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# AQI Toolkit for Teachers

U.S. Environmental Protection Agency  
Office of Air Quality Planning and Standards  
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## **Notice**

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

# Toolkit Overview

**Good**

**Moderate**

**Unhealthy for Sensitive Groups**

**Unhealthy**

**Very Unhealthy**





# Toolkit Overview

## Introduction to the AQI and This Toolkit

Children are one of the sensitive groups at risk for health effects from air pollution, in part because their lungs are still developing. The Air Quality Index (AQI) is an important tool for letting children know when air quality in their area is unhealthy and how they, their families, and communities can protect their health. The AQI uses a color-coded scale and maps to provide daily air quality information. Check the AQI at [www.airnow.gov](http://www.airnow.gov), download the AirNow App, or install the AirNow Widget on your website. Many local newspapers and television and radio stations also present the AQI. You can also sign up for air quality emails at: [www.airnow.gov/enviroflash](http://www.airnow.gov/enviroflash).

Compiled by the U.S. Environmental Protection Agency (EPA), this Toolkit provides teachers with easy-to-use and engaging lesson plans, additional activities, and other resources to teach students about the connections between air quality, health, weather, and other related science topics, as well as actions students can take to protect their health and reduce air pollution.

The lesson plans in this Toolkit meet Next Generation Science Standards and can be easily incorporated into school curriculums.

## What's In This Toolkit?

*This Toolkit includes:*

- **Key messages**—Bullet point lists of key air quality messages for each age group.
- **Lesson plans** appropriate for:
  - Grades K through 2
  - Grades 3 through 5
  - Grades 6 through 8
- **Additional activities**—Brief descriptions of other activities about air quality that teachers can conduct with students.
- **Handouts**—Simple one-page, age-appropriate handouts for students on air quality that highlight how they can protect their health and the environment.
- **Background information** for teachers on air quality, the AQI, and related health impacts, including:
  - *Fact Sheets on:*
    - Air Pollution and Health
    - The Air Quality Index
  - *Bibliography* of curricula, lesson plans, activities, publications, and Web sites

## Teachers' Guide

The Key Messages in the Toolkit provide an overview of air quality issues covered in the lesson plans. The Background Summary section of each lesson plan offers a brief synopsis of the lesson's topics and procedures; these sections are written in easy-to-understand language to assist teachers in communicating relatively complex environmental and health topics to students. For more information, teachers can review the Toolkit's fact sheets. The age-appropriate handouts can be distributed at the beginning or end of a lesson, or independently, to let students know "at a glance" what they can do to protect themselves and the environment when air quality is unhealthy.

Two pollutants in particular, ground-level ozone and particle pollution, are sometimes present at unhealthy levels in many parts of the United States. The Toolkit focuses on these two air pollutants, with information on sources of these pollutants, how to use the AQI to find out current levels of these pollutants in particular locations, and ways to improve air quality and protect our health.

## Quick Prep

- Read the Key Messages and fact sheets in this Toolkit to familiarize yourself with air quality issues, the AQI, the health effects of air pollution, and ways to protect air quality.
- Visit EPA's AIRNow Web site at [www.airnow.gov](http://www.airnow.gov) for further information about the AQI and to obtain local air quality information.
- Review the table of Next Generation Science Standards and Toolkit Lesson Plans (next page) to help you decide which lesson plan(s) to use.
- Read the *Background Summary* sections of the Toolkit lesson plans to help you select and prepare for lessons.
- Checklist:
  - \_\_\_\_\_ Copy of lesson plan(s) you will be conducting with your class.
  - \_\_\_\_\_ Copies of Student Worksheets, as needed, and Teacher Answer Sheets.
  - \_\_\_\_\_ Internet access, as needed.
  - \_\_\_\_\_ Copies of age-appropriate handout for each student.
  - \_\_\_\_\_ Materials needed for the selected lesson plan(s).

