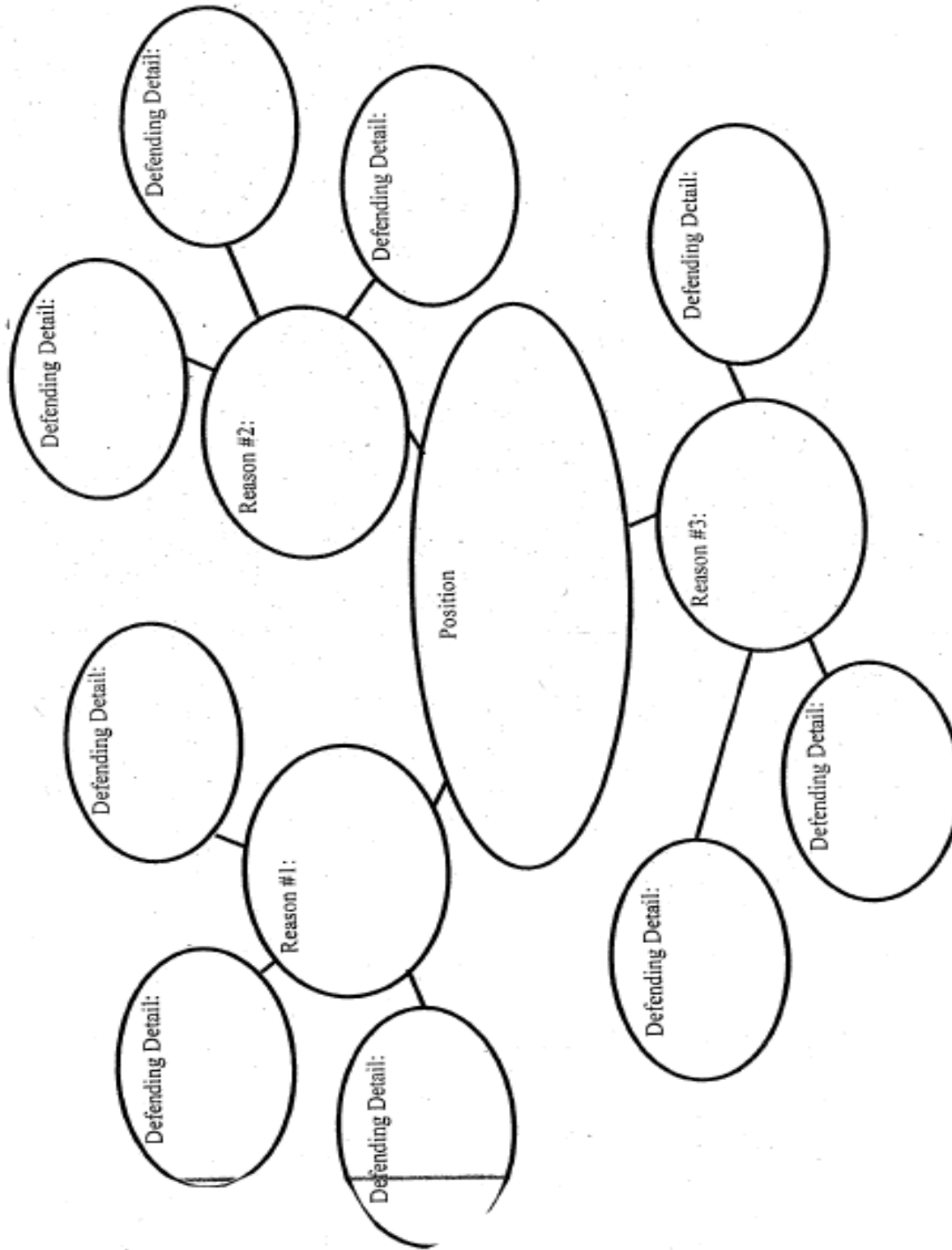
<http://www.mass.gov/dep/air/community/schbusir.htm>

\*From the Earth Day Network Anti-Idle Campaign ([www.earthday.net/education](http://www.earthday.net/education))

## Six Major Air Pollutants

Pollutant	Causes	Effects
Ozone		
Carbon Monoxide		
Nitrogen Oxides		
Sulfur Dioxide		
Particulate Matter		
Lead		

# Persuasive Organizer



### **Student Directions: Persuasive Essay**

1. Create a persuasive essay to convince the community to reduce idling.
2. The paper should have a clear title and introduction that lists your 3 primary reasons why drivers should not idle.
3. Your paper needs to have a body paragraph for each of the 3 primary reasons and they need to be filled with substantiating data.
4. Your paper should have a conclusion that reaffirms your position on no idling and summarizes the three reasons.
5. Your paper should be easy to read and evidence of editing and revision should be present. You should strive for clarity in your writing.
6. Your paper should be organized with an introductory paragraph, 3 paragraphs, and a concluding paragraph.

## RUBRIC

	4	3	2	1
<b>Persuasive Genre Attributes</b>	Position clearly stated and provided 3 substantiated reasons to support their Position.	Position clearly stated, however, fewer or unsubstantiated reasons	Position not clearly stated, however, fewer or unsubstantiated reasons	Position not clearly stated and reasons are unsubstantiated .
<b>Ideas</b>	There is evidence of at least 3 individual cohesive, well articulated ideas to support the topic.	Ideas do support the topic,, however, there too few in number or not well articulated	Ideas may not be well articulated. They may be repetitive, however, they do support the topic.	Ideas are not well articulated or cohesive. Ideas do not support the topic.
<b>Writing Conventions</b>	Variety of sentence structure Does not interfere with readability Subject/verb agreement Spelling Capitalization/Punctuation	Variety of sentence structure Several mistakes that could interfere with readability. Subject/verb agreement Spelling Capitalization/punctuation	Limited Variety of sentence structure Mistakes do interfere with readability Subject/verb agreement Spelling Capitalization/punctuation	Variety of sentence structure No present Does significantly interfere. not interfere with readability Subject/verb agreement Spelling Capitalization/punctuation
<b>Organization</b>	Paper has complete introduction, at least 3 supporting body paragraphs and a complete conclusion.	Paper has all components, however, one is not complete.	Paper has all components, however, more Than one are incomplete.	Paper is missing some 1 or more components.

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## OBJECTIVE

This exercise will teach the students about the Air Pollution, the causes, it's effects on our environment and health, and the latest methods desgined to combat air pollution.

## DURATION

2-45 minute classes

## MATERIALS

Flower seeds  
Potting soil  
Paper cups  
Marker  
Paper  
Pencils

## PROCEUDRE AND ACTIVITIES

### Anticipatory Set:

1. Have students review what they've learned about air pollution and health.
2. Explain the experiment to the students and have the class predict the outcomes.
3. Explain to the students that they are conducting simultaneous testing and discuss pros and cons of simultaneous testing.
4. Students can take photos to document the experiment and use for Implementation phase.

