

Additional Activities

Good

Moderate

Unhealthy for Sensitive Groups

Unhealthy

Very Unhealthy

Additional Activities

Introduction

Teachers can use these additional activities as supplements to the lesson plans in this toolkit, or as brief introductions to air quality issues if time is limited. Prior to conducting these activities, teachers may want to review the fact sheets, handouts, and *Background Summary* sections in applicable lesson plans for relevant information to share with students.

Grades K-2

Circle Game

- Access the Air Pollution Circle Game at: <http://dnr.wi.gov/air/pdf/CircleGame.pdf>. Make copies of the Circle Game (color is preferable, but black and white works fine) for each student. Tell students that some things we do make the air dirty, and other things we do help keep the air clean. Dirty air is known as polluted air. Hand out the Circle Game page to students. Tell them to circle the items they think can cause air pollution.
- Discuss the correct answers with students. The following can cause or contribute to air pollution:
 - Cars, boats, and school buses that use gasoline
 - Spray (aerosol) cans
 - Paints that are made from oil
 - Smokestacks from factories
 - Lawnmowers that use gasoline
- Discuss ways that people can make less air pollution:
 - Driving less, and instead walking or bicycling to school with an adult. Riding a train, bus, or subway. All of these things make less air pollution than riding in a car that has one or two people.
 - Driving or riding in cars that use less gasoline.
 - Using paints made with water instead of oil.
 - Using spray cans less often and using other things that do the same thing.
 - Using hand-push lawnmowers instead of mowers that use gas.
 - Using a sailboat instead of a motor boat.
 - Factories can use cleaner ways to make things.

(Source: Wisconsin Department of Natural Resources, Wisconsin Air Management Program, Educational Resources, Air Quality Circle Game)

Match Game

- Access the "clean air/dirty air" matching cards from "Connecting Activity #2 – Clean Up on Gloomy-Doomy" (see the last two pages) at:
www.intheair.org/modules/K-3-ConnectingActivity2.pdf
- Make copies of the matched sets and cut the cards apart, providing enough cards so that each student will have one card of a pair. Place the cards in a bag or box, half of them "dirty" and half "clean" air cards. Have students pick one card out of the box or bag. Ask students whether they think they have a card with a picture of what makes the air dirty or what keeps it clean. Have those with the "dirty air" cards move to one side of the room, and those with "clean air" cards move to the other side of the room. Check the accuracy of students' choices.
- Explain that the purpose of the game is to match clean air cards with dirty air cards to show how dirty air can be made cleaner. Have students look at their cards to decide what kind of match they will be looking for. Then have the two groups mingle and make the matches. When two students believe they have a match, they come to the teacher to see if they are correct. If so, they sit down together; if not, they go back into the group and try again.
- When all the matches have been made correctly, each pair describes to the class what is on their and their partners' cards and how the two pictures connect in keeping the air clean. The teacher helps students with the answers as needed, for example: a fly swatter and a can of insect spray are a match because a fly swatter can kill a fly without putting something harmful in the air that will make it dirty, or polluted, like insect spray will; a bicycle and a car are a match because a bicycle gets you places without polluting the air, while a car gets you places by burning gas that puts pollution into the air.

(Source: Missouri Botanical Garden's Earthways Center and the U.S. EPA, In the Air curriculum, K-3 Education Module)

Visible and Invisible Air Pollution

- Gather together needed materials: yellow and blue powdered drink mixes, squeezable bottles, and several large sheets of scrap paper (newspaper is fine) for the demonstration or for each group. Either the teacher can demonstrate the experiment to the class, or divide the class into groups of approximately six students each.
- Fill one squeezable bottle with yellow drink mix and water. Fill the other bottle with blue drink mix and water. Put large sheets of paper on the floor or table where the students will be making "pollution." Position the papers at a full arm's length extended from the body.
- Tell students that we all need clean air to breathe and keep us healthy. But sometimes the air gets dirty, or polluted. Tell them that some air pollution can be seen, but other air pollution is invisible. Tell students that the squeezable bottles are like smokestacks from factories, which sometimes release pollution into the air. The different colors in the bottles are like air pollution coming out of the smokestacks. The blue color is like air pollution that you can see. The yellow color is like invisible air pollution.
- Let students take turns shaking the closed bottle of the yellow mix and water. Then open the spout and tell the students with the bottles to extend their arms away from their bodies and over the paper. Help them squirt the bottle hard straight into the air above the paper. Repeat the activity with the second squeezable bottle filled with the blue mix and water.
- Ask students which color was easier to see (*Answer: blue*). Tell students that the blue color, which was easy to see, is like air pollution you can see. The yellow, which was harder to see, is like some pollution that is invisible or not very easy to see. Both kinds of pollution exist in our air. Both visible and invisible pollution can affect people, like making it harder to breathe.