# Next Generation Science Standards

The lesson plans in this toolkit meet the following Next Generation Science Standards ([www.nextgenscience.org/next-generation-science-standards](http://www.nextgenscience.org/next-generation-science-standards)), as verified by an education expert:

Lesson Plans	Next Generation Science Standards
<b>Grades K-2</b>	
<b>What Color Is My Air Today?</b>	Engineering Design Interdependent Relationships in Ecosystems
<b>Now You See It, Now You Don't</b>	Engineering Design Interdependent Relationships in Ecosystems
<b>Breathing, Playing Outside, and Air Pollution</b>	Engineering Design Interdependent Relationships in Ecosystems
<b>How Dirty is the Air We Breathe?</b>	Engineering Design Interdependent Relationships in Ecosystems
<b>Grades 3-5</b>	
<b>The Ozone Between Us</b>	Energy Interdependent Relationships in Ecosystems Matter and Energy in Organisms and Ecosystems Earth and Human Activity Engineering Design
<b>The Cilia (not Silly!) Game</b>	Energy Interdependent Relationships in Ecosystems Engineering Design Matter and Energy in Organisms and Ecosystems

Lesson Plans	Next Generation Science Standards
<b>Grades 3-5 (continued)</b>	
<b>Traffic Tally</b>	Energy Interdependent Relationships in Ecosystems Engineering Design
<b>Trapping Air Pollution: Temperature Inversions #1</b>	Weather and Climate Earth and Human Activity Engineering Design Matter and Energy in Organisms and Ecosystems
<b>Save Smog City 2 from Particle Pollution</b>	Weather and Climate Energy Interdependent Relationships in Ecosystems Engineering Design Matter and Energy in Organisms and Ecosystems
<b>Grades 6-8</b>	
<b>Symptoms Scenario</b>	Interdependent Relationships in Ecosystems Human Impacts Engineering Design
<b>Tracking Air Quality</b>	Chemical Reactions Human Impacts Weather and Climate Engineering Design

Lesson Plans	Next Generation Science Standards
<b>Grades 6-8 (continued)</b>	
<b>Smog Alert</b>	Human Impacts Earth's Systems Weather and Climate Engineering Design
<b>Trapping Air Pollution: Temperature Inversions #2</b>	Human Impacts Weather and Climate Engineering Design
<b>What's Riding the Wind?</b>	Human Impacts Engineering Design
<b>Save Smog City 2 from Ozone</b>	Human Impacts Engineering Design



# Grades K-2

**Good**

**Moderate**

**Unhealthy for Sensitive Groups**

**Unhealthy**

**Very Unhealthy**





# Key Messages: Grades K-2



- Breathing dirty air is not good for people. For example: You might feel like it's harder to breathe, you might cough, or your chest might feel tight.
- You can help protect your health when the air is dirty. Here are three things you can do.
  1. Find out how clean your air is each day.
    - You can do this by checking the AQI, just like checking the weather report. The AQI (or the Air Quality Index) uses colors to tell you how clean or dirty the air is. For example, green means the air is clean. Red means the air is unhealthy.
    - You can always find the AQI on the Internet at a site called AIRNow at: [www.airnow.gov](http://www.airnow.gov). You also might hear about the AQI on TV during the weather forecast or on the radio, or you might see it on the weather page in the local newspaper.
    - Tell your parents about the AQI so they can check how clean or dirty the air is.
  2. If you play outside when you know the air is polluted, you can protect your health by taking it easier. For example, walk instead of run, take breaks often, or play outside at another time or on another day when the air is cleaner.
  3. If you notice any signs when you are playing outside like coughing, pain when you take a deep breath, chest tightness, or wheezing, stop playing and tell an adult.
    - If you have asthma, pay special attention on polluted days. If you think you or a friend may be having an asthma attack, tell an adult.



# **Lesson Plans**



# What Color Is My Air Today?



## Learning Objectives

### Students will:

- Understand how breathing the air can affect people's bodies and health.
- Describe how colors and numbers can represent different classifications of something, such as levels of air quality.
- Understand that air pollution, driving, and health are connected.

**Grade Level:** Grades K-2

**Estimated Time:** 30 minutes

## Background Summary

Some days, the air is clear and smells fresh and clean. Clean air is air that has no harmful levels of pollutants (such as dirt and chemicals) in it. Clean air is good for people to breathe. However, on a hot day with no wind—especially in some cities—the air can feel heavy and may have a bad smell. Sometimes, the air can even make your chest feel tight, or make you cough. When too much dirt or too many chemicals get into the air, the air is dirty, or polluted. Polluted air is not good for people to breathe.