### Activity:

1. Have students get into groups of 2 and decorate their paper cups labeling one cup heavy traffic zone and the other clean air.
2. Students should plant an identical amount of flower seeds into the two paper cups.
3. Students should observe the growth of the seeds over a 2-week period of time, during which the plants are watered on a regular basis with identical amounts of water. Students should observe the plants and record growth activity.
4. At the end of the 1<sup>st</sup> week period, the students should plot the number of plants grown, the size of the plants, the color of the plants and write a short conclusion about the effect of air pollution on growth.
5. Continue 2<sup>nd</sup> week recording observations.

**Closing:**

1. Review results against student's predictions, group variations, discuss different variables that might alter results (rain, wind, seasonal variations).
2. Student should write an essay or journal from one of the points of view of the plants using the data collected and observations made. Things to include could be:
  - a. what would they be feeling;
  - b. what effects would their environment have on them compared to the clean plant
  - c. what could they do to change their environment
3. Have students share their stories with the class.

\*Adapted from the Minnesota North Star Chapter of the Sierra Club ([www.northstar.sierraclub.org](http://www.northstar.sierraclub.org))



## OBJECTIVE

This exercise will allow students to visibly analyze where and why accumulation of particulate matter is greatest.

## MATERIALS

Four pieces of heavy paper or index cards (different colors if possible)  
Vaseline  
String or duct tape  
Wire Hanger  
Magnifying glass

## DURATION

20-30 minutes

## VOCABULARY

Particulate matter  
Pollution

## PROCEUDRE AND ACTIVITIES

### Anticipatory Set:

1. Have students review what they've learned about air pollution and health.
2. Explain the experiment to the students and have the class predict the outcomes.
3. Explain to the students that they are conducting simultaneous testing and discuss pros and cons of simultaneous testing.
4. Students can take photos to document the experiment and use for Implementation phase.

### Activity:

1. Break students into groups of 4 or 5 students.
2. Distribute colored index cards to each group.
3. Mark each index card with location, group number and date of placement.
4. Determine best methods for placing experiment near bus area. Perhaps might be able to use wire hangers and stick into ground.
5. Coat each paper with Vaseline.
6. Hang one near the bus parking area, place the second in the school, Place one in the loading dock area and put the fourth paper in a drawer or closet.
7. Remove the index cards and record results after 1 day, two days and 1 week.

**Closing:**

1. Review results against student's predictions, group variations, discuss different variables that might alter results (rain, wind, seasonal variations).

\*Adapted from the Minnesota North Star Chapter of the Sierra Club ([www.northstar.sierraclub.org](http://www.northstar.sierraclub.org))



## OBJECTIVE

This activity will demonstrate the amount of pollution that a diesel vehicle emits into the air after five minutes of idling.

## MATERIALS

Three new, white tube socks  
Heavy rubber band  
Oven Mitt  
2 Diesel Buses (one older and one retrofitted or new bus)  
Black marker

## PROCEDURES AND ACTIVITIES

### Prep work:

1. Choose one student to act as class representative and make an appt with the bus company to have them arrive early for pick-up so you can conduct your experiment.

### Anticipatory Set:

1. Have review session with students about what they've learned so far about air pollution and diesel exhaust. This can be in the form of a pop quiz or open discussion.
2. Have students make hypothesis about the new versus old vehicles socks.

### Activity:

1. Before the presentation, label each sock with black marker.
2. Have one adult place a sock over the end of the tailpipe from the diesel vehicle. If needed, secure the sock with a heavy rubber band.
3. Start the engine and idle it for at least five minutes.
4. Have adult remove the socks with an oven mitt, as the tailpipe will be hot. Turn the sock inside out to compare it with the clean sock and visibly see the accumulated particulate matter.

### DURATION

30 minutes

### VOCABULARY

Diesel vehicle  
Idling  
Particulate matter  
Pollution

**Closing:**

1. Examine the socks and discuss results with class.
2. Have students draft a letter to the school bus company urging them to install filters or replace older buses backing up their request with facts. This will be used later during the Anti-Idle Implementation Module.

\*Adapted from Minnesota North Star Chapter of the Sierra Club. ([www.northstar.sierraclub.org](http://www.northstar.sierraclub.org))



## OBJECTIVE

This exercise will allow students to take a look at how idling school buses can unnecessarily be wasteful.

## BACKGROUND

### MATERIALS

Stopwatches  
Clipboards  
Chaperons

\$\$\$  
SAVINGS

### DURATION

60 minutes

### VOCABULARY

Idling

## PROCEDURES AND ACTIVITIES

### Prep work:

1. Have 2 students research your school idling policy to determine if there is an idling policy and what the idling restrictions are.
2. Have 1 student contact the school bus fleet manager to determine how much fuel is being used by the fleet's buses when they idle. If the fleet manager doesn't know, assume a half gallon of diesel fuel is used for every hour (0.5 gallons/hour) the school bus idles.
3. Choose 3-4 students who can arrive early to school to meet you (before the buses arrive for school) and survey the AM buses.
4. Choose 3-4 different students who can survey the PM buses.
5. Students need to collect the following info:
  - a. How many buses are there during drop off and pick-up? Note bus numbers for reference.
  - b. Estimate the amount of time (in minutes) each bus idles.
  - c. Are there any buses not idling?

### Activity:

1. Have students work in pairs or groups and calculate the average additional cost of the fuel for buses that idle too long based upon the current average cost of diesel fuel. (NOTE: If both the start-up idling time and the waiting idling time fall into the range of the school district's recommended idling times (typically five to 15 minutes), then

the students may wish to assume that the buses idle 30 minutes in the morning and afternoon, just to demonstrate the savings.)

2. Using the total amount of time your school district's policy allows per bus for idling, multiply this number times the number of buses in use for the morning bus run (report in minutes).
3. Add all of the morning idling times of all buses together (report in minutes).
4. Subtract the total idling time allowed under the policy from the total number of minutes buses actually idle in the morning. This calculation demonstrates how much unnecessary idling is occurring at the school each in the morning.
5. Repeat this exercise for the afternoon run; report in minutes.
6. Add the morning and afternoon unnecessary idling times together and report in minutes. This is your school's daily unnecessary idling for one day (that was monitored), in minutes.
7. Determine the number of school days in a month and multiply that number by the amount of time your school bus fleet wastes on unnecessary idling for one day. This is your school's unnecessary idling for the month.
8. Take the annual idling time for your bus fleet (number of hours/month) and multiply that number by the amount of fuel used when the bus is idling (0.5 gallons/hour idling) to determine how many gallons of diesel fuel are being wasted on unnecessary idling in one month.
9. Determine how many months are in a school year. Multiply the number of months in a school year by the number of gallons of diesel fuel used every month on unnecessary idling. This is the amount of money being wasted on unnecessary idling in a school year.

### **Closing:**

1. Discuss the savings amongst the class.
2. Have them revise their letters to the bus company to incorporate this new information urging them to consider reducing their idling practices.

### **EXTENSIONS**

- If time permits, have them estimate the amount of time other vehicles spend idling when they come to school. Example: estimate the amount of time a car idles when used by parents who transport their kids to and from school.