(Source: Indiana Department of Environmental Management, Activities, Lesson Plans, and Coloring Books, Environmental Education Plans, Air Quality, Clearing the Air lesson, Activity #2, www.in.gov/idem/files/clearingtheair.pdf)

Milkweed Polka Dots

- In this Internet activity, students learn that plants can be damaged by air pollution (ground-level ozone pollution, in particular). Students examine photos of milkweed leaves, which typically display black dots on their top leaf surfaces when stressed by high amounts of ground-level ozone. Students compare ozone damage to other types of damage.
- Introduce students to both milkweeds and monarch butterflies on the following Web page: www.dnr.state.wi.us/org/caer/ce/eeek/veg/plants/milkweed.htm.

(Since the URLs for this Web page and the next one are long, you may want to first save them to your "Favorites" list for easy access.) Let students know that monarch butterflies lay their eggs on milkweed plants and that monarch caterpillars eat the leaves. If you are able to find one, show students a healthy milkweed leaf.

- Go to the following Internet Web page to view milkweed damage from ozone pollution: www.dnr.state.wi.us/org/caer/ce/eeek/earth/field/milkweed/slideshowindex.htm. Have students study the photo of the ozone-damaged leaf. Discuss the symptoms of milkweed damage from ozone pollution with students: small black dots on the top (not bottom) of the leaves; damage to the leaf, not the veins; damage that won't rub off or wash off. On this same Web page, click on "See the list of slides." Either have students pick a few of these slides to compare with the ozone-damaged leaf photo, or allow them to view the entire slide show. Share with students the information provided on some slides regarding how the damage shown differs from ozone damage to milkweed leaves.

(Source: EEK! Teachers Pages – Milkweed Monitoring Project, www.dnr.state.wi.us/org/caer/ce/eeek/teacher/milkweedmonitoring.htm)

More Activity Ideas

- Make a clean air kite.
- Draw a picture of your favorite clean air environment (e.g., a park, forest, lake).

Grades 3-5

Lung Capacity

- In this activity, the teacher demonstrates "lung capacity" to the class—the amount of air that you can hold in your lungs. Tell students that doctors and nurses sometimes measure lung capacity to see how well a person's lungs are working. Also tell students that air pollution can reduce a person's lung capacity. A person with reduced lung capacity breathes less air into his or her lungs. Reduced lung capacity can contribute to heart and lung diseases. Access this experiment at: www.tryscience.org/experiments/experiments_begin.html?lung.

(Source: Tryscience, IBM Corporation, New York Hall of Science, and the Association of Science-Technology Centers, Experiments, Lung Capacity)

Tomorrow's Air Quality Index (AQI)

- As homework, tell students to find your local Air Quality Index (AQI) forecast for the next day and report it to class tomorrow. Tell students to try to find the AQI forecast for tomorrow in local newspapers, which is often on the weather report page, and cut it out. Or, they can try to find the AQI on the Internet at www.airnow.gov, print it out, and bring it to class. If they hear the AQI forecast for tomorrow on the radio or TV, they can report what they heard to the class. The teacher should bring in his or her own AQI information to verify students' responses. In class the next day, discuss students' results and the AQI (e.g., colors, meanings, health effects, what students can do to protect their health on days with poor air quality).

Air Quality Crossword Puzzle

Directions

Fill in the crossword puzzle with your answers to the questions below.