Scientists measure pollution in the air across the country. Then they use something called the Air Quality Index, or AQI for short, to tell people how clean or dirty the air is each day in different places. The AQI uses colors, words, and numbers to tell you about the air.

Using EPA's online Air Quality Index color game, students will learn that air quality can be classified according to different levels of pollution, and that these levels can be represented by colors and/or numbers. They will also learn that they can find out what the Air Quality Index is on any given day and understand what it means for people's outdoor activities. This lesson also introduces students to different types of transportation and ways that transportation choices can affect air quality.

## Materials Needed

- Internet access (preferable) (or, print version of AQI Color Game included with this lesson)
- Computer printer, preferably color, if not conducting activity online
- Chart of AQI colors and their meanings (simplified print version included)

- AQI color posters (online or printed, see Step 6)

## Key Questions

- What is air pollution? (*Answer:* Air pollution is when too much dirt or chemicals get into the air.)
- What is the Air Quality Index, or AQI? (*Answer:* The AQI tells us how clean or dirty the air is each day.)
- How can you and your family help reduce air pollution? (*Possible Answers:* Walk more, ride bikes, or carpool. [Carpooling is when more than one person not related to each other share a ride somewhere.] People can also take the bus, train, or subway to reduce air pollution instead of driving in their cars.)

## Vocabulary

**Air Pollution**—Occurs when too much dirt or too many chemicals get into the air and make it dirty.

**Air Quality Index**—Colors and numbers used to tell how clean or dirty the air is.

## Steps

1. Have the class play the *AQI Color Game* online at: [www.airnow.gov/index.cfm?action=aqikids.games](http://www.airnow.gov/index.cfm?action=aqikids.games) easy or hand out copies of the game (Easy version).

It may take a minute for the color chart to load onto your computer.

(Note: The AQI Color Game is available online at different levels: easy, medium, and hard. First have students play the "easy" game, which discusses AQI colors only. Then add a discussion of the AQI numbers, as discussed in the "Steps" below.

The medium and hard versions of the game are appropriate for students in Grades 3–5.)

If printing, also print out the answer key for the teacher. It is best if the student game can be printed in color.

2. Discuss the AQI colors and their meanings with students. Tell students that each day, the AQI is one of these colors. The colors tell you how healthy the air is to breathe that day. The colors go from Green to Yellow to Orange to Red to Purple, with each color telling you that the air is less clean than the color before.

(Note: If students ask, you can tell them that the last AQI color, Maroon, which represents the worst air quality, is usually not included with the other AQI colors because air quality in the U.S. has not been Maroon in many years. This is probably because people have been working hard to clean up the air.)

Give students the following simplified chart of the AQI colors and their meanings, and read the chart to them.

3. Tell students to look at their AQI Color Game Student Worksheet. With the help of the chart of AQI colors and meanings you gave them in Step #2, tell students to draw a line from the AQI words on the left side to the correct color on the right side of the worksheet. For younger students (e.g., kindergarten), the teacher can read the words and ask students which words go with which colors. For older students (e.g., Grade 2), the teacher may need to assist students in reading and understanding some of the key words, as discussed in the table above.
4. Discuss the correct answers using the Teacher Answer Sheet.
5. Add a discussion of the AQI numbering system. An index uses numbers to tell people how good or bad something is. For example, you might say your school lunch is a 1 (very good) or a 5 (yucky). The Air Quality Index uses numbers from 0 to 500. These numbers are used to decide the AQI color for a particular day. On days measuring less than 100, the air is clean. If the air is dirtier, the numbers get bigger. On days measuring more than 100, the air can be bad for you to breathe.