## SCIENCE MODULE EXTENSIONS

You can assign these research activities to students as a means to reinforce the lessons learned in class. Students can work on these assignments individually or in small groups.

1. Have students determine their "energy footprint" based on their activities or equipment used. For example, can they compare the energy that it takes for them to get to and from school, either in a car or by bus?
2. Have students find out more about what fuel is used in the vehicles operated by their own school district or the community's municipal vehicles. What kind of fuel do these vehicles use?
3. How many gallons of fuel are used by the school district or the municipality to operate its vehicles each year? Can the estimated amount of fuel to be used during idling versus the amount of fuel used overall be determined?
4. Have students research other types of engines that are used in vehicles. Are they more efficient? Besides the way they operate the vehicles, do these impact the environment differently?
5. Have students learn about other forms of pollution control technologies, whether it is for reducing air or water pollution.

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### **GOAL OF MODULE:**

By doing the activities outlined in this module, your students will learn

- How EPA regulates air pollution
- How air quality impacts your communities
- What they can do to improve air quality in their community

### **BACKGROUND:**

This section focuses on how EPA regulates air quality, what air quality is, and how it impacts our communities. Pollutants of concern are identified as well as some of the common sources that produce them. Students should be able to determine air quality and know what steps can be taken to reduce the impact of daily activities on the community air quality.

Community involvement with Idle-Management Policies and other pollution prevention measures will be touched upon. Free materials are available on the EPA website that can be used to help educate the School Board and the City Council will be identified. (NOTE: Be sure to check the EPA website to get more information from the Clean Air Act, and read the EPA publication *The Plain English Guide to the Clean Air Act*) Publication Number 400-K-93-001 found via this link: <http://www.epa.gov/air/caa/peg/>

### **QUESTIONS AND ANSWERS:**

Q: *How can diesel exhaust harm my community?*

A: Once diesel exhaust gets into the air, it can go anywhere that is open to it, such as fresh air intakes and open doors and windows.

Q: *What is stewardship?*

A: Stewardship is the act of taking responsibility for caring for the Earth or any part of it. This includes taking responsibility for using resources and creating as little waste and pollution as possible.

Q: *What is an "Idling-Management Policy or Idle Reduction Policy"? Does your school have such a policy?*

A: This policy is established by the school, the district or the community. It specifies how much time a school bus should be idling during certain conditions. It should outline any special concerns pertaining to the bus driver, special needs children, safety, maintenance and weather.

Q: *What can our school district do to reduce air pollution from buses?*

A: School districts can:

- Plan for routine maintenance of buses
- Encourage drivers to not follow other buses too closely (i.e., don't caravan too closely)
- Assign the newest buses to the longest routes
- Implement a reduced -idling program fro the school or district
- Use free materials about the importance of reducing idling offered on EPA's website
- Create a comfortable space inside the school building or bus depot where drivers can wait and stay warm or cool.



## OBJECTIVE

This activity lets students practice making choices and experience the sometimes difficult process of making decisions related to air pollution.

## MATERIALS

None

## BACKGROUND

Whether we are children or adults, our lives are influenced by a constant series of choices. Some choices we make ourselves. Some are made by parents for their children, and many are made by people we don't even know. The combinations of all of these choices determine the quality of each of our lives. Making these choices is not easy because sometimes what a person perceives as the right choice for him or her as an individual may be perceived as the wrong choice for the neighborhood, the community, or the Nation. For example, a person may not want to join a car pool to get to school or work in the morning because it means coordinating his or her schedule with someone else's and, maybe, getting up earlier in the morning to be ready on time.

The combination of choices made by individuals, business and industry owners, and Government over the years has had a huge impact on the quality of the air we breathe and the air pollution problems the world faces today. For example, as a country, we have chosen to pay the higher prices of cars with emission control systems in order to reduce pollution from motor vehicles.

## PROCEDURES AND ACTIVITIES

### Anticipatory Set:

1. Explain that the class is going to act out a situation that illustrates the difficult process of making clean air choices. For the exercise, students are to assume that there has been a proposal brought before the city (town) council to close the downtown commercial district to automobile traffic because of the pollution level and

## DURATION

2 class periods or  
90 minutes

## VOCABULARY

Acetaldehyde  
Auto emissions  
Benzene  
Carcinogens  
Clean fuel  
Criteria pollutants  
Formaldehyde  
Hydrocarbons  
Nitrogen oxides  
Non-attainment  
area  
Ozone  
Particulate matter  
Smoke  
Soot  
Standards

traffic congestion. Under the proposal, only fire and police emergency and public transit (buses) vehicles would be allowed on downtown streets between the hours of 8:00 am and 6:00 pm.

2. Divide the class into 8 teams. Explain that each team will represent one of the "players" in this drama: three city (town) council members, two citizens, two downtown business owners, and one impartial expert that has been paid to evaluate the impacts of the proposal and report to the council (you may choose to be more specific about the roles to approximate the makeup of your community). Assign a role to each team and explain that each team will have to choose (not now) one team member to be the actor when the drama is played out at the next class (give a specific date but allow a few days to prepare).
3. Explain that in order to act out the role they have been assigned; each team will have to define the characteristics and views of that person. Does the character live in the city (town) or out in the suburbs (in a rural area)? What does the person do for a living and where does he or she work? How does the person get to and from work? Does the person have a family? Where does the person shop? The last page of this activity is sample "Character Attribute" worksheet that each team can fill out to help define its role.
4. Explain that once each team has defined its character, the team should define the character's concerns related to the proposal. Stress that this should go beyond deciding whether the character would be "for" or "against" the proposal and should include defining why this particular character might feel one way or the other. Encourage students to talk to their parents, local city (town) council members, and business owners to help develop these perspectives.
5. Explain that for the role-play activity, the actor from each team will have to describe the team's character and make a statement about that person's views on the proposal as if the character were addressing the council members during a meeting. (Remind the council members that they have a broader responsibility to the community and should be prepared, if necessary, to make a choice between their own individual views and what's best for the community as a whole.)
6. Give students the remainder of the class to work together and assign them to continue work outside of class in order to be prepared for the role-play activity.

#### **Activity:**

1. Arrange desks or a table at the front of the room with chairs to accommodate the three city (town) council members. Place a desk or small table somewhere else in the room from which the expert, citizens, and business owners will make their statements.
2. Instruct the actor from each team to describe the team's character (based on the worksheet completed by the team). Have the expert deliver his or her impartial report to the council members and audience at the council meeting. Have the citizens and business owners state their views on the proposal. Have each council member

make a similar statement. (NOTE: In the event that all teams take the same position on the proposal, be prepared to offer an opposing argument yourself, so that both sides of the issue will be heard by the class.)