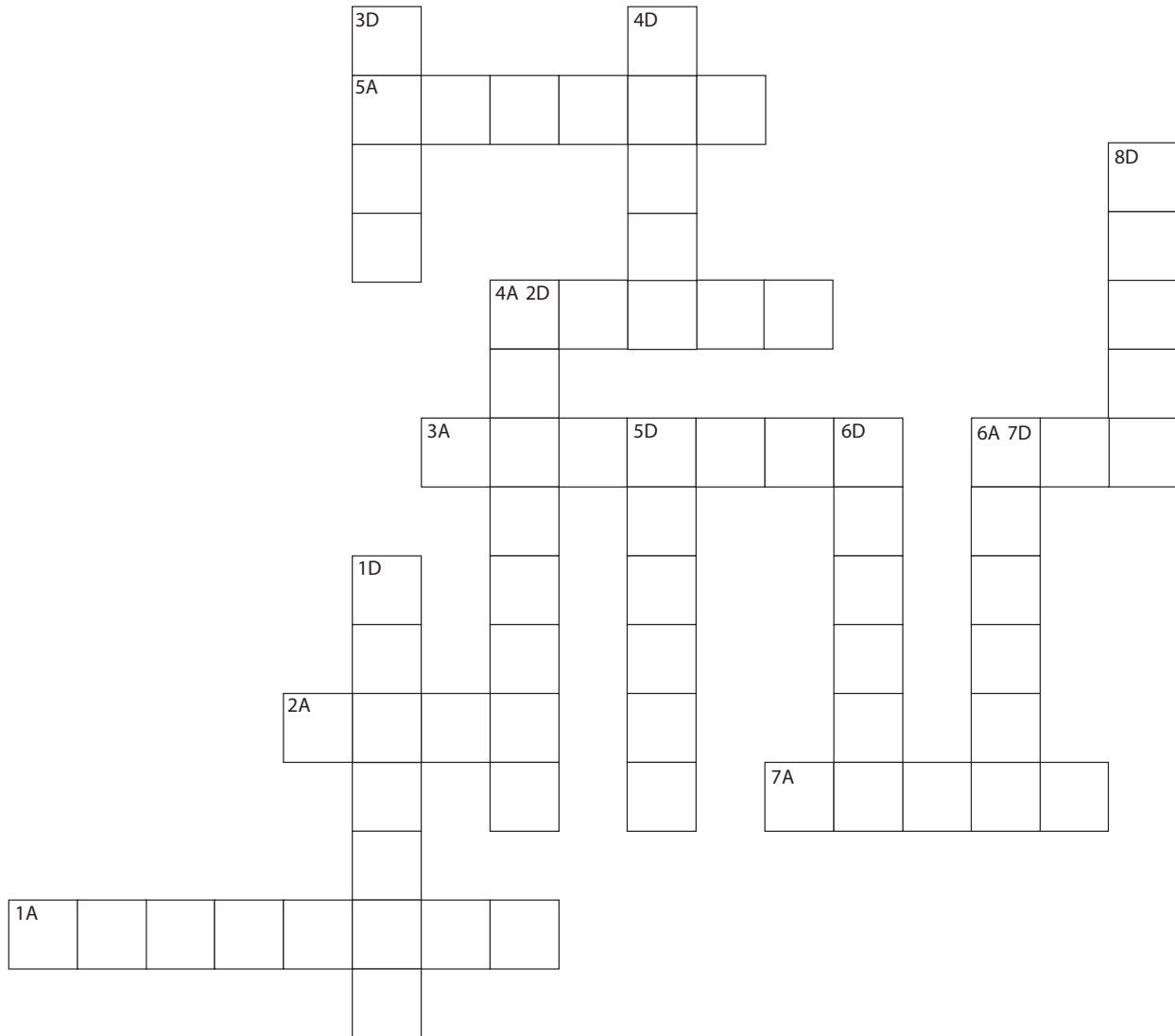
Across

- 1A. What we call the air when it is dirty from things like dust, soot, or chemicals.
- 2A. In addition to power plants and factories, these moving things that take us places can pollute the air.
- 3A. Tell an adult if you find it harder to _____ on a day when the air is polluted.
- 4A. Forest _____ can pollute the air.
- 5A. The name of the Web site where the AQI can be found.
- 6A. We need to breathe _____ to live.
- 7A. The AQI color that means the air quality is "good."