If Color is...	What This Means for Outdoor Activity
<b>Green</b>	The air is <b>"good"</b> and it's a great day to be active outside!
<b>Yellow</b>	The air is <b>"moderate"</b> – it's fine for most people to be active outside. However, people who are unusually sensitive to air pollution may notice symptoms such as coughing or shortness of breath. These are signs to take it easier.
<b>Orange</b>	The air is <b>"unhealthy for sensitive groups."</b> This group can include people with heart or lung problems (such as asthma), kids, and older grown-ups, who should take it a little easier.
<b>Red</b>	The air is <b>"unhealthy."</b> Everyone should take it a little easier or spend less time being active outside.
<b>Purple</b>	The air is <b>"very unhealthy."</b> People should be active indoors on purple days.

For more complete Air Quality and Outdoor Activity Guidance for Schools, visit [www.epa.gov/airnow/school\\_flag/school-chart-2013.pdf](http://www.epa.gov/airnow/school_flag/school-chart-2013.pdf)

Here is how the AQI numbers match up with the AQI colors:

<b>AQI Numbers</b>	<b>AQI Colors</b>
<b>0 to 50</b>	<b>Green</b>
<b>51 to 100</b>	<b>Yellow</b>
<b>101 to 150</b>	<b>Orange</b>
<b>151 to 200</b>	<b>Red</b>
<b>201 to 300</b>	<b>Purple</b>

- Have students view the six AQI color posters online, or print out several sets of the posters and pass them around the class, available from the EPA AIRNow website at: [www.epa.gov/airnow/aqikids/pdffiles/posters.pdf](http://www.epa.gov/airnow/aqikids/pdffiles/posters.pdf)

It is best if these posters can be printed in color.

- Discuss the six posters in sequence (from Green to Purple), which will reinforce the lesson thus far, including both AQI colors and numbers.
- Tell students how they and their families can help reduce air pollution. Most cars contribute to air pollution. To reduce air pollution, students and their families can walk more, ride their bikes, or carpool. (Carpooling is when more than one person share a ride somewhere.) People can also take the bus, train, or subway to reduce air pollution instead of driving their cars.

## Adaptation

For older students (Grades 3–5), play the Medium and/or Hard versions of the AQI Color Game. Add more in-depth discussion from the EPA Web site at: [www.epa.gov/airnow//aqikids/pdffiles/aqirefer.pdf](http://www.epa.gov/airnow//aqikids/pdffiles/aqirefer.pdf)

## For Further Exploration

If using the Internet, go to [www.airnow.gov](http://www.airnow.gov) and under the map find “Local Air Quality Conditions and Forecasts” and choose a state or click on “Select by map.” Review the information for the nearest city with the students. You can click on a city name for more detailed information. Ask students what the air quality is for today and expected to be tomorrow.

Have students try to find and cut out the Air Quality Index in the newspaper and bring it in to class to discuss; the AQI can often be found on the weather page in newspapers.

## Acknowledgments/Resources

U.S. EPA. Air Quality Index Kids Page at: [www.airnow.gov/index.cfm?action=aqikids.games](http://www.airnow.gov/index.cfm?action=aqikids.games)

## Next Generation Science Standards

**Engineering Design**  
**Interdependent Relationships in Ecosystems**

# Student Worksheet: What Color Is My Air Today?

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

## AQI Color Game

### Easy Game

To play this game, first print this page and then draw a line from the AQI word(s) on the left side to the correct color on the right.

1. Good
2. Moderate
3. Unhealthy for Sensitive Groups
4. Unhealthy
5. Very Unhealthy

Green

Yellow

Orange

Red

Purple



## Teacher Answer Sheet: What Color Is My Air Today?

### AQI Color Game

#### Easy Game

- |                                   |   |        |
|-----------------------------------|---|--------|
| 1. Good                           | → | Green  |
| 2. Moderate                       | → | Yellow |
| 3. Unhealthy for Sensitive Groups | → | Orange |
| 4. Unhealthy                      | → | Red    |
| 5. Very Unhealthy                 | → | Purple |



## Now You See It, Now You Don't



### Learning Objectives

#### Students will:

- Observe differences between gases and particles, in the context of air pollution.
- Identify common gases and particles in the air that can contribute to air pollution.