### **Closing:**

1. Ask the council members to vote. Examine the results. How did each member vote? How did they decide what to vote? Discuss the results and the choices involved with the class.
2. Have students write a summary of the events and answer the following questions:
  - a. Did they agree with the council members?
  - b. If they could have been someone else in the role playing what role would it have been, why and what would they have done differently?
  - c. What could someone have done differently to change the outcome?
3. Have students share with the class or teacher can share of summary of summaries.

### **EXTENSIONS**

- Record the event so students can review the activity later so you can discuss pivotal events within the council meeting.
- Have someone act as a reporter and ask probing questions to the role players. Explain that this is something that happens frequently at meetings. Reporter could write an article in lieu of required summary. See how accurate info is recorded.

\* From Project A.I.R.E. (Air Information Resources Education). Visit [www.epa.gov/region1/students/teacher/aire.html](http://www.epa.gov/region1/students/teacher/aire.html) for more educational exercises.

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### OBJECTIVE

This activity lets students research the Air Quality in their Community and look at ways to improve local AQ.

### MATERIALS

Access to internet

### DURATION

2 class periods or  
90 minutes

### VOCABULARY

Air Quality Index

### PROCEDURES AND ACTIVITIES

#### Anticipatory Set:

1. Have students review the health effects of poor air quality and indicators of poor air quality. This can be done in a game format.
2. Show students the AirNow website ([www.airNOW.gov](http://www.airNOW.gov)) and explain that they will be researching the AQ for their community. Discuss what influences AQ in their community. (Businesses, weather, etc.)
3. Ask students to make predictions about seasonal and diurnal variations.

#### Activity:

1. Have students work in groups of 3 or 4 to come up with companies in the area that attribute to their air quality and list chemicals used, if possible. Be prepared to share and compare with the class. The chemical list can be completed for homework.
2. Have each group research the AQ seasonal variations and diurnal variations in their area.
3. Students can also access GoogleEarth to track Air pollution in their community.

#### Closing:

1. Discuss information as a class.
2. Have students draft a letter to local companies urging them to reduce their air pollution using the data and knowledge from this activity.

### EXTENSIONS

- Students could research other areas of the county with different climates and pollution problems and compare to their community. They could also make comparison between developing countries like China and industrialized nations like the US and Canada.

- Have students chart community air quality on a chart and record daily.
- Students could post local AQ alerts for their area or include it in their daily announcements.
- Have students research to see if there are monitoring devices nearby and set up a field trip, if possible or have someone from the EPA regional office or monitoring company give a presentation on air monitoring.

\* From Project A.I.R.E. (Air Information Resources Education). Visit [www.epa.gov/region1/students/teacher/aire.html](http://www.epa.gov/region1/students/teacher/aire.html) for more educational exercises.



### **OBJECTIVE**

Students will work in small groups to investigate, analyze, interview and problem-solve. They will answer questions related to the sources and impacts of air pollution on the health of students and staff.

### **MATERIALS**

Survey questions  
Map of school

### **BACKGROUND**

### **PROCEDURES AND ACTIVITIES**

1. Break the students into small groups of 3 or 4.
2. Ask them to answer the following on the survey sheet and complete the map of school.
3. While students are completing their maps you should have one ready on the board or overhead so students can fill out during discussion.
4. After they have answered the questions in their groups, engage the entire class in a discussion on the results of their team audit.

### **DURATION**

45 minutes

### **VOCABULARY**

Air Quality  
Idling  
Indoor air  
pollution

### Survey: Where do the buses park

1. On a separate sheet of paper, create a sketch of the school complete with parking area, and directional map (which way is north).
2. Where do the buses park? (Mark on diagram) and how many do you estimate arrive/depart each day?
3. In addition to school buses, what other trucks or cars come to school? (e.g., food or supply delivery trucks, mail trucks, UPS trucks, cars Dropping off/picking up students). Mark on diagram. Again, how many do you estimate arrive/depart each day?
4. Do any of these cars, trucks, or buses leave their engines running (idling) while at school?
5. Where are the school's air-intake vents, mark on diagram? How far away from the idling vehicles?
6. Are there any anti-idling signs posted? If so, how many? Mark on diagram.
7. Does air pollution from the idling vehicles enter the school? Why and how?
8. Are there any other sources of outdoor air pollution around the school that might impact the health of students and staff? Are there sources of indoor air pollution in the school as well? Mark on diagram.

9. What does "Air Quality" mean? What is the Air Quality like today in your area?
  
10. Does the school have an anti-idling policy? If so, obtain and review and summarize below.
  
11. Does your state have an anti-idling policy? If so, does your school comply?
  
12. List 4 suggestions that you could provide to the school as a result of this school audit.

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## OBJECTIVE

Students will problem solve and discuss the pros and cons of the Industrial revolution and air pollution. Students will examine the case of Donora, PA and the "Fluoride Fog".

## MATERIALS

Internet  
Video or articles on Donora, PA

## BACKGROUND

Industrial revolution brought about many side effects to human health and air pollution. The students will learn an overview of the industrial revolution and discuss impacts.

## PROCEDURES AND ACTIVITIES

### Anticipatory Set:

1. Have students research the following and be prepared to discuss in class:
  - a. industrial revolution and it's impact on air pollution
  - b. Donora Death Smog

### Activity:

1. Have students discuss the IR and Donora PA link and it's impact on air pollution.
2. Watch the video on Donora, PA about the "Fluoride Fog" obtained from the Donora Smog Museum or watch the links below:
  - a. <http://www.npr.org/templates/story/story.php?storyId=103359330>
  - b. Weather Channel-Donora and EPA  
[http://www.youtube.com/watch?v=ujIJC6\\_o1hs](http://www.youtube.com/watch?v=ujIJC6_o1hs)
  - c. KDKA Pittsburgh News Coverage  
<http://kdka.com/video/?id=47716@kdka.dayport.com>
3. Discuss their reactions to the video.
4. Discuss causes of Donora Death Smog making sure they address the temperature inversion.
5. Explore what causes temperature inversions and perhaps see if your area has had any temperature inversions recently. Could this have happened to your town?

## DURATION

45 minutes

## VOCABULARY

Industrial Revolution  
Air Quality  
Temperature Inversion

### **Closing:**

1. Explain to the students that their school is in a town that has a similar experience as in the town of Donora, PA.
2. The students need to research the chemicals used in the steel and smelting plants. Specifically, fluoride and sulfur dioxide. Students should determine the health effects, physical properties, and uses, etc.
3. Have students develop safeguards or controls to ensure the chemicals (fluoride) are contained.
4. During classroom discussion, teacher should discuss impacts of individuals with Asthma and the "Fluoride Fog" impact on them.
5. Can use Trapping Air Pollution: Temperature Inversions # 1 & #2 from the AQI Toolkit for teachers. See Air Now website for more information.  
[http://www.airnow.gov/index.cfm?action=resources.aqi\\_toolkit](http://www.airnow.gov/index.cfm?action=resources.aqi_toolkit)

### **EXTENSIONS**

- Have students create a timeline linking industrialization to Air Quality
- Using the list of industrial companies in the area, have students research the chemicals used and the effects from exposure. Have students research the current safeguards in place to ensure this doesn't happen here.
- Have a representative from a local chemical company talk about the safeguards and practices they have in place to protect their community and also notification procedures in place in case of emergencies.
- Have students research local or national chemical spills, explosions, burglaries, etc at chemical companies and relate to the air pollutants exposed.
- Have students write a position paper discussing how the case in Donora PA could have lead to the Clean Air Act.