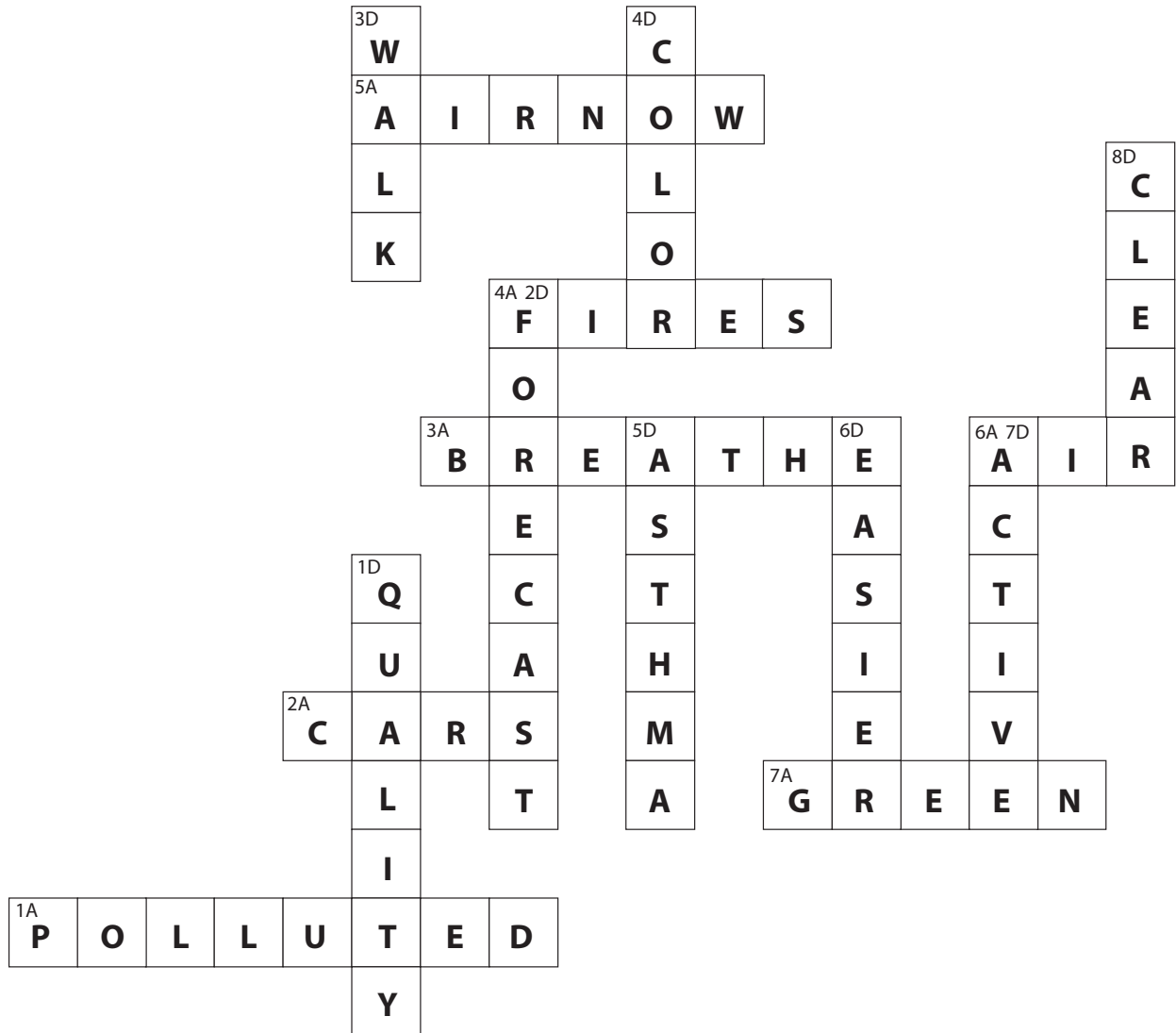
Down

- 1D. "AQI" is an acronym for the Air _____ Index.
- 2D. You might hear about the AQI on the TV, or see it in the newspaper, as part of the weather _____.
- 3D. You might want to do this instead of run on days when the air is polluted.
- 4D. If possible, find out what _____ the AQI is for today and tomorrow.
- 5D. Air pollution can make this breathing problem worse.
- 6D. Take it _____ when you're outside when the air is polluted.
- 7D. We breathe faster and more deeply when we're _____ than when we're resting.
- 8D. Most of the time, when the air is not polluted, it is _____.

Air Quality Crossword Puzzle



Answers to Air Quality Crossword Puzzle



What's Your A.Q.I.Q.? (Air Quality Intelligence Quotient): True or False

Student Worksheet:

Circle "true" or "false" as the correct answers for the statements below.

- | | | |
|--|------|-------|
| 1. Air pollution is only a problem in big cities. | True | False |
| 2. Dirty air is costly to every American. | True | False |
| 3. When the air is polluted, you can always see and smell it. | True | False |
| 4. Clean air is the responsibility of industry alone. | True | False |
| 5. The only health effect of ozone pollution is coughing. | True | False |
| 6. Cars contribute a lot to air pollution problems. | True | False |
| 7. Air pollution is now under control and will not be a problem in the future. | True | False |

What's Your A.Q.I.Q.? (Air Quality Intelligence Quotient): True or False

Teacher Answer Sheet:

1. **Air pollution is a problem only in big cities.** *False.* Everyone is affected by air pollution. The air we breathe does not usually stay in the same place, hovering over us. Oftentimes the air moves. Wind carries pollution to us from hundreds of miles away. Also, the pollution that we produce, no matter how small an amount it may seem, can be significant when combined with everyone else's "small amounts."
2. **Dirty air is costly to every American.** *True.* We pay in health problems caused by air pollution, and the cost of treating people with those health problems. Also, we pay hidden costs in the price of things we buy, for example, the cost of new technology to reduce air pollution. It is frequently less expensive to prevent pollution from occurring in the first place, rather than cleaning it up after it pollutes the air.
3. **When air is polluted, you can always see and smell it.** *False.* Some pollutants are odorless and colorless (such as ozone). That is why it is important to find the Air Quality Index (AQI) in the newspaper, on your favorite news station, or on the Internet (at: www.airnow.gov).
4. **Clean air is the responsibility of industry alone.** *False.* We all have an important role to play in improving our air quality. Choices you can make to improve air quality include turning off lights, TVs, and computers when not using them, and walking, bicycling, or taking a train, bus, or subway (with adult permission) instead of driving places in a car, when possible.
5. **The only health effect of ground-level ozone pollution is coughing.** *False.* Ozone pollution can cause people to cough, but it can also affect our lungs—it can make it harder to breathe, and make asthma worse.
6. **Cars contribute a lot to air pollution problems.** *True.* The automobile industry has made some improvements in equipment in cars that helps reduce pollution, and individual cars and buses release fewer pollutants into the air today than before. However, more people are driving today than ever, and that adds up to a lot of pollution.
7. **Air pollution is now under control and will not be a problem in the future.** *False.* Ozone and particle pollution are still serious problems in many locations in the United States. We all need to be aware of how our activities contribute to pollution and find ways to reduce air pollution and protect our health from the effects of air pollution.