**Grade Level:** Grades K–2

**Estimated Time:** 30 minutes

## Background Summary

Sometimes the air is clean, and sometimes it's dirty. When the air is dirty, it's called pollution. There are different kinds of air pollution. Some air pollution is made of particles, such as small pieces of dirt or dust. This is called particle pollution. Other kinds of air pollution are gases, which usually you cannot see. Ozone near the ground where we can breathe it in is a harmful air pollutant that is a gas. But ozone many miles above the Earth (in the stratosphere) is good for us. It helps protect us from sunburn. You can't see ozone in the air. The cars that we ride in can make air pollution—both particle pollution and gases like ozone. If people walked, bicycled, or took buses or trains more often instead of driving places, fewer cars would be on the road. This is one way to make less air pollution.

In this lesson, students observe differences between gases and particles in the air. Water represents air. Milk in water acts like an air pollutant that is a gas. Pepper in water acts like particle pollution in the air. Students then identify common gases and particles in the air that can contribute to air pollution.

## Materials Needed

- Two clear glass bowls (if teacher demonstrates) or 2 large clear plastic cups per group (if students perform activity)\*
- One tablespoon of milk for one bowl or cup
- One teaspoon of pepper for the other bowl or cup
- One plastic spoon for each bowl or cup
- Water
- Student Worksheet (included)
- Teacher Answer Sheet (included)

*\*Note:* If the teacher does this as a demonstration with the clear glass bowl, it helps to have a light or white paper behind the pepper so it is easier to observe. Alternatively, students can do this in small groups using clear disposable cups instead of the glass bowl.

## Key Questions

- What is the water supposed to be in this experiment? (*Answer:* Air.)
- (During Step 2)—What kind of air pollution do you think the milk is like when it combines with the water: a gas, or particle pollution? (*Answer:* A gas)
- (During Step 3)—What kind of air pollution do you think the pepper is like when it combines with the water: a gas, or particle pollution? (*Answer:* Particle pollution)

## Vocabulary

**Gas**—Something that is not a solid or a liquid. A gas doesn't have a particular shape, and usually is invisible.

**Particle**—A small bit of something, such as dirt or dust.

**Pollution**—Harmful substance put into the environment, for example into the air, water, or soil.

**Ozone**—A gas. When ozone is near the ground, it is bad, and is air pollution. Ozone high up in the atmosphere is good, and helps protect us from sunburn.

## Steps

1. Review vocabulary as needed and age-appropriate. Divide the class into small groups (if the teacher is not conducting the activity for the entire class). Fill the clear glass bowl or clear disposable cups half full with water. Tell students to think of the water

as "air." Tell students to carefully look at the bowls (or cups) to see what happens as you add things to the water.

2. Add one tablespoon of milk to one of the bowls or cups of water and stir to mix. Then ask: What happened to the milk when it was added to the water? (*Answer:* It mixed with the water, or a similar answer.) Then ask: What kind of air pollution did the milk act like in the water—air pollution that is a gas, or particle pollution in the air? (*Answer:* Gas.)
3. Now add one teaspoon of pepper to the other bowl or cup of water and stir. Then ask: What happened to the pepper when it was added to the water? (*Answer:* It did not mix with the water; it stayed separate from the water, or a similar answer.) Then ask: What kind of air pollution did the pepper act like in the water—air pollution that is a gas, or particle pollution in the air? (*Answer:* Particle pollution.)
4. Ask students: If the bowls or cups were left on a shelf all day, which do you think would sink to the bottom of the bowl or cup—the pepper or milk? (*Answer:* Pepper.) Ask: Would it be easier to get the milk or the pepper out of the water? (*Answer:* Pepper.) Remind students that the milk is like air pollution that is a gas, and the pepper is like particle pollution in the air.
5. Ask students: Do you think it would be easier to get gases or particles out of the air? (*Answer:* Particles.) Why?
6. Use the Student Worksheet, first for word recognition, then have students fill out the Worksheet as best they can, with teacher assistance.
  - (a) Begin this step as a word recognition task: For older students who can read (e.g., Grade 2), tell students to highlight or circle some of the words they recognize on the Student Worksheet. For younger students, the teacher can use an overhead transparency or make word cards to read, and lead a class discussion.