## **SOCIAL STUDIES/CIVICS MODULE EXTENSIONS**

You can assign these research activities to students as a means to reinforce the lessons learned in class. Students can work on these assignments individually or in small groups.

1. Students can invite a local retrofit company to give a presentation on their technology.
2. Give students a set amount of grant/donation money and they need to determine the best technology to install on the buses, amount of buses they can retrofit, potential problems, emission reductions, etc. Culmination can be a presentation to the class about their proposal.
3. Invite local grantee (if possible) to talk about their grants projects.
4. Invite EPA representative to talk about the Diesel Emission Reduction Program
5. Invite State representative to discuss their part in decreasing diesel emissions, (laws, grants, projects, etc)

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It is suggested that you first begin your class lessons on air pollution and idle reduction with the various activities in the health, science and social studies modules prior to moving on to the contents of this module. The students should have a solid grasp on the information presented in those modules, and once you are certain that they have a good understanding of those lessons, you may choose to move on to the larger scope project presented here.

The goal is to first educate your students on the importance of idle reduction, and then to move on to the education of bus drivers and transportation officials. The latter can be accomplished by an idling reduction campaign at your school, and this module will guide you through the steps of developing and initiating such a campaign. Here you will find the necessary steps for getting started, tips on what the campaign components should be, and sample materials which can be used to market the campaign. You may choose to have your students develop their own campaign materials, using the ones provided here as examples or templates.

### **Developing An Idling Reduction Campaign for Your School**

First, your school will need a school bus idling policy. A sample school bus idling policy is provided within this module. It can be used as is, or merely as a template for a more detailed policy. At the very least, the following should be stated in the policy:

- As a general rule, buses should be moving whenever the engine is on.
- The engine should be turned off as soon as possible after arriving at loading or unloading areas.
- The school bus should not be restarted until it is ready to depart.
- Limit idling time during early morning warm-up to what the manufacturer recommends (generally no more than five minutes).

Secondly, you will need to publicize your program, so you will need marketing materials. In this module, you will find various examples of such materials. You may choose to use these or have your students create their own materials. Consider including fact and tip

sheets, pledge cards for drivers, "no idling" signs and posters for posting on school grounds, and window stickers. A sample fact sheet and pledge card provided.

### **Implementing Your Idling Reduction Campaign**

Loading and unloading areas, delivery areas and bus depots should be spot-checked for adherence to the idling guidelines. Have your students develop a protocol for doing this. Help them determine the appropriate locations and times for spot checks.

Recognize drivers who successfully reduce idling by having your students develop a rewards systems.

- Begin by awarding drivers with a certificate of recognition. A sample certificate is provided in the module.
- Local businesses or non-profit organizations working on clean air issues could be asked to donate gift certificates or other items as rewards. Parent-Teacher organizations could be asked to do the same.

Calculate your fuel and dollar savings achieved through your idle reduction campaign and advertise these achievements around the school. A fuel savings calculator can be found at [http://www.epa.gov/otaq/schoolbus/idle\\_fuel\\_calc.htm](http://www.epa.gov/otaq/schoolbus/idle_fuel_calc.htm).

Consider sharing your school's successes with other schools, the media, and the general public. A sample press release is included in the module. Have your students create outreach materials. For sample outreach materials, please visit <http://www.epa.gov/otaq/schoolbus/outreach.htm#event>.



### OBJECTIVE

This exercise uses fiction designed for children as a basis for lessons about air pollution and the importance of reducing school bus idling. It can be used independently or in conjunction with other classroom activities.

### MATERIALS

Scholastic's *The Magic School Bus Gets Cleaned Up*  
Healthy Heart and Lungs Lesson Plan  
Small diameter straws  
Clock or timer

### PROCEDURES AND ACTIVITIES:

#### Anticipatory Set:

1. Split the students into groups of 4 or 5, depending upon the number of 2<sup>nd</sup> grade classes. Assign each group to a 2<sup>nd</sup> grade class. Assign each student in the groups to a certain section of the book. Assistance from the 2<sup>nd</sup> grade teachers is necessary to help move students along in the lesson if they are stuck.
2. Have students teach the class about what they've learned in and that they would like to pass on this knowledge to them, the second grade.
3. Explain to your students that they should read their page(s) and show the book to the class. Perhaps you might want to assign the pages to your students the night before so they can practice their assigned pages.
4. Distribute the Healthy Heart and Lungs lesson plan to the students so they know how to teach the lesson. Choose 2 students who are the most comfortable in front of the classroom to explain this activity.

#### Activity:

1. Have 2<sup>nd</sup> graders assemble in the reading area around your students. Have your students read their assigned pages and discuss with the 2<sup>nd</sup> grad class.
2. Upon completion, have your students explain the straw exercise to the 2nd grade class. Have students perform test.

### DURATION

60 minutes

### VOCUBULARY

Air  
Diesel fuels  
Diesel-fueled engine  
Exhaust  
Idling  
Lungs  
Particulate Matter  
Pollutants/Pollution  
Soot

**Closing:**

1. Have your class lead a discussion with their students about the *Magic Schoolbus* and the straw experiment.
2. Have the 2<sup>nd</sup> grade teacher complete an evaluation of your students and share the comments with the class.
3. Have students journal about this lesson. Specifically, what they learned, what they liked or disliked about this exercise, what they found to be most challenging about teaching this subject to 2<sup>nd</sup> grade students.



## **OBJECTIVE**

This lesson plan is the culmination project of the toolkit. Students take everything they've learned through this module and put it into practice; they develop an Anti-Idle Campaign at their school.

## **DURATION**

Dependent upon  
projects chosen

## **MATERIALS**

Computer with PowerPoint

## **PROCEDURES AND ACTIVITIES:**

### **Activity 1: Develop Workplan**

Students will need to create a workplan that they will use to persuade the school officials to create an Anti-Idle Policy at the school.

### **Activity 2: Anti-Idle Campaign Presentation**

Students will need to develop a presentation for the principal, teachers, school officials and transportation officials showing them the benefits of creating an Anti-Idle Policy at the school and ultimately throughout the school district. The students will be the driving force behind the Anti-Idle Campaign. They can use the sample policy, press release and pledge provided in the Tool-kit or they could create their own literature.

### **Activity 3: School Announcements**

Students will prepare a school announcement that they will read over the loud speaker every morning. Perhaps it could be called "Idle Facts". It could be in the form of Facts/Myths, Trivia, Success stories, School's policy activities, etc.