(Source: Ozone Action! Let's Clear the Air. West Michigan Clean Air Coalition, Education, Educational Packet 6-8, www.wmcac.org)

Concept Map

- Have students develop their own concept maps on air quality. For information on concept maps, see: www.inspiration.com/vlearning/index.cfm?fuseaction=concept_maps

As a class, review a couple of concept maps, such as:

<http://classes.aces.uiuc.edu/ACES100/Mind/graphics/arbor-map.gif>

<http://classes.aces.uiuc.edu/ACES100/Mind/graphics/food-map.gif>

- Have the class make a list of key words relating to air quality, for example, some of the vocabulary words in the lesson plans and fact sheets in this toolkit. Examples of possible key words are: air pollution, emissions, ozone, particle pollution, AQI, smog, visible, invisible, health, breathing problems, cough, heart problems, temperature inversion, school bus, cars, factory smokestacks, asthma, car tailpipes, dirty windows.
- In class or as homework, have students begin by writing the words "air quality" in the middle of a blank page (preferably unlined paper). Tell them to add words that relate to air quality, and add lines to connect the related words. Have them add "connecting words" on the lines so that each statement makes sense (an example is "can cause" between "air quality" and "breathing problems" and between "air quality" and "air pollution"). Tell students that they can extend the branches out to three or four branches, and that they should try to include examples and words from their own personal experiences. Tell students they should also include pictures and colors in their concept maps. Have students share their maps with the class, and hold a class discussion.

More Activity Ideas

- Write a clean air poem.
- Make a poster showing what people can do to protect their health when air quality is not good (see *Breathe Smart! Four Things Kids Can Do* handout in this toolkit).
- Make a poster showing what people can do to improve air quality (see *Breathe Smart! Four Things Kids Can Do* handout in this toolkit).
- Make a poster showing poor air quality (e.g., pollution from vehicle tailpipes, particle pollution on windows, smokestacks) and good air quality. Remind students that air pollution can also be invisible.

Grades 6-8

- **Create a timeline** linking industrialization to air quality.
- **Write an essay.** Tell students: You live in a biosphere because there is no clean air left outside of it; write 10 of your thoughts/feelings about this. Have students read the essays in class and discuss.
- **Write a report.** Tell students: You are a local elected environmental official. What environmental regulations might you pass? Consider important issues in your community (e.g., air quality in the community), and what barriers you might encounter (e.g., industry doesn't want to spend more money on controlling air pollution; no public transportation exists in your community). Read and discuss the reports in class.
- **Write a jingle/song** encouraging people to improve air quality.
- **Take a series of photographs** on air quality and display them on poster board. Share students' photo displays with the class/school.

(Source: Flight for Life, www.nb.lung.ca/FFL/)

- **Research "green" vehicles**, as described in the following activity.

Green Vehicles

Through class discussion and online resources, students learn about "green" vehicles—those that are more fuel-efficient and/or produce less air pollution emissions—and "shop" for their first car.

Ask students what they think "green" vehicles are. Then tell them that "green" vehicles can refer to vehicles that are either energy-efficient, produce less air pollution, or both. Ask students why they think most vehicles on the road today are not "green." Most cars today burn gasoline made from oil to produce energy to move the vehicle forward. Burning gasoline releases emissions into the air that contain air pollutants or pollutant-forming substances. Because the number of vehicles on the road, and the miles they travel, have almost doubled since 1970, air pollution is still a serious problem. Decreasing amounts of oil available to produce gasoline is also a major concern.

Describe several types of green vehicles to the class, including:

- **Hybrid vehicles** – are more energy-efficient than conventional cars because hybrids use electricity part of the time instead of gasoline; at other times they use gasoline. Hybrid cars may or may not produce less air pollution emissions.
- **Low emission vehicles** – produce less air pollution than older gasoline-powered vehicles. There are also "ultra-low," "super-ultra low," "partial zero," and "zero" emission vehicles. Most newer vehicles now meet low emission or ultra-low emission requirements. Electric and fuel cell vehicles are examples of zero emission vehicles.

Green Vehicles (continued)

- **Alternative fuel vehicles** – use fuels other than gasoline, such as biofuels made from biomass (natural materials such as plants and biodegradable wastes), ethanol, and methanol. Propane or natural gas can also be used; these produce air emissions, but less than gasoline-powered vehicles.
- **Electric cars** – run completely on electricity instead of gasoline, and produce no air emissions.
- **Fuel cell vehicles** – use hydrogen instead of gasoline; other chemicals could also be used, but these would most likely produce some air emissions (while fuel cells do not), although less than using gasoline.

Hybrids are currently available to buy commercially. Vehicles powered by ethanol in combination with gasoline are also readily available. The other types of green vehicles or alternative fuels are generally not yet commercially available, but much research is being conducted on them.

Ask students: If you were going to buy your first car next week, what things would you look for? (Probable answers: color, speed, cost, special features.) Ask them if they would consider how much gasoline a vehicle uses (miles per gallon), and much fuel would cost to fill up the tank (how “fuel-efficient” the vehicle is). Ask them if they would consider how much air pollutant emissions a car produces.

- With students, visit EPA's Green Vehicle Guide Web site at www.epa.gov/greenvehicles/Howto.do and compare hybrids to other makes and models.
- Also visit the U.S. Department of Energy's and EPA's Fuel Economy Web site at www.fueleconomy.gov/feg/findacar.htm, which compares vehicles based on miles per gallon, annual fuel cost, and EPA pollution score.

For more information on green vehicles, see the Web site:
www.sdrafvc.org/PDFS/CarsCarsCars05.pdf.