- (b) Next, tell students to fill out the Worksheet for the highlighted or circled items. Tell them to check off whether they think the things listed in the first, left-hand column can make particle pollution (2nd column), a gas that is air pollution (3rd column), or both particle pollution and a gas (last column).

Review the Student Worksheets with the class. (The Teacher Answer Sheet provides the correct answers.)

## Adaptation

Students could receive a star or sticker for answering correctly.

For older students, introduce the concepts of solutions (i.e., milk and water) and suspensions (i.e., pepper and water) in scientific terms. Also, see the lesson plan, "Parts Per Million," on the Rutgers University Web site listed below.

## For Further Exploration

Have the students research some of the types of air pollution listed on the Student Worksheet.

## Acknowledgments/Resources

Suspended Particulates Lab Lesson Plan. Rutgers Engineering, contributed by D. Gioffre, Hillsborough Middle School, Hillsborough, NJ 08844 at: [www.engineeringplanet.rutgers.edu](http://www.engineeringplanet.rutgers.edu)

## Next Generation Science Standards

**Engineering Design**  
**Interdependent Relationships in Ecosystems**

## Student Worksheet: Now You See It, Now You Don't

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

<b>Air Pollution from...</b>	<b>...is particle pollution?</b>	<b>...a gas?</b>	<b>...both particle pollution and a gas?</b>
<b>Car tail pipes</b>			
<b>Cow burps</b>			
<b>Dirt</b>			
<b>Dust</b>			
<b>Factory smoke stacks</b>			
<b>Fireplaces</b>			
<b>Forest fires</b>			
<b>Volcano ash</b>			

## Teacher Answer Sheet: Now You See It, Now You Don't

Air Pollution from...	...is particle pollution?	...a gas?	...both particle pollution and a gas?
Car tail pipes			✓
Cow burps		✓	
Dirt	✓		
Dust	✓		
Factory smoke stacks			✓
Fireplaces			✓
Forest fires			✓
Volcano ash	✓		

# Breathing and Air Pollution



## Learning Objectives

### Students will:

- Observe how breathing changes with physical activity.
- Learn how air pollution can affect breathing and our health.

**Grade Level:** Grades K-2

**Estimated Time:** 30 minutes

## Background Summary

Most living things, including people, need the oxygen in air to breathe. When we're more active, like when we're running, bicycling, or jumping, our bodies need more oxygen and air. We may notice that our breathing is faster and we take deeper breaths when we're active. This faster and deeper breathing is how our body takes in more oxygen and air when needed, which can help make us healthier.

Breathing dirty, or polluted, air is not good for people. For example, it might make you cough, or you might feel like it's harder to breathe. If an adult tells you the air is polluted while you're playing outside, you can protect your health by taking it a little easier. For example, walk instead of run, take breaks often, or play outside at another time or on another day when the air is cleaner. If you have trouble breathing on days with a lot of air pollution, tell an adult.

This lesson involves having a few students count their breaths while at rest and again after jumping up and down. The class will discuss differences in breathing when at rest and after jumping, and how students can protect their health from air pollution.

## Materials Needed

- Stopwatch, watch, or clock with second hand
- Blackboard
- Handout (included)

## Key Questions

- Does a person breathe faster when active or when sitting still? (*Answer:* When active.)
- How can faster and deeper breathing improve our health? (*Answer:* It gives our bodies more oxygen.)
- How can we protect our health from air pollution? (*Answer:* We can take it easier on days when there

is a lot of air pollution. We can walk instead of run, take more breaks, or play outside when the air is cleaner. If you have trouble breathing on days with a lot of air pollution, tell an adult.)

## Vocabulary

**Pollution**—Things put into the air that can make the air dirty.

**Improve**—To make better.

**Protect**—To keep from being hurt.

## Steps

1. Tell the class that they are going to see how being active affects breathing.
2. Pick three student volunteers. (*Note:* Do not pick students who are not feeling well or have health conditions that restrict exercising.) Write their names on the blackboard horizontally so you can add information in columns under each name.
3. Have all three student volunteers seated at the front of the class. Tell the volunteers to breathe normally. Tell the volunteers and the class that when you say "Go," the volunteers are going to count how many breaths he or she takes in 30 seconds, when he or she is just sitting and is not active, until you say "Stop." Remind the volunteers to take normal breaths.
4. Say "Go," remind the volunteers to start counting, and watch the clock for 30 seconds.
5. After 30 seconds, say "Stop" and ask the volunteers how many breaths each of them took. Record the numbers on the blackboard under the students' names.