### **Activity 4: Poster/artwork Contest**

Students can hold a poster contest (per grade) throughout the school to encourage everyone to get involved in the Anti-Idle Campaign. Students could judge the contest and create a calendar with the winning posters. Calendars could be sold to make money offset some of the cost for the Anti-Idle signage. They could also hold a contest for the development of the Anti-Idle artwork that will be used for the school signs and literature.

**Activity 5: Newspaper Article/TV Interview**

Have students meet with a local newspaper and TV reporter to explain the Anti-Idle Campaign that the school is developing. You may want to have the questions prior to the event so you can prepare the students for the interview.

**Activity 6: DERA**

Students could meet with representatives of the Mid-Atlantic Diesel Collaborative to learn about the grants available for school districts to reduce diesel emissions, initiate an Anti-Idle Campaign and purchase cleaner vehicles.

**Activity 7: Anti-Idling Make a Difference Video**

Create video on idling in your community and use as teaching tool for anti-idling regulation adoption.

**Activity 8: Anti-Idling music video**

Have students create a music video showing and discussing all they've learned throughout the module, stressing importance of anti-idling.

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on route to cleaner air



**Air Quality Awareness &  
Idle Reduction Toolkit**  
**Module 4: Implementation**  
**Press Release**

FOR IMMEDIATE RELEASE

Contact: [Name] [Phone Number] [E-mail Address]

[YOUR SCHOOL] CELEBRATES IDLE-REDUCTION INITIATIVE [EVENT]

[PLACE- Release DATE]

Today [institution] will [honor Mr. John Doe; host an Open House; etc.] to celebrate making [your school's] buses a little greener. [Short background on person/event/project].

[Time, place of event, invitation to public.]

[Your school] has been one of the leaders in reducing emissions from diesel school buses. Our idling reduction campaign has resulted in [X] savings in dollars, in [X] savings in gasoline, and in reduced emission of pollutants. Children riding the buses, school personnel, and the community all benefit from the reduction of pollution.

[Quote from official]

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*School Name*

*Policy Number: #*

*Effective Date:*

*Applicability:*

This policy applies to the operation of every school bus.

*Rationale*

Diesel exhaust from idling school buses can accumulate in and around the bus and pose a health risk to children, drivers and the community at large. Exposure to diesel exhaust can cause lung damage and respiratory problems. Diesel exhaust also exacerbates asthma and existing allergies, and long-term exposure is thought to increase the risk of lung cancer. Idling buses also waste fuel and financial resources.

*Purpose*

Eliminate all unnecessary idling by school buses such that idling time is minimized in all aspects of school bus operation.

*Guidance*

1. When school bus drivers arrive at loading or unloading areas to drop off or pick up passengers, they should turn off their buses as soon as possible to eliminate idling time and reduce harmful emissions. The school bus should not be restarted until it is ready to depart and there is a clear path to exit the pick-up area. Exceptions include conditions that would compromise passenger safety, such as:
  - A. Extreme weather conditions
  - B. Idling in traffic
2. At school bus depots, limit the idling time during early morning warm-up to what is recommended by the manufacturer (generally 3-5 minutes) in all but the coldest weather.

3. Buses should not idle while waiting for students during field trips, extracurricular activities or other events where students are transported off school grounds.
4. In colder weather, schools are directed to provide a space inside the school where bus drivers who arrive early can wait.
5. In colder weather, if the warmth of the bus is an issue, idling is to be at a very minimum and occur outside the school zone. The "warmed" bus is to enter the school zone as close to pick-up time as possible to maintain warmth and then shut down.
6. All service delivery vehicles shall turn off the engines while making deliveries to school buildings.
7. Transportation Operations staff are directed to revise bus schedules so that school bus caravanning can be avoided and the cleanest buses assigned to the longest routes.
8. All drivers shall receive a copy of this bulletin at the beginning of every school year.



## Take the Pledge!

It's as easy as 1, 2, 3...

### *Idle Reduction Pledge*

You hold the key to a healthier ride! Show your commitment to reducing idling by completing the **Idle Reduction Pledge**.

To take the pledge, simply complete the form below, detach and return to your school's idling reduction campaign coordinator. Thank you!

\*\*\*\*\*

I, \_\_\_\_\_, pledge to:

- 1.** Limit idling time in school bus loading and unloading areas.
- 2.** Turn the engine off in the school yard whenever possible.
- 3.** Learn more about implementing idle reduction programs and policies in my school district.

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

School: \_\_\_\_\_

City and State: \_\_\_\_\_

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## **Air Quality Awareness & Idle Reduction Toolkit**

For the Fact Sheet and Certificate, please see Appendix F and G.



**RESOURCES**

Below you will find a list of various resources and supplemental information which can be used to expand your Air Quality Awareness & Idle Reduction.

**EPA Resources**

- EPA's Clean School Bus USA program  
<http://www.epa.gov/otaq/schoolbus/index.htm>
- Campaign Materials provided by EPA  
<http://www.epa.gov/cleanschoolbus/form.htm>
- National Idle-Reduction Campaign  
<http://www.epa.gov/otaq/schoolbus/antiidling.htm>
- Anti-Idling Strategies  
<http://www.epa.gov/otaq/schoolbus/antiidling.htm>
- AirNow  
<http://airnow.gov/>
- Air Pollution: What's the Solution  
<http://www.k12science.org/curriculum/airproj/index.html>
- AirData: Air Pollution Data  
<http://www.epa.gov/air/data/>
- Air Quality Toolkit  
[http://airnow.gov/index.cfm?action=resources.aqi\\_toolkit](http://airnow.gov/index.cfm?action=resources.aqi_toolkit)

**Background Info for Classroom Activities**

- Human Health  
<http://www.epa.gov/otaq/schoolbus/humanhealth.htm>
- Different fuels used in transportation and how they relate to energy  
[www.rqriley.com/energy.htm](http://www.rqriley.com/energy.htm)
- How a diesel engine works (compression ignition) and how gasoline engine works (spark ignition)  
[www.auto.howstuffworks.com/diesel.htm](http://www.auto.howstuffworks.com/diesel.htm)
- How a gasoline engine works  
[www.auto.howstuffworks.com/engine.htm](http://www.auto.howstuffworks.com/engine.htm)
- Fuel Savings Calculator  
[http://www.epa.gov/otaq/schoolbus/idle\\_fuel\\_calc.htm](http://www.epa.gov/otaq/schoolbus/idle_fuel_calc.htm)

- From Project A.I.R.E. (Air Information Resources Education)  
[www.epa.gov/region1/students/teacher/aire.html](http://www.epa.gov/region1/students/teacher/aire.html)
- Minnesota North Star Chapter of the Sierra Club  
[www.northstar.sierraclub.org](http://www.northstar.sierraclub.org)

#### **Existing Idling Reduction Campaigns**

- West Virginia Idle-Free Zone Campaign  
<http://www.wvdep.org/alt.cfm?asid=151>
- Earth Day Network  
[www.earthday.net/education](http://www.earthday.net/education)



## **Air Quality Awareness & Idle Reduction Toolkit**

### **FEEDBACK FORM**

Thank you for using our Air Quality Awareness Packet—Idle-Reduction Toolkit materials, sponsored by the Mid-Atlantic Diesel Collaborative, for educating your school on the importance of reducing idling and keeping the air clean.