Also let students know that properly maintained vehicles pollute much less and get better gas mileage. Tell them that they can encourage their family to keep vehicle engines properly tuned and tires properly inflated, and not to top off the gas tank when fueling – gas spills evaporate and contribute to smog. Also tell them that turning off a car when it's standing still (like when you're waiting for someone to come out of his or her house), rather than keeping it going at such times (known as “idling”), reduces air pollution and saves gasoline.

Summarize by telling students that one of the best ways to protect air quality is to reduce our use of gasoline-powered vehicles when possible and switch to cleaner fuels when available. Using buses, bicycles, subways, trains, and car pools, or walking places instead of using cars, helps keep the air clean.

(Source: American Lung Association of San Diego and Imperial Counties, CA, Education, Cars, Cars, Cars Lesson Plan & Teacher's Guide, www.sdrafvc.org)

Resources for Teachers

Good

Moderate

Unhealthy for Sensitive Groups

Unhealthy

Very Unhealthy

Air Pollution and Health

Through regulation and voluntary change, levels of many air pollutants have decreased significantly in recent decades. Still, in many parts of the U.S. the air is often polluted at levels that can affect our health. Millions of people are exposed to unhealthy levels of ground-level ozone or particle pollution every year.

Ozone

What is ozone? Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ozone occurs naturally in the Earth's upper atmosphere (the stratosphere) and as a pollutant at ground level. Stratospheric ozone protects us from the sun's harmful ultraviolet rays. This beneficial ozone is gradually being destroyed by manmade chemicals. At ground level, ozone is a harmful pollutant formed when emissions from vehicles, power plants, and industrial sources react in the presence of sunlight and heat.

When and where is ozone a concern? Because it needs heat to form, ozone pollution is a concern in warmer weather, particularly in the afternoon and early evening. Ozone can be transported by winds hundreds of miles from where it formed, so it can be found in both urban and rural environments.

Can we see ozone in air? By itself, ozone in air is invisible, so we can be breathing harmful ozone levels even when the air looks clear. When ozone mixes with particles (described below), it forms a brown summertime haze known as "smog."

Why is ozone pollution bad? Ozone can trigger a variety of health problems, even at relatively low levels. Health effects from ozone include aggravated asthma and increased 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 you are active outdoors. But ozone damage can also occur without any noticeable signs. And, for some people, several months of repeated exposure to ozone can permanently damage the lungs. Ozone is also bad for our environment, damaging plants and trees and reducing crop and forest yields.

Who's at risk from ozone pollution? People with respiratory problems are most vulnerable, but even healthy people and children who are active outdoors can be affected when ozone levels are unhealthy. This is because during physical activity, ozone penetrates deeper into the parts of our lungs that are most vulnerable to ozone.

Particle Pollution

What is particle pollution? Particle pollution includes dust, soot, dirt, and liquid droplets. Some particles are large enough to be visible. Others can only be seen under a microscope. The smaller particles cause the greatest health concern because they penetrate deeper into the lungs and can even enter our bloodstream.

What causes particle pollution? Sources of particle pollution include vehicles, factories, and power plants, as well as natural sources such as forest fires and volcanoes.

When and where is particle pollution worst? Particle pollution can be high at any time of year. It can be especially bad during winter, when warm air above cold air causes "inversions"

that can trap pollutants in one area for a period of time. Particle pollution can be especially unhealthy near busy roads and factories, and can reach very hazardous levels in areas downwind of forest fires. Particle pollution can be high indoors, especially when outdoor particle levels are high.

Why is particle pollution bad? Health effects from particles range from coughing and aggravated asthma to chronic bronchitis and even premature death. Many studies link particle pollution levels with increased hospital admissions and emergency room visits. If you have heart disease, particle exposure can cause serious problems in a short period of time—even heart attacks—with no warning signs. Particle pollution also has significant environmental effects. Particles are a major component of haze, which can reduce visibility, for example in national parks and other scenic vistas. Particles are a major contributor to "acid rain," which harms the environment in a number of ways, including making lakes and other water bodies more acidic, which can harm the health of aquatic life; damaging trees and soils; and deteriorating buildings and statues.

Who's at risk from particle pollution? People with heart or lung disease are at risk because particle pollution can aggravate these diseases. Many studies show that when particle levels are unhealthy, older adults are more likely to be hospitalized, and some may die of aggravated heart or lung disease, perhaps because these diseases were previously undiagnosed in these patients. Children are at risk because their lungs are still developing and they are usually very active.

Protect Your Health

Because ozone and particles remain a significant public health concern in many areas of the U.S., the U.S. EPA, in partnership with federal, state, and local agencies and tribes, have set up a nationwide network for reporting daily air quality information and forecasts for these two pollutants, as well as three others. This information is available on the Internet at: www.airnow.gov, in newspapers, via radio and television announcements, and in some areas via air quality e-alerts. Daily air quality is reported using a standard, color-coded scale called the Air Quality Index, or AQI. The AQI makes air quality reports as easy to understand as weather reports.