6. Now tell the volunteers and the class that when you say "Go" this time, the volunteers are going to jump up and down for 30 seconds. Tell the volunteers that when you say "Stop jumping and start counting," they should stop jumping and immediately start counting their breaths until you say "Stop counting."
7. Say "Go." Student volunteers should start jumping. Watch the clock.
8. After 30 seconds, say "Stop jumping and start counting."
9. After another 30 seconds, say "Stop counting." Ask volunteers for the number of breaths they counted, and write these numbers on the blackboard under the students' names.
10. Ask the class what they notice about the results. Discuss how the results are the same and different, and how the results show that breathing is faster and deeper when people are active than when they are not active. Also discuss how faster and deeper breathing when we're active is good for our health because it brings more air and oxygen into our bodies when our bodies need it.
11. Tell students that breathing dirty, or polluted, air is not good for people, and can make people not feel well. For example, it might make you cough, or you might feel like it's harder to breathe.  
  
Tell students that on days when there is a lot of air pollution outside, they can help protect their health by taking it easier. They can walk instead of run, take more breaks, or play outside when the air is cleaner. If they have trouble breathing on days with a lot of air pollution, they should tell an adult.
12. Distribute the handout, *Breathe Smart! Four Things Kids Can Do*. (See Grades K-2 Handout in this Toolkit.)

## Adaptation

Have all students in the class count their breaths at rest and after jumping. Take a few responses from the class, write them on the blackboard, and discuss the differences in breathing at rest and after jumping. (Note: If you feel that your classroom does not have enough room for jumping, or that it might be too disruptive, students can instead stand up and sit down repeatedly for one minute.)

Have students play a quick game of basketball or walk quickly up and down a flight of stairs a few times rather than jumping up and down in place.

## For Further Exploration

Explain that cars use gasoline and are one big source of air pollution. Discuss that one way to reduce air pollution is by going places with adults in ways other than cars, such as walking, bicycling, or taking a bus or train. This would reduce the number of cars on the road, which would reduce the amount of air pollution from cars.

## Acknowledgments/Resources

Adapted from the California Air Resources Board, The KnowZone at: [www.arb.ca.gov/knowzone/knowzone.htm](http://www.arb.ca.gov/knowzone/knowzone.htm)

Also see: U.S. Environmental Protection Agency's AQI (Air Quality Index) for Kids at: [www.airnow.gov/kids](http://www.airnow.gov/kids)

## Next Generation Science Standards

**Engineering Design**  
**Interdependent Relationships in Ecosystems**



# How Dirty Is the Air We Breathe?



## Learning Objectives

### Students will:

- Make a simple air pollution tester.
- Collect and observe air pollution and discuss the findings.

**Grade Level:** Grades K-2

**Estimated Time:** 30 minutes (indoors), 30 minutes (outdoors)

## Background Summary

The air around the Earth is mostly invisible. Sometimes the air is dirty, or polluted. Most of the time polluted air is also invisible, but sometimes you can see air pollution. Air pollution that you can see comes from things like the tailpipes of cars and the smokestacks of factories. Sometimes you can see air pollution near busy roads and factories. Air pollution can also come from burning wood in fireplaces and wood-burning stoves, and even from forest fires and volcanoes. Sometimes the wind can blow air pollution from where it was created to other places far away. Breathing polluted air is not good for people's health—it can make it harder to breathe, and for people with heart or lung problems, it can make their problems worse.

In this activity, students will make pollution testers, collect samples of air pollution outdoors, and discuss how air pollution can affect health and what we can do to reduce air pollution.