Please take some time to tell us what you think about our Packet. We welcome your feedback! If you need more space, please attach an additional sheet.

Please return feedback forms to:

Sue Stephenson  
Mid Atlantic Diesel Collaborative  
8600 LaSalle Road, Suite 636  
Towson, MD 21286  
phone 443-901-1882  
fax 443-901-1886  
SStephenson@marama.org

1. How useful were the activities in each of the modules? \_\_\_\_\_

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2. Would you suggest anything be added to the modules (eg. More instructional material in the Teacher's Prep)? \_\_\_\_\_

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3. Did you use the module on developing and implementing an idling reduction campaign at your school? \_\_\_\_\_

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If so, please tell us the following:

3a. How many drivers participated in the program? How many signed pledge cards? \_\_\_\_\_

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3b. Has the campaign made a noticeable difference in fuel savings? If yes, can you tell us how much? \_\_\_\_\_

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3c. When did you award recognition certificates to drivers? Were they meaningful to them? \_\_\_\_\_

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3d. Did you use the marketing materials? Were they effective? \_\_\_\_\_

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4. Did you use the Resources page? Was it helpful to you? \_\_\_\_\_

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5. Is there anything in the toolkit you would change? If so, what? \_\_\_\_\_

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6. Do you have any other comments? \_\_\_\_\_

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You can pick and choose from the following questions to create your own quiz. Quizzes can be given following an activity to enforce the lessons learned about air pollution and idling, and its effects on human health, or they may be given prior to a lesson and/or activity to gauge the student's prior knowledge on the subject. Each of these questions can also be used individually as classroom discussion questions. They have many uses. Be creative!

### Explanation Questions

1. What is air pollution?

Air pollution makes the air dirty. It can affect our health and can come from a variety of sources. Sometimes air pollution comes from nature, such as erupting volcanoes. However, the majority of air pollution is man-made and comes from factories or power plants, cars, trucks, buses, and even your family's activities like smoking cigarettes or mowing the lawn with a gasoline-powered engine.

2. What is diesel exhaust?

Diesel exhaust is the smoke that you see, and other elements that are too small to see, which are discharged into the air when diesel fuel is burned, and therefore contributing to air pollution.

3. Why are kids more harmed by air pollutants, including diesel exhaust, than adults?

Kids' respiratory systems are still developing, and kids have a faster breathing rate.

4. How can we find out about how clean or dirty the air is?

Visit the AirNow website at [www.airnow.gov](http://www.airnow.gov).

5. A bus uses fuel to operate. What is fuel?

Just as food is fuel for humans to operate, engines need fuel to run.

6. What is idling?

Idling is when the engine runs, but the bus is not moving. Sometimes idling is necessary, like when a vehicle is stopped at a traffic light or stuck in a traffic jam. Some idling is not necessary, like when the driver is waiting for students at a field

trip or has the engine running for more than the recommended time of five to 15 minutes, especially when in standard operating conditions.

### **True or False**

1. What is an average recommended time for idling school buses in standard weather conditions?  
Five to 15 minutes.  
TRUE or FALSE
2. Idling is good for your car because it warms up your engine and keeps it warm.  
True or false?  
FALSE: Idling can actually be hard on an engine because fuel doesn't undergo complete combustion, and some fuel residues condense on cylinder walls.
3. Idling wastes fuel and money and is hard on the environment. True or false?  
TRUE: Idling wastes an enormous amount of money because it burns fuel but doesn't get you anywhere. When you are idling, you are getting ZERO miles per gallon of fuel. It's also hard on the environment because it produces needless emissions from the exhaust.
4. Idling is needed on cold winter days to ensure that all of the vehicle's parts are warm enough to operate properly. True or false?  
FALSE: Many components of the vehicle will only warm up when the vehicle is moving. You need to idle no more than 30 seconds to get the oil circulating through the engine.
5. The best way to warm up a vehicle is to drive it. True or false?  
TRUE: Driving your vehicle ensures that all parts get warmed up properly and it doesn't waste fuel.

### **Multiple Choice**

1. It's a good practice to shut off the engine when your vehicle is going to be stopped for more than:
  - a. 10 seconds
  - b. 10 minutes
  - c. 30 minutesAnswer: (a) 10 seconds. More than 10 seconds of idling can use more fuel than turning off the engine and restarting it. Also, studies have shown that restarting the engine many times has little impact on components such as the battery and the starter motor.
2. Reducing idling by 10 minutes a day can save up to how much money per year on fuel per car annually (at \$3/gallon)?

- a. \$10.00
- b. \$30.00
- c. \$180.00

Answer: (c) \$180.00. Unnecessary vehicle idling is expensive and wasteful.

3. Which of the following are common reasons for idling?
- a. warming up a vehicle
  - b. sitting in the drive-through lane of a fast food restaurant
  - c. stopping to talk to a friend
  - d. waiting for someone
  - e. all of the above

Answer: (e) All of the above

4. How many pounds of pollution can you prevent by just reducing your vehicle idling by 10 minutes a day for one year?
- a. 1 pound
  - b. 15 pounds
  - c. 50 pounds
  - d. 75 pounds

Answer: (c) 50 pounds.



Savings are based on the following:

- 1 hour of idling a bus engine wastes  $\frac{1}{2}$  a gallon of diesel fuel
- The U.S. average diesel cost is \$2.83/gallon as of 2/1/2010  
(<http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp>)
- There are 180 instructional school days per year

One-Half Hour Less Idling/ Day Savings			One Hour Less Idling/ Day Savings		
Fleet Size	Gallons Diesel Fuel/ Year Savings	\$/Year Savings	Fleet Size	Gallons Diesel Fuel/ Year Savings	\$/Year Savings
1	45	\$127	1	45	\$255
10	450	\$1,274	10	450	\$2,547
20	900	\$2,547	20	900	\$5,094
40	1800	\$5,094	40	1800	\$10,188
80	3600	\$10,188	80	3600	\$20,376
100	4500	\$12,735	100	4500	\$25,470
150	6750	\$19,103	150	6750	\$38,205
200	9000	\$25,470	200	9000	\$50,940
250	11250	\$31,838	250	11250	\$63,675



1. **Gas saved= \$\$\$ saved!** Idling ten minutes per day can add up to hundreds of dollars per year in gasoline costs. Not only is it expensive and wasteful, but it doesn't even get you anywhere!
2. **It keeps the air cleaner.** Idling creates air pollution, and can add about 50 pounds of pollutants such as carbon monoxide, particulate matter, and nitrogen oxides to the air annually.
3. **It helps folks with respiratory problems.** Polluted air can make breathing more difficult for people with respiratory problems, and can cause asthma attacks.
4. **You'll conserve fuel.** When you idle, you burn gasoline while not actually going anywhere. Once you've burned it, that's it. Since oil is a limited resource, it should be used wisely, and a wise use of gasoline is eliminating unnecessary idling.
5. **It's better for your car.** Your car's engine is not designed to run idle for long periods of time. Doing so can cause wear and tear on your engine's internal parts and can increase maintenance costs as well as shorten the life of the engine. Plus, your car's starter motor won't be harmed. It's designed to be turned on and off thousands of times!
6. **You'll encourage others to do the same.** It doesn't take much to show others what a good thing you are doing. Teaching kids and others about the benefits of not idling is best done by setting the example yourself. Once others see you doing it, the word will spread to still other adults! Everyone can help conserve fuel and protect the environment.