The best way to protect your health is to check the air quality level and forecast daily for your area, and the related health messages provided by the AQI. By doing so, you can find out when ozone or particle levels are elevated. You can also take simple precautions to minimize exposure, even when you don't feel obvious symptoms. Precautions include:

- When possible, plan activities and exercise when pollution levels are lower (e.g., typically morning or evening for ozone).
- If pollution levels are unhealthy, take it easy when you are active outside. For example, reduce the intensity of your activity (e.g., go for a walk instead of a jog) or reduce the length of your activity. You can also choose to exercise at another time or on another day when the air quality is better. That way, you will reduce the amount of pollution you breathe.
- To reduce exposure to particle pollution, exercise away from busy roadways and other pollution sources.
- Check with your health care provider if you notice any symptoms (such as coughing,

wheezing, difficulty breathing, or chest pain) when the air is polluted. This is especially important if you are a member of a sensitive group (i.e., for ozone—active children or adults, and people with lung disease; for particle pollution—people with heart or lung disease, older adults, and children).

What Is the Air Quality Index (AQI)?

The AQI is an index for reporting daily air quality. It uses a simple color-coded scale to tell you how clean or polluted your air is, and how you can protect your health at different levels of pollution. The AQI helps to make daily air quality information as easy to understand as weather forecasts.

How Does the AQI Work?

The AQI is essentially 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 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Understanding the AQI

To make it easier to understand, the AQI is divided into six categories:

Air Quality Index Values	Levels of Health Concern	Colors
When the AQI is in this range:	...air quality conditions are:	...as symbolized by this color:
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Each category corresponds to a different level of health concern:

- **"Good"**—The AQI value for a particular community is between 0 and 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
- **"Moderate"**—The AQI for a community is between 51 and 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
- **"Unhealthy for Sensitive Groups"**—When AQI values are between 101 and 150, members of sensitive groups may experience health effects. This means they are likely to be affected at lower levels than the general public. For example, people with lung disease are at greater risk from exposure to ozone, while people with either lung disease or heart disease are at greater risk from exposure to particle pollution. The general public is not likely to be affected when the AQI is in this range.

- **"Unhealthy"**—Everyone may begin to experience health effects when AQI values are between 151 and 200. Members of sensitive groups may experience more serious health effects.
- **"Very Unhealthy"**—AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.
- **"Hazardous"**—AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

How Is a Community's AQI Calculated?

Air quality is measured by monitors that record the concentrations of the major pollutants each day at more than a thousand locations across the country. These raw measurements are then converted into AQI values using standard formulas developed by EPA. An AQI value is calculated for each pollutant in an area (ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide). The highest AQI value for the individual pollutants is the AQI value for that day. For example, if on July 12 a certain area had AQI values of 90 for ozone and 88 for sulfur dioxide, the AQI value would be 90 for the pollutant ozone on that day.

When and How Is the AQI Reported to the Public?

In large cities (more than 350,000 people), state and local agencies are required to report the AQI to the public daily. When the AQI is above 100, agencies must also report which groups, such as children or people with asthma or heart disease, may be sensitive to those pollutants. Many smaller communities also report the AQI as a public health service.

Many cities also provide forecasts for the next day's AQI. These forecasts help local residents protect their health by alerting them to plan their vigorous activities for a time when air quality is better.

The AQI is a national index, so the value and colors used to show local air quality and the levels of health concern will be the same everywhere in the U.S. You can always find AQI reports for areas across the U.S. on the Internet at EPA's AIRNow web site: www.airnow.gov. The AQI is also frequently reported in local newspapers, on local television and radio stations, and on many state and local telephone hotlines.

What Are Typical AQI Values in Most Communities?

In many U.S. communities, AQI values are usually below 100, with values greater than 100 occurring just several times a year. Typically, larger cities have more severe air pollution problems, and the AQI in these areas may exceed 100 more often than in smaller cities. AQI values higher than 200 are infrequent, and AQI values above 300 are extremely rare.

AQI values can vary from one season to another. In winter, for example, carbon monoxide may be high in some areas because the cold weather makes it difficult for car emission control systems to operate effectively. In summer, ozone may be a significant air pollutant because it forms in the presence of heat and sunlight. Particle pollution can be elevated at any time of the year.

AQI values also can vary depending on the time of day. For example, ozone levels often peak in the afternoon, while carbon monoxide is usually a problem during morning or evening rush hours. Particle pollution can be high at any time of day.

Additional Air Quality Resources

Curricula, Lesson Plans, and Activities

Air Pollution: What's the Solution?

This educational project uses online, real-time air quality and weather data to guide Grades 6-12 students in understanding the science behind the causes and effects of ground-level ozone pollution. Available at: www.k12science.org/curriculum/airproj/

Air Quality Education Program

The Delaware Department of Natural Resources and Environmental Control's Air Quality Education Program for Grades 6-12 includes detailed lesson plans. Available at: www.dnrec.state.de.us/DNREC2000/Divisions/AWM/aqm/education/Contnt.htm

Air Quality and Transportation Curriculum

The Alamo Area Council of Governments in Texas compiled this curriculum on air quality, transportation, and health. The curriculum provides lessons and activities for Grades K-12. Available at: www.aacog.com/Air/curriculum/