## Materials Needed

- Double-sided masking tape
- Half gallon or larger milk cartons filled with sand (optional)
- White paper for each child or group of children
- Adult assistants for outdoor placement of tape (and milk cartons if using them)

## Key Questions

- Do you think air pollution is invisible or can you see it? (*Answer:* Both. Some air pollution is invisible, some you can see.)
- Do you think that people's health can be affected by air pollution? How? (*Answers:* Yes. People might

have more trouble breathing. Some pollutants can make heart or lung problems worse.)

- How can we help keep the air clean? (*Possible answers:* Instead of driving places, we can walk, bicycle, or take a bus or train, with an adult, when it's safe to do so.)

## Vocabulary

**Invisible**—Impossible to see.

**Visible**—Possible to see.

## Steps

1. Tell students: As we look outside, we often see a clear blue sky. Where is air pollution? If using milk cartons, tell students that they are going to make a simple tester for air pollution so we can see it. If using double-sided tape only, tell students that the class is going to go outside to test the air to see air pollution.
2. Have students make the milk carton testers, if using them. Divide the class into groups with adult assistants and give the groups their materials. With the double-sided masking tape, have each group wrap the tape around the sand-filled milk carton, and make sure the tape is securely attached. If using double-sided masking tape only (no milk cartons), give each group's adult assistant a roll of the tape.
3. Take the class outside. With adult assistants, have students place the milk cartons outdoors on posts, fences, walls, and/or window sills in various locations. If using pieces of double-sided masking tape only, place tape on trees in various locations and on other surfaces on which the tape will stick. If you can, place some milk cartons or double-sided tape near a road and some in a protected location away from roads. Try to pick places where the milk

cartons won't be knocked over by pets or children's play. Leave them for 24 hours.

4. The next day, collect the milk cartons and double-sided pieces of tape, and make labels of the tester locations. Help students remove the tape from the milk cartons and lay the tape, exposed side up, on white paper. Place location labels next to each corresponding sample.
5. Have the class examine the air pollution collected on the testers.
6. Discuss the findings. *Ask:* Did your tester collect any air pollution? How does your tape compare to those of the other groups? In what places does the air seem to be the dirtiest? (*Possible answers:* Near busy roads, near factories.) Why do you think those areas might have the most air pollution? (*Possible answers:* Because cars and factories make pollution.)
7. Discuss possible health effects of breathing air pollution. *Say:* We have seen air pollution where we first didn't see any. Clean air is important for us to breathe to be healthy. Breathing in dirty, or polluted, air can make us less healthy—it can make it harder to breathe, and some pollutants can make heart or lung (especially asthma) problems worse.
8. Discuss what people can do to reduce air pollution. *Ask:* What can we do to keep the air clean? (*Possible answers:* People could drive less and walk more, such as to school, with adults. We can turn off lights, TVs, and computers when we're not using them; this saves energy and keeps the air cleaner. Factories could reduce their pollution.)

## Adaptation

For Grades 3–5, students can write a paper and explain the differences they observed among the pieces of tape.

## For Further Exploration

Have students take their tester home (along with instructions for parental assistance) to test for pollution for 24 hours. Students can then report their findings to the class the next day.

Ask students to leave the tester outside for a week (sheltered from precipitation); students can report results to the class each day and at the end of the week.

## Acknowledgments/Resources

Texas Commission on Environmental Quality at:  
[www.tceq.state.tx.us](http://www.tceq.state.tx.us)

## Next Generation Science Standards

**Engineering Design**

**Interdependent Relationships in Ecosystems**

# **Student Handout**



**Breathe Smart!**

# Four Things KIDS Can Do



1

**Find out what AQI color for today is where you live.**

- Visit the AIRNow Web site at [www.airnow.gov](http://www.airnow.gov).
- Tell your parents about the AQI so they can help you.

2

**Protect your health when the air is dirty.**

- Take it easier when you play outside.
- If it feels harder to breathe, tell an adult.



3

**Help reduce pollution.**

- Turn off lights, TVs, and computers when not using them.
- Walk, bike, or take a bus or train with an adult. But remember, your safety always comes first!

4

**Visit the AQI kids' site at [www.airnow.gov](http://www.airnow.gov)**  
(click on "Kids" in the "Learning Center")