Mid-Atlantic  
**Diesel Collaborative**  
*on route to cleaner air*



**Air Quality Awareness &  
 Idle Reduction Toolkit**  
**Appendix D**  
**WORD SEARCH #1**

H T G L R G O T N K V B Q Y S  
 E Z O P I D N O I M I L H L E  
 A H E O A Q I I V I V D U O L  
 R E T A S T M O H R I R Q O C  
 T D S L U N J R E T L I F H I  
 R U I L A S T H M A A V I C T  
 B V L E L E E F L Z Z E J S R  
 L O L N S N H U U R C R R W A  
 P C K J G E N I O M M Y L B P  
 X K O I T G L R E E E L D I F  
 N E N W S N Z D H I O S T S U  
 J E A W H S L O Q Z A W Z C N  
 J S C O U G H P J Y X R J E N  
 A E P A Y A R X K L B V S T U  
 A H S H Q E E U S L Z Q U X Y

AIR  
 ASTHMA  
 BREATHING  
 BUS

CLEAN  
 COUGH  
 DIESEL  
 DRIVER

ENGINE  
 EPA  
 FILTER  
 FUMES

HEALTH  
 HEART  
 IDLE  
 LUNGS

PARTICLES  
 POLLUTION  
 SCHOOL  
 SOOT

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**Air Quality Awareness &  
 Idle Reduction Toolkit**  
**Appendix E**  
**WORD SEARCH #2**

Q P B H D J U V S P A X J A P I F Z G D Z P B S V  
 T Y O F X W S N Z W T B S D C W G E H M P S G D T  
 O D H L H C O Z N N C T F I W Z H D A G N N Y S B  
 G M A O L I Q M F U H Q P G L E S E I D U U Q U N  
 G Y D Z S U N M Q M B K B N P U L R A L D O V O G  
 W O N S B F T U A G O M S I B P N S X L Q J C I H  
 R K I R O T N I N H M Q L H W C X A I T T E P A F  
 D M Y G E Y B H O D M S K T R S C F O R R H J Z H  
 E M I I W V X N N N I Z O A Z F N E L A F H H J U  
 U H B V M D I G Q O W F L E E B X T V E U Z B X F  
 D R Z M C S M R K J A C E R X W Q Y O H F C G C K  
 C S G L Q D D N D K F H X B L Y Y B J O V P K R S  
 X M V G S U K Q P W A F H R I U Y U I U S Z E R V  
 D Q W F L E O Z O N E Q A K L P Y Q L R S T M P K  
 L T N N M U I J O R H Y U A I P H I N Z L R R H J  
 M O S C T Y N G D M K M S N R S U Y L I Q W Q B V  
 C N X H H P Y Q R Z O C T C D V K J F E L P Y D Q  
 A R C N Q M X S K E I E T U O K L S J P H L R Q Q  
 B X Q R P A R T I C L E S C O V E X D L F S D R E  
 F P M L P F R H I Q Y L A U S R N Q V P H L R T E  
 T N E M N O R I V N E D A C U I I Z C T B D V C S  
 E Z H J W I F D H F A J H I D A G N A E L C J I X  
 D L P D R L E X D Y U O A M N T N E S E F U E D Z  
 H E A M W I N P Y H O E J C N I E F O S S I L L W  
 X P Z O E F K A V L Y Z L B N S J X I R M T H E J

AIR  
 ALLERGIES  
 ASTHMA  
 BREATHINIG  
 BUS  
 CLEAN  
 COUGH  
 DIESEL

DRIVER  
 EMISSIONS  
 ENGINE  
 ENVIRONMENT  
 EPA  
 EXHAUST  
 FILTER  
 FOSSIL

FUEL  
 HEALTH  
 HEART  
 IDLE  
 LUNGS  
 ODOR  
 OZONE  
 PARTICLES

POLLUTION  
 SAFTETY  
 SCHOOL  
 SMOG  
 SOOT



## Turn the key to save a life!

Every day, 25 million children ride a school bus on their way to and from the classroom. Unfortunately, unnecessary school bus idling can pose a health risk to this precious cargo, generating air pollution that can aggravate children's asthma, allergies, or other respiratory problems.



As a school bus driver, you always put the safety and security of the kids on your bus first. Now you have another opportunity to protect their health, as well as your own.

Just by turning off the school bus engine when you arrive at the loading and unloading area at schools, you can decrease the amount of diesel emissions to which children, as well as you, are exposed. By reducing the idling time of a school bus, you can help save fuel and money, reduce pollution, and, most importantly, protect children from harmful pollutants contained in diesel exhaust.



### Idle Reduction:

- Keeps the air cleaner.
- Helps folks with respiratory problems!
- Saves gas and money!!
- Aides in fossil fuel savings!
- Increases life of the buses!



***It's time for  
you to do  
your part!***

## *Did you know...*

- ◆ Contrary to popular belief, idling actually does more damage to an engine than starting and stopping.
- ◆ Idling causes additional wear on an engine's internal parts and can increase maintenance costs while shortening the life of an engine.
- ◆ Today's bus engines require only three to five minutes of warm-up time, even in cold weather.
- ◆ Winter blends of fuel and fuel additives better withstand colder temperatures and have solved gelling problems.



## *Reducing Idling Saves Gas and \$\$\$! Simple Math and Simple Solutions*

- **1/2 hour less idling per day per school bus = \$ 127 and 45 gallons of diesel fuel saved per year!**
- **One hour less idling doubles that...a savings of 90 gallons and \$254 annually!**

## *What Can you Do?*

- *Be sure to follow all state and local regulations and policies.*
- *Turn off the engine as soon as possible after arriving at school loading or unloading areas. Only restart the bus when you are ready to depart.*
- *Limit your idling time during early morning warm-up to what the manufacturer recommends (generally no more than five minutes).*
- *Drive farther behind a vehicle with visible exhaust or a noticeable odor.*
- *Talk to your school district about applying for a Diesel Emission Reduction Grant to assist with installing idle reduction technologies*

*The KEY to reducing idling is  
YOU!*



*Mid-Atlantic Diesel Collaborative*

# *Idle-Reduction Recognition Certificate*

Presented to

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for helping to keep the air clean by reducing school bus idling.

Mid-Atlantic  
**Diesel Collaborative**  
on route to cleaner air



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DATE

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COORDINATOR  
Idle-Reduction Initiative