AQI Toolkit for Weathercasters

EPA's AQI Toolkit for Weathercasters is a companion to this AQI Toolkit for Teachers. The weathercasters toolkit includes presentations on air quality, weather, the AQI, ozone, particle pollution, and health for Grades 3-8 and adults, and earlier versions of the lesson plans in this toolkit. Available at: www.airnow.gov/index.cfm?action=weathercast.main

Clean Air Campaign

The Clean Air Campaign and the Georgia Environmental Protection Division provide air quality lesson plans as well as school programs and children's activities. Available at: www.cleanaircampaign.com/for_schools/

Eco Badge® Educational Products

Vistanomics' "eco store" sells air quality educational materials, including the Eco Badge® (a compact, easy-to-use device to measure ozone levels at home or in the work environment). The site also provides examples of successful teacher programs using the Eco Badge. Available at: www.ecobadge.com

EPA Teaching Resources—Air

This Web page provides links to curricula and activities on a variety of environmental topics, including ozone and the AQI. Available at: www.epa.gov/teachers/air.htm

Flight for Life

The New Brunswick Lung Association provides educational resources on respiration, indoor and outdoor air quality, climate change, and health for elementary, middle school, and high school teachers and students. Available at: www.nb.lung.ca/FFL

In The Air

Provides environmental education materials for Grades K-12 and adults on airborne toxics. Developed by the Missouri Botanical Garden's Earthways Center and the EPA. Available at: www.intheair.org

Ozone Action

The West Michigan Clean Air Coalition offers educational packets with lesson plans and activities for Grades K-12. Available at: www.wmcac.org/resources/education.html

Project A.I.R.E. (Air Information Resources for Educators)

The units in Project A.I.R.E. cover air quality, rainforests, radon, environmental laws, the greenhouse effect, and ozone, among others, for Grades K-12. Available at: www.epa.gov/region01/students/teacher/aire.html

Teaching Environmental Sciences (TES)

The Texas Commission on Environmental Quality provides Grades K-12 background information, lesson plans, activities, and resources on air quality for teachers. Available at: www.tceq.state.tx.us/assistance/nav/tes.html

The KnowZone

Developed by the California Air Resources Board, The KnowZone offers a variety of teacher and student resources, including lesson plans, a video, a presentation, and Safe Routes to Schools information. Available at: <http://www.arb.ca.gov/knowzone/knowzone.htm>

SunWise School Program

An environmental and health education program designed to teach children and their caregivers how to protect themselves from overexposure to the sun. Available free of charge to schools, the SunWise Tool Kit contains classroom lessons and background information for Grades K-8. Available at: www.epa.gov/sunwise

Walking for Health and the Environment Curriculum

This curriculum for Grades K-5 helps students make connections between exercise, health, and the environment. Developed by Walk Boston and Eastern Research Group, Inc. (ERG). Available at: www.walkboston.org/work/safe_routes.htm#

Selected Web Sites

AIRNow Web site

The AIRNow Web site provides the public with easy access to air quality information. The Web site provides real-time air quality conditions and daily air quality forecasts for over 300 cities across the U.S., teacher and student resources, links to more detailed state and local air quality Web sites, and real-time images of air quality and visibility via webcams. Available at: www.airnow.gov.

AIRNow's air quality resources for teachers can be found at: www.airnow.gov/index.cfm?action=static.resource

AIRNow's Air Quality Index Kids Page can be found at:
www.airnow.gov/index.cfm?action=aqikids.index

Smog City 2

The Smog City 2 Web site explores particle pollution and ozone pollution in a hypothetical city. Users can change variables such as weather conditions, emission levels, and population, and see how these changes affect air quality. Developed by the U.S. EPA and the Sacramento Air Quality Management District. Available at: www.smogcity2.org

Selected EPA Air Quality Publications

The following U.S. EPA publications are available online (print versions may be available free of charge) at: www.airnow.gov/index.cfm?action=static.publications

- **Air Quality Index—A Guide to Air Quality and Your Health.** This booklet explains EPA's Air Quality Index (AQI) and the health effects of major air pollutants.
- **Air Quality Guide for Ozone.** This guide provides information about ways to protect your health when ozone levels reach the unhealthy range, and ways you can help reduce ozone air pollution.
- **Air Quality Guide for Particle Pollution.** This guide provides information about ways to protect your health when particle pollution levels reach the unhealthy range, and ways you can help reduce particle air pollution.
- **Particle Pollution and Your Health.** This short, colorful pamphlet describes who is at risk from exposure to particle pollution (also known as particulate matter), what health effects may be caused by particles, and simple measures that can be taken to reduce health risk.
- **Ozone and Your Health.** This short, colorful pamphlet describes who is at risk from exposure to ozone, what health effects are caused by ozone, and simple measures that can be taken to reduce health risk.
- **Ozone: Good Up High, Bad Nearby.** This publication provides information about ground-level and high-altitude ozone and their different effects.
- **Smog Who Does it Hurt?** This 8-page booklet provides more detailed information than "Ozone and Your Health" about ozone health effects and how to avoid them.
- **Summertime Safety: Keeping Safe from Sun Smog.** This document discusses summer health hazards that pertain particularly to children and includes information about EPA's Air Quality Index and UV Index tools.